

STUDY OF STUDIES

FINAL REPORT (Part B)

[Reference No. STAT/3/2020-O/o DS (IFD and BDG dated 27/01/2021)]

Submitted to
MINISTRY OF DEVELOPMENT OF NORTH EASTERN REGION
Vigyan Bhawan Annexe, Maulana Azad Road,
New Delhi – 110011



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Foreword

The Government of India has encouraged research and development in the North Eastern Region (NER) with the aim of enhancing developmental activities and socio-economic condition of the people living in the region. Various academic and research organizations engaged in diverse fields have been supported for conducting various studies over the years. An analysis of outcomes of these research studies, measured in terms of recommendations and their implementation as well as impact on society—was deemed useful for the scientific community, policy makers and the people.

The Energy and Resources Institute (TERI), with support from the Ministry of Development of North Eastern Region (MDoNER), carried out a detailed study of studies conducted in the NER during 2010 to 2020. As an outcome of this endeavour, a compendium has been brought out presenting information and analysis of each study with illustration.

I am confident that the holistic exercise by TERI team will greatly benefit the entire NER, researchers, academia, students, Government, and other stakeholders. I congratulate both the teams from TERI and the MDoNER for their diligent efforts in bringing out this purposeful and valuable compendium.


Lok Ranjan

4 April 2022
New Delhi
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PREFACE

Ministry of Development of North Eastern Region has been created for planning, execution and monitoring of schemes and projects for the development of North Eastern Region. To fasten the development activities in the North East, this ministry co-ordinates with various line ministries/departments and extends necessary support for taking up developmental and welfare activities in the North East.

There have been a plethora of studies which have been conducted in the past across different sectors and states in the North East by different research and academic institutions to access the developmental requirements needed further for strengthening the states in terms of income generation, employment opportunities and infrastructure facilities. Some of these studies are done on multiple sectors covering multiple states. Though, these studies have been conducted by various agencies for various purposes, the details of the projects and the recommendations made by them have not been compiled or made available in an easy accessible form. An attempt has been made to compile and prepare a compendium of all such studies conducted so far and cull out major recommendations in a nutshell, so that it could be used for ready reference.

A study titled as "Study of Studies" was given to "The Energy and Resources Institute (TERI)", New Delhi for compiling these studies conducted over the past 10 years (2010-2020). I hope that this study can be used as a reference tool for policy related decision making and for the larger benefit of policy makers and academicians alike.

21st October, 2022
New Delhi
India

21.10.22
Suresh Kumar S.



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Acknowledgements

The study team is grateful to the Ministry of Development of North Eastern Region (MDoNER), Government of India, for providing the opportunity to undertake 'Study of Studies'. The study could not have been contemplated and conducted without the support of Shri Lok Ranjan, Secretary, MDoNER.

The study team conveys sincere thanks to Dr Chandramani Sharma, Former Statistical Adviser, Shri Suresh Kumar S, Statistical Adviser, Shri Purushottam Verma, Deputy Secretary, Sanjay Rawat, Under Secretary(Retd.), Shri Sunil Kumar, Assistant Director, Shri Ram Dayal, Senior Statistical Officer, Shri Manish Jain, Junior Statistical Officer and Shri Sunil Kumar, SSA, MDoNER for their invaluable guidance, inputs, and cooperation.

The study in its present form would not have been possible without the support of project investigators, heads of various scientific and academic institutions, ministries and departments of Government of India as they provided the team with invaluable inputs such as relevant reports and data with respect to the respective studies conducted in the context of North Eastern States during the period of study— January 2010 to June 2020.

Special thanks are due to the project team members for their indulgence, commitment, and hard work in carrying out the perception survey, collecting, compiling, and authenticating data from various sources located across the country. We extend our gratitude to TERI administrative professionals for their contribution towards the timely completion of the study.



Acronym

Acronym	Full Form
AACP	Assam Agricultural Competitive Project
AAU	Assam Agriculture University
ACABCs	Agri-Clinics and Agri-Business Centres
ADB	Asian Development Bank
ADF	Acid Detergent Fibre
AIBP	Accelerated Irrigation Benefit Programme
ALPCO	Assam Livestock and Poultry Corporation Ltd
AMD	Acid Mine Drainage
AMGC	Assam Meghalaya Gneissic Complex
AMMP	Agriculture Mission Mode Project
ANC	Antenatal Care
ANR	Assisted Natural Regeneration
APEDA	Agricultural and Processed Food Products Export Development Authority
APMC	Agricultural Produce. Marketing Committee
ARDD	Animal Resources Development Department
ASCAD	Assistance to States for the Control of Animal Disease
ASDMA	Assam State Disaster Management Authority
ASHA	Accredited Social Health Activist
ASRLMS	Assam State Rural Livelihood Mission Society
AWPB	Annual Work Plan & Budget
AWS	Automatic Weather Station
BGREI	Bringing Green Revolution to Eastern India
BHS	Biodiversity Heritage Site
BINM	Biofertilizer Based Integrated Nutrient Management
CAC	Comprehensive Abortion Care
CBDMP	Community-Based Disaster Management Programme
CBV	Central Brahmaputra Valley
CCA	Community-Conserved Areas
CDDL	Central Disease Diagnostic Laboratory
CDG	Community Development Group
CETP	Common Effluent Treatment Plant
CRPS	Community Resource Persons
CRPs	Community Resource Persons
CSAP	Comprehensive State Agriculture Plan
CSF	Classical Swine Fever
CTCRI	Central Tuber Crops Research Institute
DAC&FW	Department of Agriculture & Farmers Welfare
DCIDGM	Directorate of Commerce and Industries
DEM	Digital Elevation Model



EMP	Environment Management Plan
ESPPF	Environment and Social Policy & Procedures Framework
FARMER	Fellowship for Agri-Resource Management and Entrepreneurship Research
FGD	Focus Group Discussion
FIC	Field Irrigation Canal
FPS	Fair Price Shop
FSS	Farmer Field Schools
FTAs	Farm Tele Advisors
GAPs	Good Agricultural Practices
GDP	Gross Domestic Product
GHADC	Garo Hills Autonomous District Council
GIS	Geographic Information System
GSDP	Gross State Domestic Product
GSI	Geographical Survey of India
HNSCC	Head and Neck Squamous Cell Carcinomas
IA	Implementing Agencies
IAY	Indira Awaas Yojana
IEAR	Initial Environment Assessment Report
IEC	Information, Education, and Communication
INRM	Integrated Natural Resources Management
IPR	Intellectual property rights
ISC&ED	Integrated Supply Chains and Enterprise Development
IVCS	Integrated Village Cooperative Societies
IVOMD	In-vitro Organic Matter Digestibility
IWMP	Integrated Watershed Management Programme
JFMC	Joint Forest Management Committee
JICA	Japan International Cooperation Agency
JJB	Juvenile Justice Board
KVK	Krishi Vigyan Kendra
LB	Local Bodies
LHZ	Landslide Hazard Zonation
LMIS	Labour Market Information System
MAP	Medicinal and Aromatic Plant
MBDIS	Mountain Biodiversity Database and Information System
MBMA	Meghalaya Basin Management Agency
MDM-ARM	Mid-Day Meals Automated Reporting & Management System
MDoNER	Ministry of Development of North Eastern Region
MFP	Minor Forest Produce
MGC	Meghalaya Gneissic Complex
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MIS	Market Intervention Scheme
MRL	Maximum Residue Limit

MSAM	Meghalaya State Aqua Mission
MSP	Minimum Support Price
NAES	National Agricultural Extension System
NAFED	National Agricultural Cooperative Marketing Federation
NAIS	National Agricultural Insurance Scheme
NAIS	National Agricultural Insurance Scheme
NAPCC	National Action Plan on Climate Change
NATT	National Agricultural Technology Transfer
NBM	National Bamboo Mission
NBPGR	National Bureau of Plant Genetics Resources
NBPZ	North Bank Plains Zone
NCU	Neem-coated Urea
NDF	Neutral Detergent Fibre
NeGP	National e-Governance Programme
NEP	National Environment Policy
NEPED	Nagaland Empowerment of People through Economic Development
NER	North Eastern Region
NERLP	North East Rural Livelihood Project
NESAC	North-Eastern Space Applications Centre
NFSM	National Food Security Mission
NGMC	National Geochemical Mapping Programme
NGOs	Non-Governmental Organizations
NHB	National Horticulture Board
NHM	National Health Mission
NICRA	National Innovations in Climate Resilient Agriculture
NIV	National Institute of Virology
NOB	Naga Ophiolite Belt
NPA's	Non-Performing Assets
NRHM	National Rural Health Mission
NSC	National Seeds Corporation Ltd.
NSSO	National Sample Survey Office
NTFP	Non-Timber Forest Produce
NWLS	Nongkhyliem Wild Life Sanctuary
O&G	Obstetrics and Gynaecology
ODA	Official Development Assistance
PAH	Project Affected Households
PBR	People's Biodiversity Register
PDS	Public Distribution System
PHED	Public Health Engineering Department
PI	Project Investigator
PNC	Postnatal Care
PPP	Public-Private Partnership



PSS	Price Support Scheme
PSU	Public Sector Undertakings
RTC s	Root and tuber crops
S&T	Science & Technology
SAPCC	State Action Plan on Climate Change
SCIA	Standardized Cumulative Impact Assessment
SDP	State Domestic Product
SGSC	Standard Global Soil Composition
SHAG	Solar Hot Air Generators
SHC	Soil Health Card scheme
SHG	Self-Help Group
SHP	Small Hydroelectric Project
SIMP	Social Impact Mitigation Plan
SOP	Standard Operational Procedure
SPSU	State Project Support Units
SRTT	Sir Ratan Tata Trust
SSDM	State Skill Development Mission
STGs	Small Tea Growers
SUDA	State Urban Development Agency
SWM	Solid Waste Management
T&D	Transmission & Distribution
TESV	Total Estimated Susceptibility Values
TPPFL	Twin Pit Pour Flush toilets
TSP	Telecom Service Provider
TVET	Technical Vocational Education & Training
UAV	Unmanned Aerial Vehicle
UNDP	United Nations Development Programme
VDF	Village Development Fund
VECs	Village Employment Councils
VHND s	Village Health and Nutrition Days
VTP	Vocational Training Providers
WEI	Women Empowerment Index
WUA	Water Users Association
YwD	Young people with Disability

Glossary

Sectors/ Terms Used	Studies Refer / Relate to
Agriculture and Allied	Food security, farming and cultivation of crops, plants, soil, animals, fungi, medicinal plants and other related studies, forestry, fishery/aquaculture/ pisciculture, horticulture, sericulture, animal husbandry, jhum, food processing.
Banking and Finance	Financing, rural banking, lending, loans, credit facilities and other economic activities
Commerce and Industry	Service activities, namely transport, communication, warehousing, banking and insurance, international trade, small- and middle-scale enterprises (SMSE).
Completed Studies	Sponsored studies in various sectors relating to the North Eastern Region completed between January 2010 and June 2020.
Energy	Energy efficiency, renewable energy, energy science
Environment	Studies related to climate change, biodiversity, land, water, forests, pollution, population, waste management, natural disasters, environmental health, natural resources, mineral resources, human-made disasters.
Extramural Research Projects	Sponsored or funded studies/projects in various sectors relating to the North Eastern Region.
Funding Agencies	Ministries and Departments of Central Government, multi-/bi-lateral organizations, state government departments who have sponsored studies relating to the North Eastern Region.
Health and Nutrition	Health and development, child and maternal health, pregnancy, improving living conditions, quality healthcare services and nutrition to the women and children, non-communicable diseases, poverty and malnutrition, healthcare infrastructure, healthcare system, healthcare services, access to healthcare services, indigenous healthcare practices.
Human Resource Development	Employment, HR in infrastructure industries, higher education recruitment, human resources in Science & Technology, manpower estimation, manpower management, personnel management, productivity of manpower, S&T professionals, S&T manpower, Technical education such as medical, engineering, training and skill development programmes.
Implementing Institutions	Studies related to North Eastern Region carried out by universities, medical colleges and hospitals, national research laboratories, scientific and industrial research organizations during the period 2010 to 2020.
Infrastructure	Transportation systems, communication networks, rail, road, sewage, water, electric systems, waste management, inland waterways, airways, road construction, cold storage system.
Law and Governance	Studies related to law and governance, access to justice, human dignity and well-being, economic and social development, indigenous and tribal laws/customary laws.
MDoNER	Ministry of Development of North Eastern Region, Government of India.



Sectors/ Terms Used	Studies Refer / Relate to
Meta Data	Summarizes basic information about each study, study title, start and end dates of the study, implementing institution, funding agency, study objectives, location, recommendation.
North Eastern Region (NER)	The present study covers eight North Eastern States: Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Tripura.
On-going Studies	Refer to sponsored studies in various sectors relating to the North Eastern Region not yet completed as of June 2020.
Principal Investigators (PIs)	Primary individual responsible for the preparation, conduct, and administration of a research grant, cooperative agreement, or other sponsored studies.
Recommendations	Recommendations in the context of the present study are based on the results of the sponsored studies/research. These indicate specific measures or directions that can be taken in future.
Rural Development	Studies refer to social, economic, political and spiritual development of the people living in rural areas, management of rural resources – including planning and executing rural development programmes that benefit the rural livelihood. Self-help groups (SHGs), community development, government schemes and programmes such as MGNREGA, etc.
Science & Technology	Studies related to Science and Engineering Research, Technology Development, S&T Communication; S&T infrastructure, S&T Entrepreneurship, S&T Cooperation; GIS, Spatial Data Infrastructure, policies and practices. S&T at the State, District, and village levels for grassroots development, Application of S&T for weaker sections, women and other disadvantaged sections of society, geotechnical mapping, geochemical mapping, remote sensing, survey, laboratory research, innovation, prototype design, explorations
Sectors	Refer to studies conducted in various broad subject areas: (i) agriculture and allied, (ii) banking and finance, (iii) commerce and industry, (iv) energy, (v) environment, (vi) health and nutrition, (vii) human resource development, (viii) infrastructure, (ix) law and governance, (x) rural development, (xi) science and technology, and (xii) tourism.
Tourism	Rural tourism/tourism infrastructure development, medical and wellness tourism, travel trade, human resource development for tourism, sanctuaries, wildlife parks, ecotourism, art, culture and festivals, music, sacred groves, mysticism, religion and spirituality.

Executive Summary

North Eastern Region (NER) of India consists of eight states, namely (i) Arunachal Pradesh, (ii) Assam, (iii) Meghalaya, (iv) Manipur, (v) Mizoram, (vi) Nagaland, (vii) Sikkim, and (viii) Tripura. The region is endowed with immense natural resources, accounting for 34% of the India's water resources and nearly 40% of its total hydropower potential. The location and natural resources make NER a potential powerhouse of India, much required for the country's growth and development. In the light of the mentioned facts, it can be established that the NER is blessed with the prerequisites to scale-up growth and development of its natives, which in turn, will help drive the gross domestic product (GDP) growth of India.

For the last few decades, Government of India has been giving due attention to NER with the aim of enhancing the developmental activities and uplifting the socio-economic conditions of the people inhabiting the region. Many studies pertaining to NER on multiple subject domains have been completed by various organizations, agencies and government, non-governmental organizations (NGOs), individuals, and many more in various sectors. Despite these studies conducted for the region, it was observed that still many proposals are submitted for further studies on similar or related subjects. Hence, there is an urgent need of an information system and database of the ongoing and completed studies that can play a pivotal role in monitoring developmental programmes, impact analysis, and proper allocation of the funds for future potential studies in NER.

Objective of the study

Against this background, the Ministry of Development of North Eastern Region (MDoNER), Government of India, has sponsored a study titled 'Study of Studies' to The Energy and Resources Institute (TERI), New Delhi to analyse the impact of these studies in NER development. The study is aimed at listing out and compiling various studies conducted from January 2010 to June 2020 in different sectors in the context of the NER, and analyse and compile recommendations of such studies, which would be useful for MDoNER in policy and decision-making purposes and for the benefit of the scientific community and the society.

Scope and Limitation

The scope of the study are as follows:

- Prepare a master database of the studies conducted during the period 2010 to 2020.
- Categorize/organize these studies on the basis of subjects/sectors/states/areas of study/implementing institutions
- Study and analyse the actions taken on the recommendations of the studies/present status of implementations of such recommendations and reasons for non-implementations
- Study and analyse the feasibility/practicability of implementation of the recommendations of such studies, list out implementable recommendations along with the pre-conditions required for implementing these, and agencies responsible for implementation.
- Analyse the outcomes of these studies using appropriate statistical techniques.
- Assess the usefulness of such studies.
- List out areas/sectors in which no worthwhile studies have been conducted in the past 10 years and suggest such areas/sectors that require detailed studies in future.



While conducting the study, the following limitations were encountered:

- **Travelling/visits to different North Eastern states/institutions:** Owing to the widespread COVID-19 pandemic across the country, visitors in any organization were not allowed to meet face to face, hence obtaining print copies of reports became a difficult task in the first phase of this project. Moreover, in the second phase of this project, the project team was not allowed to enter any villages and meet the beneficiaries. However, the team overcame the issue, to a large extent, by telephonic interview and video-conferencing facilities.
- **Incomplete information in study reports:** Though many study reports are available in the open domain, certain key information required for the study, such as 'study start date', 'year of completion', 'name of funding organization', 'contact details', and in some reports 'recommendations' were found missing. To obtain such important missing pieces of information, the project team then contacted the respective principal investigators/heads of institutions. However, this proved to be a challenging task as many of the PIs had got transferred, were no longer associated with the implementing institutions, or had retired.
- **Phone/Internet connectivity in NER:** Owing to the issue of poor Internet connectivity, many a times receiving electronic copy of reports became a challenge as uploading/attaching voluminous reports in an e-mail/cloud entailed lot of time. Keeping this situation in cognizance, the NER team scanned a few important pages of the voluminous reports to fill in the metadata. The phone connectivity was also very poor in many places in NER, hence sometimes it became demanding to conduct key performance indicators (KPIs) and interviews with the beneficiaries.

Approach & Methodology

The 'Study of Studies' project has been broadly divided into two phases: data collection and analysis to reflect impacts. The first phase of this study (27 January to 26 June 2021) focused on (i) collection and compilation of completed and ongoing study reports and project information, (ii) preparing a master database of the collected studies, and (iii) categorization/organizing these studies by sectors, subjects, areas, states, funding and implementing agencies. The study team conducted perception survey and collected knowledge inputs from principal investigators (PIs), project of implementing institutions and funding agencies for the purpose. A total of 983 studies (833 completed and 150 ongoing) were identified. Soft copies of 833 such completed study reports were collected, compiled, and organized in a specially developed MS-Excel-Database with relevant meta-data including sectors, sub-sectors, objectives, and recommendations. The reports were categorized under 12 broad sectors: (i) agriculture and allied, (ii) banking and finance, (iii) commerce and industry, (iv) energy, (v) environment, (vi) health and nutrition, (vii) human resource development, (viii) infrastructure, (ix) law and governance, (x) rural development, (xi) science and technology, and (xii) tourism.

In the second phase of the study, the 833 study reports were analysed by the experts keeping the focus on the impact of these studies and the status of recommendations. The information required for the analysis was collected by conducting stakeholders discussions through interviews, online meetings, questionnaire, and also by referring to secondary literature (reports and news) on the particular subject. The analysis has been broadly done in two major parts: i) Broad Analysis and ii) Report-wise Analysis.

Sector-wise Analysis

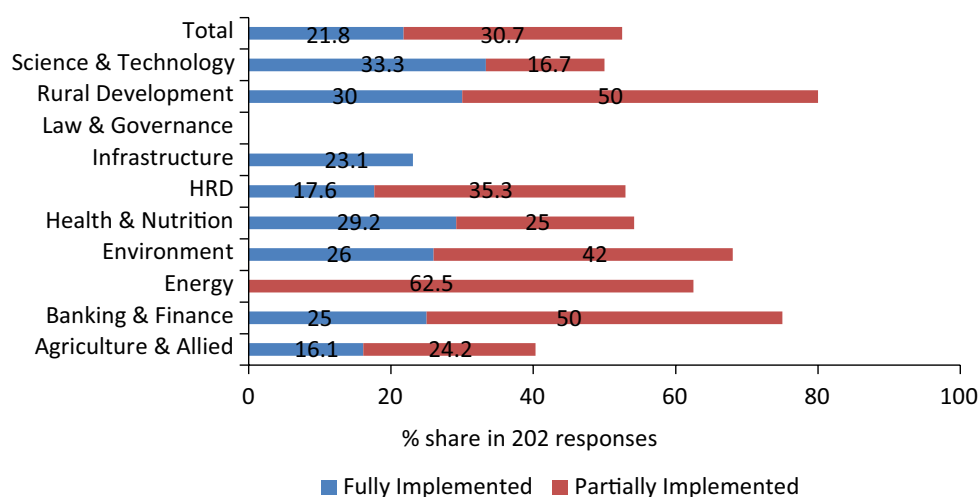
A broad analysis of the selected 12 sectors has been done by examining the data received through questionnaires that has been filled-up by the respective PIs, stakeholders, and implementing institutions. To measure the status of recommendations of various research studies, a questionnaire comprising various quantitative and qualitative questions was sent to all study representatives (Principal Investigator if available). The study received only 202 responses, of which 31% of studies belonged to agriculture and allied, 25% environment, and 12% health and nutrition sectors. Law and governance had the lowest share (1%) among the responses.

Table 1: Number of studies conducted in different states under various sectors

Sectors	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	More than one state	Grand total
Agriculture and Allied	4	52	2	21	7	12	5	7	17	127
Banking and Finance	1	2	1	2	1	1	1	1	1	11
Commerce and Industry		1						1	6	8
Energy	3	18	7	13	6	10	3	9	1	70
Environment	40	60	14	71	25	30	36	20	48	344
Health and Nutrition	1	22	1	6	2	1	6	4	9	52
Human Resource Development	6	9	1	10	1	2	2	3	12	46
Infrastructure	1	10	2	18	1		3	5	7	47
Law and Governance		2		2			2		2	8
Rural Development		3		7	12	1		1	3	27
Science and Technology	17	24	8	7	4	5	1	3	18	87
Tourism		1		2		1	1		1	6
Grand total	73	204	36	159	59	63	60	54	125	833

The responses were categorized on the basis of gender representation among PIs. It has been observed that about one-fifth (19.3%) of the 202 responses had the female PIs. Similarly, one-fifth of agriculture and environmental studies had the female PIs.

The status of recommendations of various studies and their impact on target issue/groups has been scrutinized based on the survey responses. It was revealed that 21.8% of study recommendations were fully implemented, 30.7% of the studies indicated that their recommendations were partially implemented. Another one-fifth (20.8%) of the recommendations were not implemented, and 26.7% of the responses failed to identify the status of the implementation.

**Figure 1: Status of implementation of recommendation across sectors**

Further, the reasons for partial implementation or non-implementation of the recommendations of the studies have been analysed. It was observed that respondents indicated a few issues that impacted the implementation of the recommendations. These are administrative, financial, judiciary, lack of awareness/knowledge, lack of community participation, and regulatory issues. More than 40% of the respondents indicated that due to 'administrative' reasons the recommendations were either partially or not implemented, while 20% and 18% of them pointed out that 'financial' and 'regulatory' factors were responsible. While 2% and 3% of those respondents blamed 'judiciary' and 'lack of awareness/knowledge' for partial/ non-implementation, one-tenth of them cited various other reasons. *Lack of community participation* and *site-specific issues* were some of the other factors indicated by respondents as reasons for partial/non-implementation of recommendations.

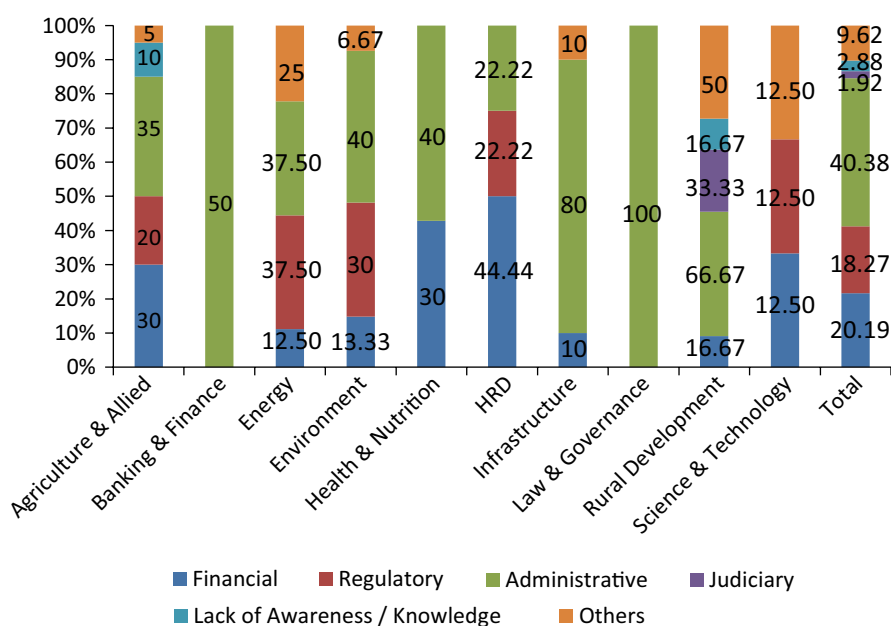


Figure 2: Reason for partial/non-implementation of recommendations

Various developmental aspects, which can result from the implementation of the recommendations, were also analysed from the 202 responses. Based on the information provided by 106 respondents who confirmed partial/full implementation of their study recommendations, it was revealed that 22.6% of these studies perceived that there has been a high impact and 22.6% acknowledged medium impact on employment generation as a result of the implementation of their recommendations. While 10.4% of the studies thought that there is high impact on women empowerment, another 35.8% believed that the implementation resulted in medium impact on women empowerment. Similarly, 32.1% of the studies perceived medium impact on income opportunity and 19.8% perceived high impact.

The impact of the implementation of the recommendation has been analysed based on the 202 responses received through perception survey. The data revealed that in agriculture and allied sector, 20% reported high impact on employment generation (as indicated in Figure 3.10), while 28% reported high impact on women empowerment. One-third (32%) of agriculture and allied studies reported high impact on income opportunity, only 12% reported high impact on infrastructure development.

In banking and finance sector, one-third (33.3%) of the studies reported high impact on employment generation and one-third (33.3%) of studies reported high impact on income opportunity and infrastructure development.

In the energy sector, 80% of the studies reported high impact on employment generation, while one-fifth (20%) reported high impact on income opportunity. In environment studies, 29.4% reported high impact on employment generation, 5.9% on women empowerment, 11.8% of environment studies reported high

impact on income opportunity, and 26.5% reported high impact on infrastructure development. In health and nutrition studies, 7.7% reported high impact on employment generation. 22.2% of human resource development studies reported high impact on employment generation, and 11.1% reported high impact on women empowerment. One-third (33.3%) of infrastructure studies reported high impact on employment generation, and access to market and finance. On high impact on income opportunity, access to market and finance, access to resources, livelihood improvement, increase in productivity, it was 12.5% in the case of rural development studies and 25% for high impact on skill development.

Half of science and technology studies reported high impact on skill development, 16.7% of it studies reported high impact on each of income opportunity, infrastructure development, access to resources, livelihood improvement, and increase in productivity.

Respondents were asked to suggest measures for better implementation of respective recommendations. 54.95% suggested 'Better coordination among various government departments', 52.97% 'Effective coordination among all stakeholders', and 43.56% put forward 'Pro-active local governance'. On the other hand, 30.20%, 28.71% and 27.72% respondents indicated measures such as 'Enthusiasm from target group (like association)', 'Public-private partnership', and 'More engagement of social institutions (such as NGO, SHGs)', respectively. The data revealed that more engagement of social institutions (such as NGO, SHGs) and Public-private partnership can play an important role in effective implementation of their recommendations.

It was also observed from the responses that 52.5% of the studies indicated full/partial implementation of their recommendations. Rate of success (percentage share of full/partial implementation) is highest among 'rural development'-related studies followed by 'banking and finance-' and 'environment'-related studies while success is very poor among 'law and governance,' and 'infrastructure'-related studies. 'Administrative' (by 40.38% respondents who reported partial/non-implementation) factors were identified as the most important barrier against implementation of recommendations. 'Better coordination among various government departments' and 'Effective coordination among all stakeholders' were suggested by more than 50% of the respondents for better implementation of recommendations. For effective implementation of recommendations, the above aspects can play an important role and, hence, these aspects need to be considered with utmost importance in future for better and effective implementation of recommendations.

State-wise Analysis

Based on the data collection exercise, the study conducted an in-depth analysis of the 833 reports keeping in view their impact and the recommendations by the Principal Investigators, stake-holder discussions; and the perception survey. A detailed analysis of each of these study reports focusing on the designated 12 sectors has been presented in the sector-wise chapters. For a quick glance through, a brief of the analysis is given below.

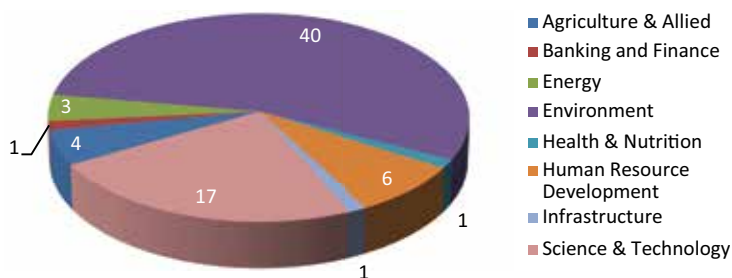
Arunachal Pradesh

AGRICULTURE: Studies broadly focussed on state irrigation, district inventory of agriculture and development of orange harvesting. The "State Irrigation Plan under PMKSY" study aimed at formulating strategic action plans to address on-farm water use efficiency and the water gap in the state. The study relating to orange farmers necessitated to develop tools to increase the efficiency of orange harvesting. **BANKING AND FINANCE:** The study 'Outcome evaluation of state finance' provides an analysis of the finances of the State Government; and presents and analyses the State Government's resources and their application; recommends steps to enhance the efficiency of expenditure. **ENERGY:** Many of the studies were focussed on hydropower development including generation, transmission, distribution, renewable energy, and energy efficiency measures. Compensatory schemes need to be strengthened and implemented to compensate the



forest land diverted for the construction of projects. ENVIRONMENT: Studies related to thematic mapping, landslides, ecosystem restoration, climate change mitigation, biodiversity conservation, etc., were conducted. Several initiatives have been taken to overcome the existing environmental problems in Arunachal Pradesh. The geotechnical studies related to the stability of the slopes are of utmost importance for the development of infrastructures. HEALTH: In-depth research on the various facets of high-quality, affordable, healthcare services and nutritional aspects in the state has been a challenge. The study focussed on optimization of load carrying capacity in Sherpa and Backpack mode for agricultural workers. HUMAN RESOURCES: Skill development is a continuous process in the state. However, there is no standardized quality control and quality assurance system in place. Development of industry-specific course and faster creation of Sector Skill Councils are necessities to ensure training quality, regulatory mechanism, infrastructure development in the state and subsequent livelihood generation. INFRASTRUCTURE: There are development potentials in infrastructure like road connectivity, transformation in the tourism industry, and reformation in the power sector like mega hydropower projects, etc. SCIENCE & TECHNOLOGY: Studies were mostly related to geochemical mapping of different districts in Arunachal Pradesh, and are significant to understand the geochemical composition of the area with respect to mineral prospect.

Sectorwise No. of Studies Conducted in Arunachal Pradesh



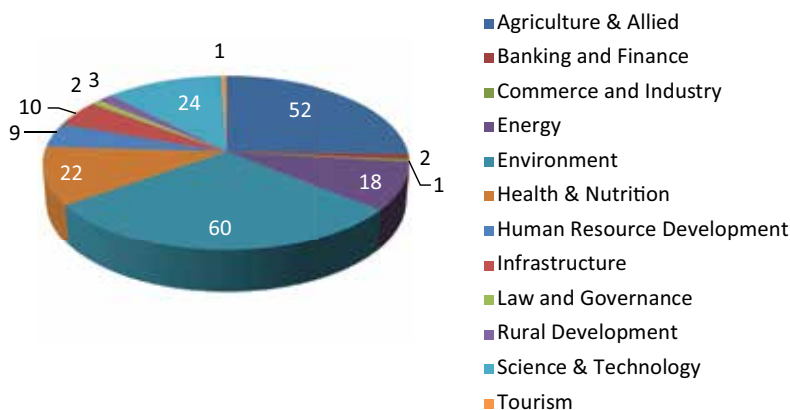
Assam

AGRICULTURE: There were 52 study reports; many of them have highlighted the scope of increasing farmers' income through on-farm and off-farm activities. The present situation of demand supply promises good potential of interventions for agriculture and allied sector and off-farm activities in the state. BANKING AND FINANCE: The outcome evaluation study provides an insight into Assam's Finances over a 13-year period.

Another study throws light on

how districts are faring with an informal microfinance system in place. COMMERCE AND INDUSTRY: The tea garden community constitutes more than 20% of the state's population. Bagan Bazar project was implemented with the objective to help the local tea tribe people to get their essential items at their doorstep, including nutritious food. ENERGY: Studies mostly focussed on power, which immensely contributed in bringing down the T&D losses in the state and helped the state attain self-sufficiency in electricity production. Renewable energy efficiency technologies and applications were the focus areas of other sponsored studies. HEALTH: Improved service delivery and people's access to healthcare, primarily in rural areas, has been the core focus of the studies. Boat clinics in Assam have become the primary access to healthcare. ENVIRONMENT: Studies conducted focussed on flood mitigation, flood

Sectorwise No. of Studies Conducted in Assam

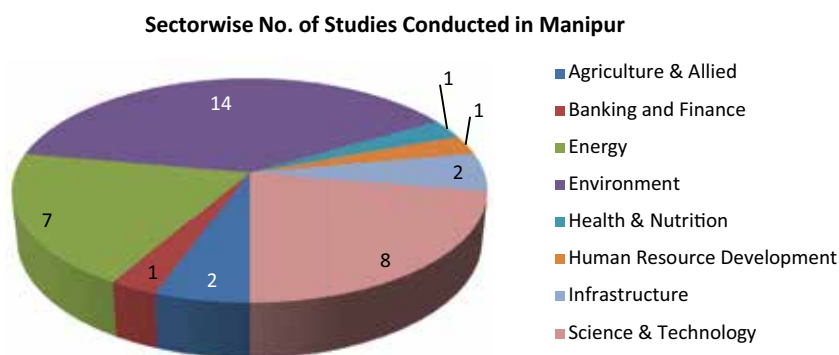


management and conservational studies of biodiversity, ecosystem, arsenic poisoning, etc. Some studies were also carried out on geological mapping for investigation of earthquake-prone zone, mineral richness, and other geological studies. HUMAN RESOURCES: Skill development and job creation for Assam tribes have been studied in great depth. Promotion of job opportunities and self-employment through seminars, workshops, industry meet, job fairs, etc., with support from Rural Livelihood Mission and State Nodal Agency for Skill Development would improve the success rate. INFRASTRUCTURE: Majority of the studies focussed on transportation/road sectors. Inadequacy and volatility of the budgetary allocations have been the main challenges for asset creation and maintenance in the sector. LAW AND GOVERNANCE: Pendency of Cases before the Juvenile Justice Boards (JJB) in Assam and (2) Secondary Data Analysis on Trafficking of Women and Children in Assam were the two studies. The State Government has created and operationalized Anti Human Trafficking Units (AHTU) in all the districts of Assam to effectively combat crimes related to trafficking of persons, especially women and children. RURAL DEVELOPMENT: The studies focussed on rural community development, livelihood and water resource management. TOURISM: The state government is taking positive steps towards tourism sector development in the state. Promotion and branding of cultural and craft works would be more beneficial to give boost to tourism activities in the area. SCIENCE & TECHNOLOGY: Studies conducted geochemical mapping in all the districts of Assam with the objective of generating baseline geochemical data that has wide-ranging utilities in the fields of resource development, agriculture, medical geology, and environment. Studies were also carried out for development of nano-composite materials from waste plastics and non-conventional plant materials; GIS modelling-based impact assessment of groundwater arsenic contamination in Brahmaputra basin among others.

Manipur

AGRICULTURE: The study conducted on use of arbuscular mycorrhiza (AM) fungal inoculation technology suggested that the technology can be used in the restoration of fragile habitats. Another study suggested that appropriate watershed programmes adopting ridge to valley approach with people's participation need to

be encouraged to harness the untapped benefits that the state has. **BANKING AND FINANCE:** The study on evaluation of state finances suggested cost minimization; enhancing revenue and no debt capital receipts to control debt levels; and increase overall transparency and efficiency in governance. **ENERGY:** The seven studies conducted were intended to augment the existing T&D infrastructure to improve the reliability of service delivery across the state and build institutional capacity of the power utilities and departments in the state. **ENVIRONMENT:** Studies focussing thematic mapping for exploring potential zones of mineralization, photogeological mapping, magnetic survey of chromite-bearing ultramafic rocks, among other, were conducted. The studies of ecosystem restoration, biodiversity conservation, climate change, flood, etc., revealed that much work has to be done in the environmental sectors in Manipur. Therefore, in future, these projects would be appreciated in these regions. **HEALTH:** The lone study covered analysed interaction among genes at the variant level contributing to heroin use disorder based on STRING database. **HUMAN RESOURCES:** Studies highlight skill development status, potential of jobs and entrepreneurship development in Manipur. Various central government policies and involvement of state departments have helped the state to develop skillsets across the state. Government and private vocational training agencies

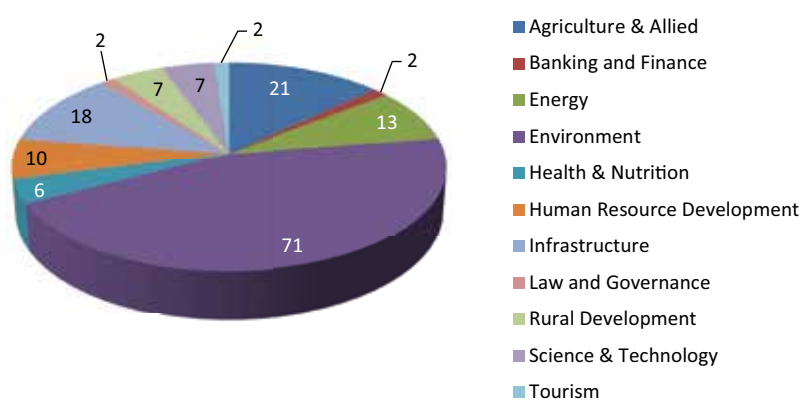


are continuously providing trainings in panchayat-zilla levels to local youths under Skill India Mission and other state initiative. **INFRASTRUCTURE:** The studies focussed on the development of road network and establish improved road connectivity in the state. **SCIENCE & TECHNOLOGY:** Studies mainly focussed on geological mapping, remote sensing, and magnetic survey at different locations of Manipur. In another study, carried out by the Institute of Bioresources and Sustainable Development, it demonstrated how long-term consumption fermented food, called hawajar and dahi impact human intestinal microbiota structure and stability.

Meghalaya

AGRICULTURE: There is a need to provide technical inputs and capacity building in land and agriculture productivity enhancement. Effective use of biomass could reduce deforestation, as felling of trees for fuel has been ranked by the community as the second largest driver of deforestation. **BANKING AND FINANCE:** Mining receipts are the major head of non-tax revenue generation for the state. Considering the significant drop in the mining receipts, there is a

Sectorwise No. of Studies Conducted in Meghalaya



critical need to address the emerging issues of livelihoods loss in the region. The state should focus on boosting the primary sector-based economic activities since majority of state population depends directly or indirectly on activities like farming, fisheries, and other allied activities. **ENERGY:** Studies focussed more on the power sector/hydropower development including generation, transmission and distribution systems in the state. These studies aimed at increasing the generation capacity; providing reliable and assured supply of power; and electricity to all the villages of the State in order to achieve 24x7 Power for All. **ENVIRONMENT:** Studies conducted were successful, which contributed and suggested potential points to upgrade the environment. They recommended several new areas of research related to the objectives and location of research being done, which will promote sustainable mining, urban infrastructure development, conservation and management of forests, etc. **HEALTH:** There is immense scope of ethnobotanical studies due to the natural forest coverage in the state. Due to poor transportation and medical facilities in the rural areas, the rural folks to a great extent still hold onto their traditional faith in local medicine men and wild herbal plants. There is a concerted effort by the State to empowerment of the local health practitioners/traditional healers with knowledge pertaining to various health issues. **HUMAN RESOURCES:** Studies mostly highlighted two pressing issues—child education and job-oriented skill development. More government initiatives, policy support and grant-in-aid are necessary to bring school infrastructure and tribal children to the mainstream education process. The State Government has constituted task forces and evolved a mechanism to eradicate child labour. **INFRASTRUCTURE:** Studies focussed broadly on roads’ development, solid waste management infrastructure, and urban development. Social impact assessment studies suggested establishment facilitation centres—entry and exit points in various Meghalaya districts to act as a check for exchanging and interacting goods and services between the States of Assam and Meghalaya. **LAW AND GOVERNANCE:** The study “Knowledge Attitude Practice End line Survey Report for Citizens of Meghalaya” recommended (i) to maximize the usage of media to a larger extent for sharing/providing

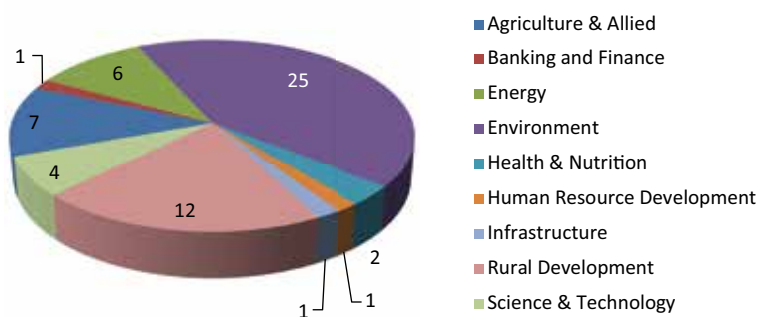
election-related information and (ii) scaling up Systematic Voters' Education and Electoral Participation programme for voter education, spreading voter awareness and promoting voter literacy in the state. **RURAL DEVELOPMENT:** Studies focused on livelihood and infrastructure, housing schemes, and rural employment in the rural areas of Meghalaya. **TOURISM:** The State Tourism Department has taken several initiatives towards development of both international and domestic tourism in the state and to understand the unique culture of Meghalaya and its biodiversity. Vibrant tourism website has been developed for maximum outreach. **SCIENCE & TECHNOLOGY:** There is a significant importance in mineral exploration in the North Eastern Region (NER). There are two studies on geochemical mapping conducted at two different locations. These studies have aimed towards generating a geochemical elemental baseline database in the area as part of the National Geochemical Mapping Programme for use in developing and managing natural resources and various other social concerns.

Mizoram

AGRICULTURE: Studies suggested identification of environmentally sound crops for hilly areas, integrated local enterprise policy, specific support for small enterprises and new cropping strategies and development of marketing networks, risk mapping using the various climate scenarios to cover all contingencies, intensive monitoring mechanism and mid-term evaluation missions are some of the activities to develop agriculture and allied sector in the state. **BANKING**

AND FINANCE: The study emphasized the necessity of keeping revenue deficit to zero, zero fiscal deficit below by 2020-2024 and interest payment below 10% of revenue receipt, for a sustainable fiscal roadmap in the FC-XV period of 2020-25. **ENERGY:** Studies focussed on strengthening of the intra-state transmission and distribution system and undertaking capacity building initiatives in the state. **Environment:** Studies were mostly related to geological mapping for combating natural hazards like landslides, and earthquakes and the development of infrastructure and towns. The outcome of these studies was very significant which identified the locations of weak zones and thrust areas. **HEALTH:** Kayakalp initiative is a key intervention to improve the infection control practices and also to improve the aesthetic appearance in the hospital. The study validated the Kayakalp achievements and provided directions to further enhance the improvement in a holistic way. Predicting the possibility of developing stomach cancer and correlate the percentage of methylation of the particular gene/s and stomach cancer were demonstrated in another study. **HUMAN RESOURCES:** Studies focussed on skill development requirements in the areas of agriculture & allied subjects, sericulture, tourism, fashion & apparel, IT-based services, etc. Indigenous skills like handicrafts, cultivations, animal husbandry, forest produces, tailoring, traditional health practices, etc., require conservation efforts and also have great potential for future employment generation. **INFRASTRUCTURE:** The study carried out the environmental impact assessment to identify, predict, and evaluate the potential environmental impacts resulting from the captive biomedical wastes treatment facility and develop a suitable environmental management plan to mitigate the undesirable effects. The study recommended formulation of solid waste management policy, including hospital waste management. **LAW AND GOVERNANCE:** Studies focussed on the community development plan in different villages in Mizoram. Activities such as piggery and poultry farming, enhancement of crop production through oil and water conservation, afforestation have been

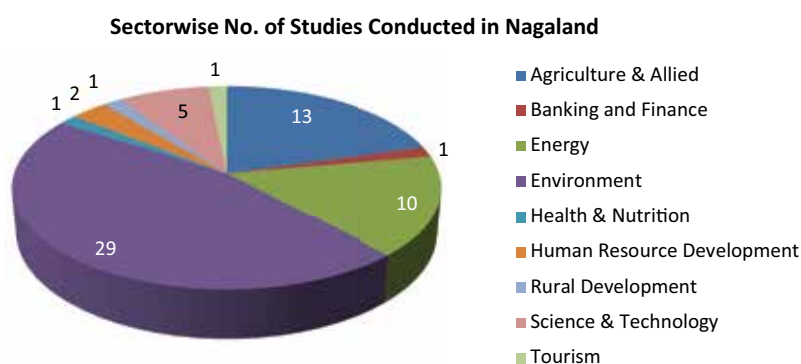
Sectorwise No. of Studies Conducted in Mizoram



implemented. Involvement of rural people in decision making, planning and implementation, monitoring & evaluation, and sharing the benefits of the development is suggested. **SCIENCE & TECHNOLOGY:** Two studies were based on landslide susceptibility mapping in the region of Lunglei, Saiha, Aizwal, Serchip, and Mamit Districts of Mizoram. The study has important applications in planning and development and disaster management. The study provided qualitative estimate of landslide susceptibility of the study area. The results are of important societal value and can provide inputs for regional land-use planning and planning of risk reduction strategies.

Nagaland

AGRICULTURE: The study conducted on management of genetic resources proposed enhancement of the understanding and capacity of people dependent on Jhum in the management of genetic and other natural resources under the climate change scenario. Bamboo forestry has significant impact on the employment, income, livelihood, and access to



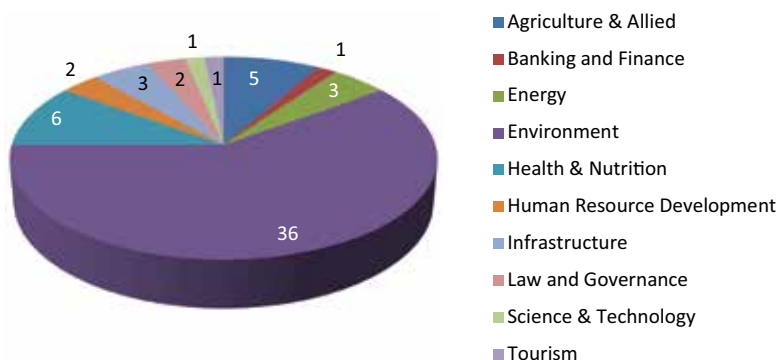
resources and hence bamboo resource mapping is required for proper planning to improve the bamboo sector in the state. **BANKING AND FINANCE:** The Evaluation of State Finances report provides an analysis of the finances. It suggested that the state set up a monitoring/regulatory cell for the clearance of arrears and set the targets for individual companies; take action plan for outsourcing. **ENERGY:** Studies focussed on development and welfare activities in the fields of hydro energy and intra-state transmission and distribution (T&D) system in the state. Studies on socio-economic impact of hydropower projects analysed the socio-culture, economic, and environmental risks due to dam construction. **ENVIRONMENT:** Studies were conducted in Nagaland especially focusing on various kinds of mapping like Macro-Scale (1:50,000) landslide susceptibility mapping for preparing landslide inventory database, Geochemical mapping of Ophiolite belt for creating the database, corridor mapping establishing a detailed lithostratigraphy and tectonic relations between different lithological units across Schuppen Belt of Naga-Arakan Yoma Suture. Such studies helped much to develop the infrastructure, and expansion of towns, which were suggested to be carried out in the low susceptibility slopes. **HEALTH:** The Nagaland Health Project aims to improve management and delivery of health services and increase their utilization by communities in targeted locations in Nagaland. An Environmental Monitoring Plan, which addresses the potential impacts and risks identified through environmental assessment, has been included in project. **HUMAN RESOURCES:** Studies highlighted various skill development requirements. Agriculture & allied areas, food processing, animal husbandry, forest produces, handicrafts, construction, tourism and IT-based innovative services have future demand. Preservation of indigenous knowledge and practices can be achieved through mass awareness and improvement in school education curriculum. **RURAL DEVELOPMENT:** The study primarily focused on multi-skill development and training centre in the field of entertainment and fast fading cultural heritage of the NER. **TOURISM:** A study on different categories of tourists, their profile, expenditure, and their period of stay in Nagaland were conducted, in order to aid as a tool for entrepreneurs venturing into tourism business. **SCIENCE & TECHNOLOGY:** In a study, the Geological Survey of India has launched a National Geochemical Mapping with a view to generate baseline data, which will be useful in locating/developing natural resources and in wide application in environmental studies, agriculture, public health, and other social concerns.

Sikkim

AGRICULTURE: The agriculture sector of Sikkim is facing a number of challenges, which results in low productivity, poor quality, and high wastage due to post-harvest losses. Subsidy on promotion of traditional crops; introduction of organic manure; addressing the problems of diseases and pests through organic modes are the need of the hour considering the

pattern of agriculture scenario of the state. **BANKING AND FINANCE:** The state continues to adopt an inclusive development process in which fiscal policy plays an enabling role. The State has taken several reform measures to strengthen its rural and urban local bodies including the tax sharing pattern. **ENERGY:** Studies focussed mainly on hydro energy. The need for the Rongnichu Hydro-Electric project, with installed capacity of 115 MW, has been considered. Capacity enhancement will enable an annual design energy (90% dependability) of 413.78 GWh. The Ting Ting HE study envisages the utilization of the flow of Rathong Chhu for the generation of electric power. Various environmental management plans were proposed to be implemented encompassing impacts on the ethnic diversity, socio-cultural and socio-economic aspects including displacement, resettlement and rehabilitation of human societies. **ENVIRONMENT:** Studies exploring potential zones of mineralization; geotechnical studies for investigating the stability of the dam slope, among others, were conducted. Several important recommendations were made for these studies like geotechnical study for finding out the stability of the dams, identification of new locations for mineral exploration, conservation of biodiversity-rich areas, etc. **HEALTH AND NUTRITION:** The state has undertaken several initiatives to strengthen the schemes under the National Health Mission. Mobile Medical Units have been a significant service delivery investment to enable reaching marginalized population. The Comprehensive Annual and Total Check-up for Healthy Sikkim (CATCH) programme has improved the health status of people in the state. **HUMAN RESOURCES:** Studies highlighted the skill developments and future opportunities in Sikkim. The focus areas include agriculture, tourism & hospitality, handicrafts, rural development, banking & finance, healthcare services, precision engineering, construction and IT-enabled services. Appropriate skill development framework needs to be evolved by creating opportunities and scope for the talented youths of Sikkim and to upgrade these sectors. **INFRASTRUCTURE:** The study of proposed Pakyong Airport Area focussed on the dynamic behaviour and probable causes of the slope instability and conducted site-specific geotechnical evaluation and assessment of the affected slope. **LAW AND GOVERNANCE:** The Social Impact Assessment study highlighted the dynamics of relationship between the Indian military and the villages in terms of societal impact, especially with regard to livelihood. The study on "Traditional Self-Governing Institutions in North-East India" acknowledged the effectiveness of self-governing institutions in Sikkim with specific reference to Dzumsa of North Sikkim to preserve the unique cultural and ethnic diversity of India. **TOURISM:** Sikkim has a huge scope for different kinds of tourism such as cultural, nature/eco, rural, adventure, etc. Studies were conducted to understand the profile of tourists and best season for tourism. Such studies have been of great use for strategic planning for the sector.

Sectorwise No. of Studies Conducted in Sikkim



Tripura

AGRICULTURE: The state needs infrastructural facilities like storage and processing of fruits and vegetables, which will encourage the farmers to export and increase crop diversification towards high value crops and will raise the farm income in the state. Steps are to be taken to effectively integrate dairy, poultry, fishery, goat, and sheep rearing in the farming system.

BANKING AND FINANCE: Enforcement of financial modalities, assessment of the financial management procedures and mid-term reviews of activities of the local bodies and other institutions may be helpful for making the decentralization initiatives of the state government more effective.

COMMERCE AND INDUSTRY: Tripura is known for its famous “Kew” and “Queen” varieties of pineapple for its special aroma and flavour. By facilitating better storage and inventories, more emphasis can be put on converting it into one of the big industries of the State.

ENERGY: Studies focussed on power systems network and rural electrification. The Environment Assessment Studies aimed at strengthening the transmission and distribution network in West Tripura, South Tripura, Khowai and Sepahijala districts in Tripura, thereby improving overall power supply situation in the state.

ENVIRONMENT: Studies conducted were related to thematic mapping, mineral exploration, conservation of biodiversity, seismic activity, development of infrastructure in such zones, landslide susceptibility mapping, etc. The outcomes have improved the development of basic infrastructures like a dam for hydropower generation in Tripura, which have great potential for electricity generation.

HEALTH AND NUTRITION: The National Health Mission Tripura envisages a dynamic community owned and managed health system, so as to enable the community meet their health needs. The study assessed the level of coverage of the MMU that will help to augment healthcare services.

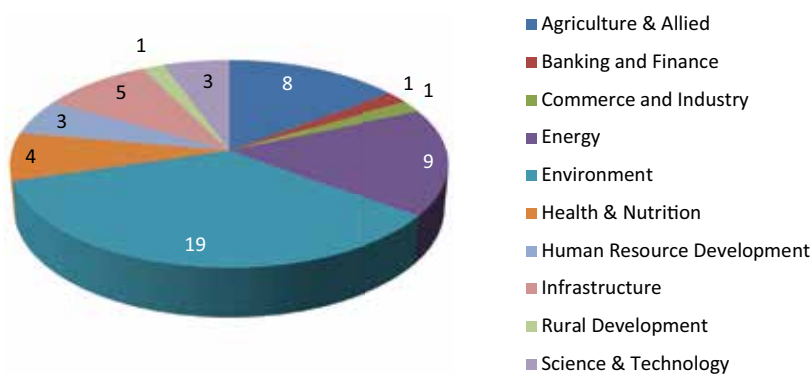
HUMAN RESOURCES: The study on Human Development Report (II) in Tripura, reported success of government policies, programmes and achievements in ensuring improved literacy rate, low mortality rate, better health practices. However, there is a deep rooted social tension between tribals and non-tribals and low women participation in work. Mass education among the population is necessary for development.

INFRASTRUCTURE: Studies focussed on habitat, infrastructure development, road construction & safety, urban services, and smart city. The goal of the socio-economic assessment project was to determine the fundamental needs of the citizens of each city and to highlight the need for infrastructural improvements to the city’s basic amenities.

RURAL DEVELOPMENT: Studies focussed on livelihood analysis of vulnerable groups. The employment provided by the scheme makes the differently-abled more financially secured, aware of their rights and entitlements, and enable them to interact with various officials, negotiate the wage rate, participate in various local-level institutions and share ideas, which in turn, enrich their self-dignity and bring down the negative attitude of the family and society.

SCIENCE & TECHNOLOGY: Study on geochemical mapping of tertiary fold belt of three districts, viz., Khowai, South and West Tripura have been conducted to generate geochemical baseline database for multipurpose uses like managing/developing natural resources and applications in agricultural, environmental, public health, and other societal concern. The study will help in understanding the environment, especially mineral resources in the area.

Sectorwise No. of Studies Conducted in Tripura



It has been observed that some of the contemporary issues have not been addressed in the past hence it has been recommended to carry out more studies under the following sectors:

Agriculture and Allied: Agricultural practices in the North-East India are mostly subsistence in nature, and jhum cultivation being one of them. It is very crucial to find alternative and productive methods of agriculture practices for the region. This requires developing new techniques, tools, and machineries that suit the terrain of the region. While horticulture, floriculture, forestry, and other husbandries offer alternatives livelihood generation potential to agriculture, it is important to preserve rich agricultural or genetic diversity of the region. It is recommended that due attention must be given to set up food processing industries and cold-storage facilities in the strategic locations.

Lack of awareness about the benefits of high-value agriculture, inadequate hands-on training programmes for farmers etc. contributes to the challenges for agricultural development in north-eastern part of India. However, despite of these challenges, the North-east region is endowed with a varied topography and agro-climatic conditions which offer scope for development of agriculture, horticulture, and forestry sectors in the region.

Banking and Finance: Financial intermediation has an important role to play in economic development of the north eastern region. For the region, this assumes importance as on one hand large areas are left out of the formal financial networks and on the other hand the region has a significant presence of micro-activities through which majority of the people earn their livelihoods.

There is a need to strengthen the Regional Rural Banks and Urban Co-operative Banks to foster the banking services in the region.

Providing financial services to remote locations especially in the hills becomes economically unviable. Hence, IT-enabled systems and technological innovations can play a major role where the costs to the bank are reduced while also reducing the transaction costs to the borrower. Thrust should be on initiatives to promote financial literacy and thereby ensure active participation in using financial services.

Commerce & Industries: Several studies have been sponsored by the central and state governments/multi-/bi-lateral institutions, and have been undertaken by the various academic and research institutions in the past decade since 2010. Most notable among the studies included the Act East Policy (AEP) facilitating India-Myanmar border trade. Identification of thrust areas for growth opportunities in the region, setting up food processing industries, encouraging SMEs for investing in infrastructure were among other studies.

Cold storage facility has been a major issue identified in cross trade and agricultural industry, which is essential for preserving the crops/products for trade.

Involvement of the private sector is also highly essential to strengthen the NER trade links in the areas of agriculture, telecommunications, information technology, steel, oil and natural gas and food processing. Foreign investment and collaboration can also help boost economic growth in the region.

Energy: Over the past one decade – since 2010 - many research studies in the energy sector were primarily concerned with transmission and distribution (T&D) with grid expansion. These studies have been carried out by various academic, research institutions and government agencies to generate and distribute power using renewable resources which included micro/ mini hydel projects, solar hybrid and wind energy projects, and other energy efficiency technologies. A large number of un-electrified rural populations were benefitted through these projects by providing minimum need of electricity for their day-to-day requirement through renewable resources of energy.



The implementation of the draft Environment Impact Assessment 2020 could potentially see tap into the region's massive hydro power potential. It is recommended that distributed renewable energy along with energy storage can be explored as an affordable and efficient solution to ensure quality power supply in the region.

Health & Nutrition: Health care services have been a challenge in the north eastern region due its geographical location, difficult terrain, rainfall, and large number of ethnic groups. However, large scale development in the healthcare and nutrition sector has taken place in the region in the last few years due the sustained efforts of the Central and state governments. The establishment of Ayushman Bharat Health and Wellness Centers in the north-eastern states has achieved considerable progress, thereby strengthening the primary healthcare system as envisaged under the initiative. A large number of health screenings are being performed in these centers. A total of 7246 Health and Wellness Centers have been proposed for the north-east till December 2022.

Greater use of the technology in the healthcare sector, especially, setting up telemedicine centers, application of artificial intelligence and block-chain opportunities in the sector could lead to a paradigm shift in healthcare sector.

In addition, following the current trend of pandemic driven studies, implications of COVID-19 on public health should also be studied. Capacity building through training and mobilizing knowledge of health workers will play a vital role in improving delivery of healthcare in the region.

Overall, the prospects of progress in the health and healthcare of the north eastern region are very high. The role of governments, at the central, state, regional and grass root levels and their funding will be very crucial in attaining a high standard of public health and human capital.

Science and Technology: NER being a biodiversity hotspot, is a great treasury for research and documentation of many plants and animals. The studies recommended a specialized Institute of Taxonomy be set up in the region. Simultaneously, this offers a biodiversity rich of genetic pool for research at molecular and genetic level. This potential can be harnessed for different applications and purposes. One of such areas where due research is required in the application of plants derivatives and compounds in medicine and healthcare.

Environment: In NER, several issues were identified like expansion of township which is deteriorating the natural ecosystem and also inviting disastrous incidents like landslide. Therefore, the expansion should be done only in low susceptibility slopes. The future research and development should be focused on preparation of landslide susceptibility map which helps in assessment of Landslide hazard, urban planning and mitigation.

The conservation of water must be done on priority basis for the maintenance of forest ecosystem and biodiversity. The development of low carbon technology map for the reduction of greenhouse gases must be focused by the researchers.

Human Resource Development: NER has some specific issues which are recognized as major gaps towards the development of community empowerment, skill development and job creation. Because of the difficult mountain terrain and remoteness to reach to tribal populations, large industrial developments remain scanty in NER. Major emphasis was given on developing infrastructure facilities and skilling of populations in small scale industries utilizing biodiversity, cultural strengths of respective States. However, despite high potential of growth of economic activities in the region, low awareness of skilling benefits, wide-spread digital divide across the region, less number of skill based trainings conducted in several states, lack of integrated approach of schemes led by Central and State Departments, have resulted into relatively low job creation and self-employment in the region.

Infrastructure: The biggest constraint in the Northeast (NE) region has been the poor infrastructure, particularly roads, railways, waterways, and power. In NE states, there are huge development potentials in infrastructure like road connectivity, transformation in the tourism industry, and reformation in the power sector like mega hydropower projects etc. Improving the state's connectivity within the region and the rest of the country is key to its prosperity and growth.

There should be an urban solid waste management policy, including hospital waste management. National and international infrastructure development will be the best option for inclusive development in India's Northeast because national and international borders bind it.

Rural Development: There are many constraints e.g. rural infrastructure development, lacking coordinated approach among state government and government agencies, government funding etc, which come on the way of faster implementation of the Rural Infrastructure Development Fund (RIDF) in the North East region of India. These include delay in land acquisition for construction of canal, drainage, road and bridge and other infrastructure; delay in clearance from the concerned Environment Control Board; inadequate efforts towards capacity building; delay in procedural formalities within the state government and weak financial position of most of the state government departments.

The study recommends that significant portion of the problems could be resolved easily if the concerned state governments and other stakeholders of the region jointly work towards the development of rural economy by developing rural infrastructure through RIDF, it will be a boon for the rural development of the region.

Tourism: North East Region nestled under luscious verdure, rich flora and fauna has great potential for sustainable tourism. North East India is a very backward region in the whole country, yet it has the greatest potentiality to develop the region into a potent force through tourism industry, Gour Krishna Saha (2015). The region is also known for its unique and rich cultural, ethnic heritage making it a favourite tourist-spot. The flora of the region covers 43% of the total plants species and 39% of endemic species found in India making it a geographical 'gateway' for much of India's endemic flora as well as fauna.

As per the data collected in this study, only 6 studies have been conducted in the past 10 years in the tourism sector. More studies needs to be carried out in this sector in NER.

The following inferences have been drawn after analysing the focus group discussion among the stakeholders.

- There are many research agricultural institutes and various boards including spices board, rubber boards. All these have offices present in different parts of NER. As they all are doing a routine work and activities based on their own capacity, there is a need to strengthen the extension activities as their findings are not reaching to the farmers, which is resulting in lack of awareness among the latter.
- Duplication of researches is also a possibility and all the findings must be accumulated as research publication. There has to be some measures so that data is available at one place and how it can be taken forward to boost it at farmer's level. Database must be made to identify latest developments and works.
- Postharvest aspects with low-cost technology can have low-cost facility for storage and farmers can sell them when there is demand. There is lack of such facilities infrastructure. When there are bumper crops, farmers are forced to sell them at low price. The crops do not reach consumers, get wasted and as a result farmers do not get benefitted. Cold storage facilities should be installed in different regions to overcome the problem of crops and vegetables having short shelf life. It is estimated that 45% of crops are wasted because of lack of cold storage facility. These losses can be minimized through good infrastructure and cold storage.



- Plantation business and horticulture practices require high capital, which the local people cannot afford. Even banks do not give the loan to the tribal people because of non-authentication of land. Role of VLW (village-level workers) and Panchayat system have to be made more prominent in order to ensure proper distribution of government funds. State government should take action as a facilitator of any production process for creating better supply chain.
- There are high potentialities of renewable energy in NER but lack of skilled manpower is a constraint in smooth implementation of any project in the region. Local people should be involved in maintaining the equipment and properly trained.

The study team would like to highlight that among the total availability of 3500 research studies in NER states, the team could collect only 833 reports during the allocated time. Analysis of these reports with future scope and conclusions are based on the collected reports only. This may have captured partial research outcome and scope of future studies. The team strongly feel this study should be extended further to cover majority of the NER research studies for obtaining a comprehensive picture.

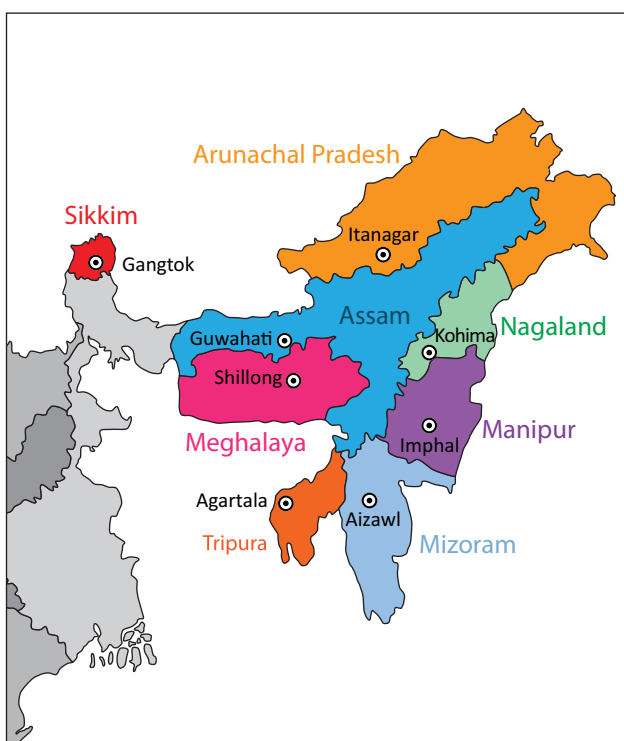
It is heartening to note that government agencies are now going digital for review and monitoring. Most of the ministries and state government department have already implemented their knowledge management system in this regard. TERI has been actively working with DST, DBT, and Government of Madhya Pradesh etc to develop such systems. We also suggest that MDoNER may consider to develop a searchable web-enabled research studies repository to have a regular access to full-text studies and establish an easy review and monitoring system.

1. Introduction

1.1 Background

The Ministry of Development of North Eastern Region (MDoNER) is a nodal department of Central Government, established in September 2001. It deals with matters related to the socio-economic development of the eight states of Northeast India: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. The MDoNER acts as a facilitator between the Central Ministries/Departments and the State Governments of the North Eastern Region (NER) in the field of economic development including removal of infrastructural bottlenecks, provision of basic minimum services, creating an environment for private investment, and removing impediments to lasting peace and security in NER.

North Eastern Region with 118 districts and an area of 262,179 km² holds 7.98% of the total geographical area of the country. As per Census 2011, the population of the region is about 45 million, constituting 3.78% of the total population of India. The region shares international borders of about 5483 km with several neighbouring countries, including Nepal (99 km), Bhutan (516 km), China (Tibet) (1346 km), Myanmar (1643 km), and Bangladesh (1879 km). It is one of the most ethnically and linguistically diverse regions in the country, and has a high concentration of tribal population. Mizoram (94.43%); Nagaland (86.48%); and Meghalaya (86.15%) represent the highest Scheduled Tribes population. The region's location and natural resources make it a potential powerhouse of India for its growth and development. These eight states are endowed with the necessary ingredients that can help in propelling their growth and development and in driving the growth of the country's gross domestic product (GDP) as well. Blessed with bounty of natural resource, exotic species, and high literacy rates, NER offers a viable business platform for national and international investors.



While the entire world has only recently been veering towards organic products, NER has been for long a stalwart in organic products, providing the country with best organic varieties of vegetables, fruits, tea, coffee, and other medicinal herbs. The natural beauty coupled with cultural heritage of the region has always attracted travellers, scholars, and researchers to learn about the life, food habits, culture, tradition, language, and source of living of more than 200 tribes inhabiting the region.

The MDoNER is responsible for the matters related to the planning, execution, and monitoring of development schemes and projects in NER. It takes up studies on different components, namely social empowerment, economic empowerment, partnerships development, and project management. As per the record (Table 1.1) available with the MDoNER, till 30 June 2020, 1970 projects worth Rs 22,773.8 crore have been sanctioned since its inception, out of which 1277 projects have been completed and 693 projects are ongoing at different sectoral levels. Apart from these projects, there are several other projects, either completed or



currently ongoing in NER, that have been funded by various other agencies (national or international). Every year several new proposals keep coming up for the development of NER. As no centralized database exists of the past completed projects/studies in NER, it becomes very difficult to finalize new proposals. The existence of a centralized database of the project completed in NER would enable avoiding issues such as the possibility of duplication of proposals and tracking the funding pattern sector-wise, state-wise, and region-wise. This will enable future allocation of funds rationally in NER.

Table 1.1: MDoNER Projects Implementation Status, since inception (Rs. in crore)

S. No.	State	Projects Sanctioned		Projects Completed		Projects Ongoing	
		No.	Approved Cost*	No.	Approved Cost*	No.	Approved Cost*
1	Arunachal Pradesh	243	3208.39	143	1623.42	100	1585.17
2	Assam	590	6537.23	321	2945.74	269	3591.48
3	Manipur	255	2822.7	154	1663.74	101	1158.96
4	Meghalaya	119	2054.37	71	986.58	48	1067.79
5	Mizoram	181	1955.21	131	1007.8	50	947.39
6	Nagaland	194	2120.69	139	1339.84	55	780.86
7	Sikkim	257	1794.68	221	1059.34	36	735.35
8	Tripura	131	2280.49	97	1238.84	34	1041.65
	Total	1970	22,773.8	1277	11,865.3	693	10,908.7

Source: MDoNER (as on 30 June 2021)

* Rs in Crore https://mdoner.gov.in/dashboard/schemetables/common_all_project_list_scheme.php?scheme=total_doner&table=table1a&index=index

1.2 Objectives

Despite various organizations, agencies, government, NGOs, etc. undertaking studies pertaining to NER on various sectors in the past, no complete data bank/record of such studies are available in a consolidated form. It has been observed that in spite of many studies being conducted in the region, many new proposals still keep being suggested for further studies on similar or related subjects by researchers, academics, and consultancy organizations. As a result, the Ministry proposed a study titled 'Study of Studies'.

The proposed study envisages to list out and compile various studies undertaken so far in various sectors in NER, and analyse and compile the recommendations of such studies, which may be then utilized at various policy and decision-making levels.

1.3 Scope of the study

The scope of the study is as follows:

- Prepare a master database of the studies conducted during the period 2010 to 2020.
- Categorize/organize these studies on the basis of subjects/sectors/states/areas of study/implementing institutions
- Study and analyse the actions taken on the recommendations of the studies/present status of implementations of such recommendations and reasons for non-implementations

- Study and analyse the feasibility/practicability of implementation of the recommendations of such studies, list out implementable recommendations along with the pre-conditions required for implementing these, and agencies responsible for implementation.
- Analyse the outcomes of these studies using appropriate statistical techniques.
- Assess the usefulness of such studies.
- List out areas/sectors in which no worthwhile studies have been conducted in the past 10 years and suggest such areas/sectors that require detailed studies in future.

1.4 Limitation

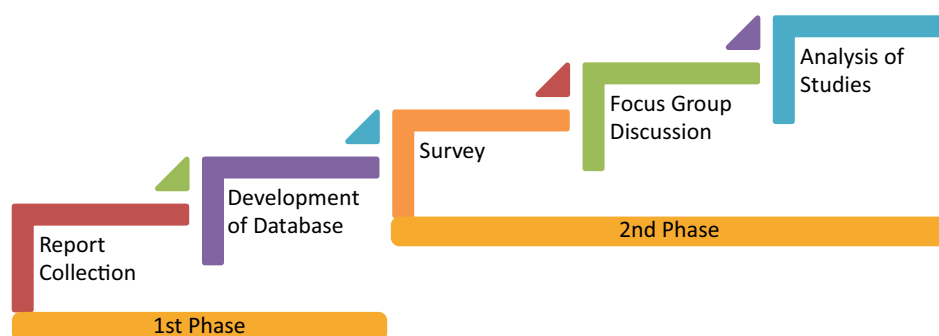
While conducting the study, the following limitations were encountered:

- **Travelling/visits to different North Eastern states/institutions:** Owing to the widespread COVID-19 pandemic, visitors in any organization were not allowed to meet face to face, hence obtaining print copies of reports became a difficult task in the first phase of this project. Moreover, in the second phase of this project, the project team was not allowed to enter any villages and meet the beneficiaries. However, the team overcame the issue, to a large extent, by telephonic interview and video-conferencing facilities.
- **Incomplete information in study reports:** Though many study reports are available in the open domain, certain key information required for the study, such as 'study start date', 'year of completion', 'name of funding organization', 'contact details', and in some reports 'recommendations' were found missing. To obtain such important missing pieces of information, the project team then contacted the respective principal investigators/heads of institutions. However, this proved to be a challenging task as many of the PIs had got transferred, were no longer associated with the implementing institutions, or had retired.
- **Phone/Internet connectivity in NER:** Owing to the issue of poor Internet connectivity, many a times receiving electronic copy of reports became a challenge as uploading/attaching voluminous reports in an e-mail/cloud entailed lot of time. Keeping this situation in cognizance, the NER team scanned a few important pages of the voluminous reports to fill in the metadata. The phone connectivity was also very poor in many places in NER, hence sometimes it became demanding to conduct key performance indicators (KPIs) and interviews with the beneficiaries.



2. Approach and Methodology

During the 10-month period of the study, the key deliverables were completed in two phases. In the first phase, the study reports were collected, compiled and classified and in the second phase, the analysis of the recommendations of each study report was done. The following methodology was adopted while undertaking the assignment.



2.1 Collection, compilation, and classification of studies

In the first phase of this study, the study team collected 833 study reports that had been completed from 2010 to 2020 in NER. To collect these reports either various organizations, state government departments, universities were contacted or their websites visited. The study reports were compiled and broadly classified under 12 sectors: (i) agriculture and allied, (ii) banking and finance, (iii) commerce and industry, (iv) energy, (v) environment, (vi) health and nutrition, (vii) human resource development, (viii) infrastructure, (ix) law and governance, (x) rural development, (xi) science and technology, and (xii) tourism (refer to Table 2.1).

Table 2.1: Number of studies conducted in different states under various sectors

Sectors	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	More than one state	Grand total
Agriculture and Allied	4	52	2	21	7	12	5	7	17	127
Banking and Finance	1	2	1	2	1	1	1	1	1	11
Commerce and Industry		1						1	6	8
Energy	3	18	7	13	6	10	3	9	1	70
Environment	40	60	14	71	25	30	36	20	48	344
Health and Nutrition	1	22	1	6	2	1	6	4	9	52
Human Resource Development	6	9	1	10	1	2	2	3	12	46
Infrastructure	1	10	2	18	1		3	5	7	47
Law and Governance		2		2			2		2	8
Rural Development		3		7	12	1		1	3	27
Science and Technology	17	24	8	7	4	5	1	3	18	87
Tourism		1		2		1	1		1	6
Grand total	73	204	36	159	59	63	60	54	125	833



After classifying 833 study reports by sector, it was observed that majority of the studies had been conducted in the environmental sector. As clear from Figure 2.1, 344 studies have been conducted in the environment sector; 127 studies have been done in the agriculture and allied sector; 87 studies had been undertaken in the science and technology sector, and 70 studies have been carried out under energy sector. As NER is known as a tourist destination in India, a substantial investment is required in studies that aim to analyse and suggest recommendations for expansion of the activities and infrastructure development in the tourist sector. As per the data collected in this study, in the tourism sector only six studies have been conducted in the past 10 years. Moreover, other sectors such as Law and Governance, Commerce and Industries, and Banking and Finance need more attention as the number of studies conducted in these sectors are comparatively very low.

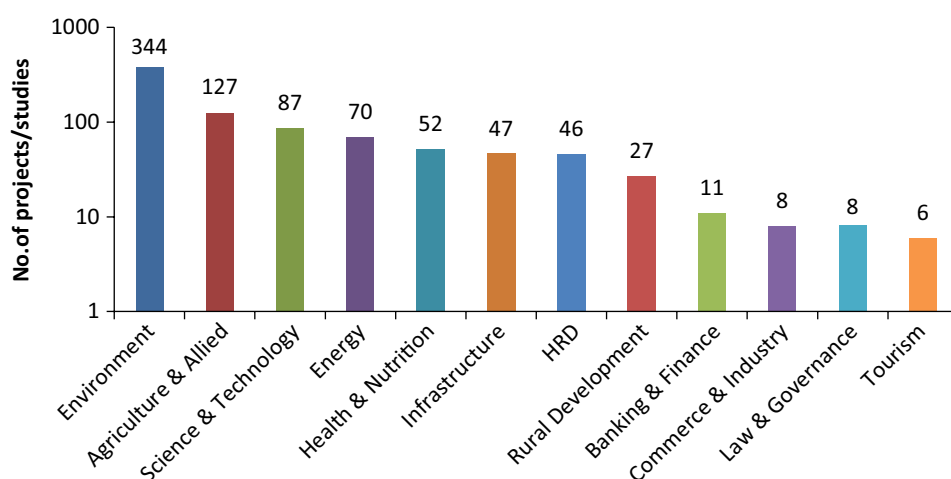


Figure 2.1: Number of studies completed in NER on various sectors during 2010-20

As per the data obtained from the database, from 2014 onwards a significant rise has been seen in the studies undertaken in the various sectors. Till 2013, the number of studies conducted per year was below 90, whereas a significant increase was observed from 2014 onwards. This analysis is based on the metadata of 833 reports collected during the first four months of this study.

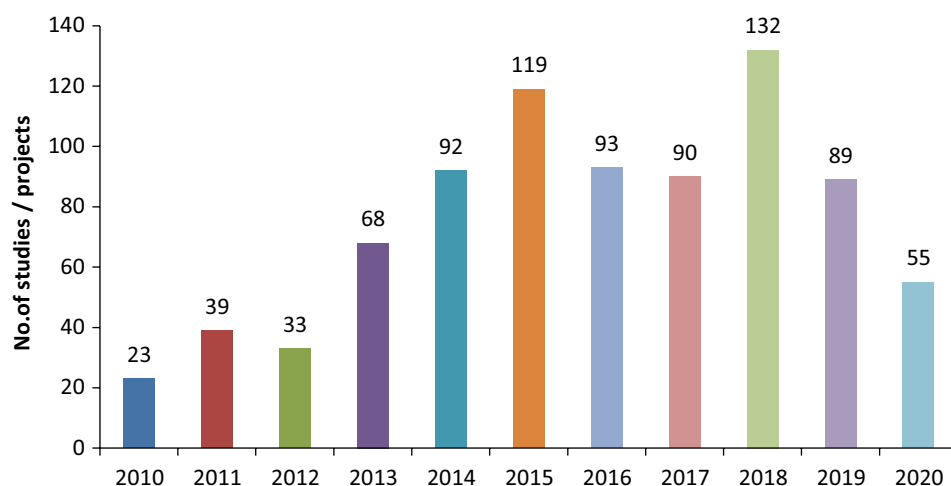


Figure 2.2: Number of studies completed in NER during 2010-20

It is worth mentioning here that the majority of the the studies primarily focussed or were implemented in Assam and Meghalaya. Out of 833 completed study reports, 204 studies (25% of the total studies) focussed on Assam while 159 studies (19% of the total studies) focussed on Meghalaya. Another observation made was that there were 125 studies whose study area covered more than one state or all the North Eastern states. The percentage of such studies is 15% of the total studies conducted during 2010–20 period.

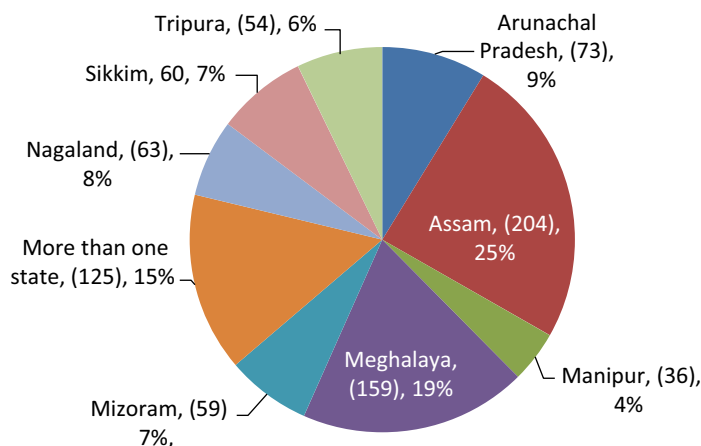


Figure 2.3: Number of studies conducted in different states during 2010–20

Ongoing Studies

The 150 on-going studies, identified and collected during the project period , have been categorized under eight sectors viz., Agriculture & Allied (50), Commerce & Industries (3), Energy (3), Environment (50), Health & Nutrition (8), Human Resource Development (13), Rural Development (11), and Science & Technology (12). As per the scope of the study, studies sanctioned during 2017-2020 and are still ongoing, have been compiled and classified under six fields viz. i) sector, ii) state (study location), iii) implementing institutions, iv) funding agency and vi) study awarded (year-wise). Based on the information collected, it was observed that a majority of the studies have been awarded to Agriculture & Allied and Environment sectors compared to other sectors. It was also observed that most of the studies (50) have been located in Assam , followed by Nagaland (13) and Meghalaya (12). Also 31% of the ongoing studies are being implemented in more than one North Eastern states.

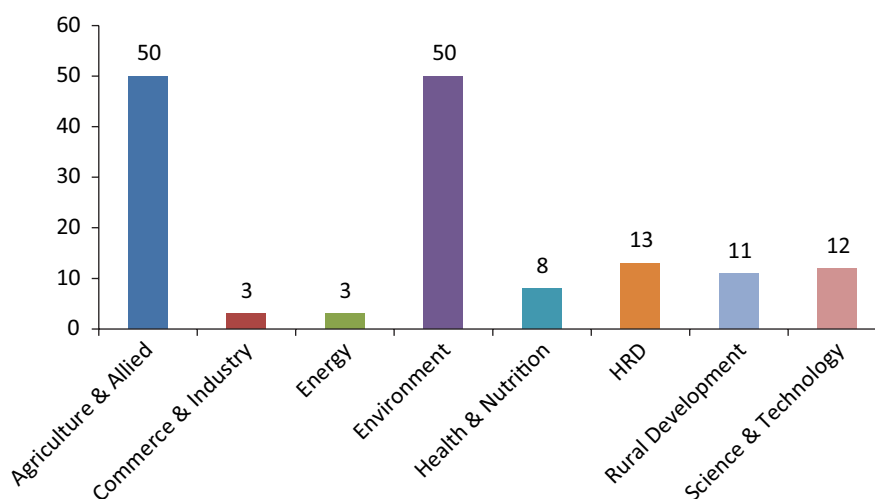


Figure 2.4: Ongoing studies during 2017-20 in NER (sector-wise)



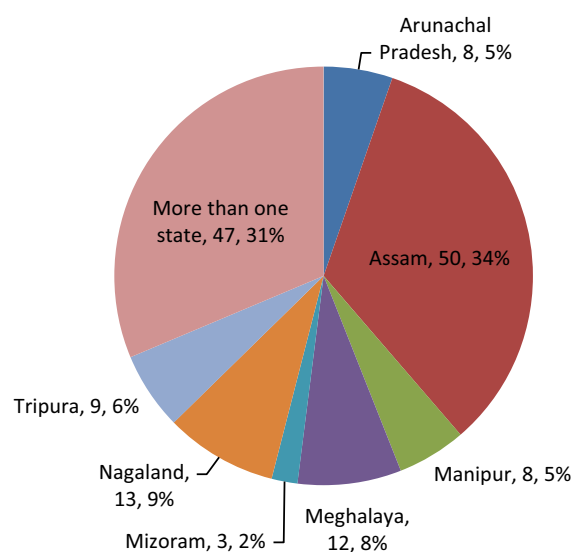


Figure 2.5: Ongoing studies during 2010-20 in NER (state-wise)

Table 2.2: Ongoing studies sanctioned sector-wise & state-wise during 2010-2020

Sectors	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Tripura	More than one state	Grand Total
Agriculture & Allied		22	4	4	1	7	1	11	50
Commerce and Industry		3							3
Energy		1				1		1	3
Environment	4	11	3	3	1	1	7	20	50
Health and Nutrition		5		1				2	8
Human Resource Development	2	4	1	2				4	13
Rural Development	1	3		1	1	4	1		11
Science and Technology	1	1		1				9	12
Total	8	50	8	12	3	13	9	47	150

2.2 Development of database and metadata entry of study reports

A well-structured database of collected study reports was developed in MS Excel. The database included the following metadata fields: study title, study completion year, implementing institution, project investigator's name, funding agency, study location, sector, study objective, location, recommendation. To ensure easy retrieval, records of each selected record was entered in the database as per the defined metadata. Further to this, for quick access to the reports, the project team member linked the softcopy of each report on the study title based on the metadata entry of each report.

2.3 Perception survey

A perception survey was conducted among stakeholders and PIs to obtain the requisite data for the analysis of the recommendation mentioned in the various study reports. A survey team of eight enumerators and two coordinators were deputed to analyse the feasibility and the status of the recommendations of the studies completed in the last 10 years. For each state, one enumerator was assigned to collect data from respective project PIs and stakeholders. Before assigning the task to the enumerators, a series of virtual-orientation programmes were conducted to brief them about the objective of the study and the steps they had to follow to collect data from various project investigator, beneficiaries, and stakeholders.

In order to study and analyse the actions taken on the recommendation of various study reports, a survey questionnaire (Annexure-1) was designed to get qualitative data. The questionnaire was developed in both online and print formats. The questionnaire was finalized in consultation with the project review and advisory committee constituted for the study. Besides, coordinators regularly monitored the progress of the survey and resolved issues that surfaced. A pilot testing was also done among the select group of PIs and beneficiaries. The pilot test helped in modifying the questionnaire as per the requirement.

A survey questionnaire with respect to 833 study reports was emailed to all the project investigators along with an authorization letter from the MDoNER. The survey team did a rigorous follow-up with the respective investigators and the concerned departments via email, telephone, and personal visits. As a result, response of 202 study reports were collected from PIs and other stakeholders. In some instances, it was found that either the project PI was unavailable or the concerned organization was unwilling to respond to the questionnaire. In such cases, the information was collected by interviewing some key persons or beneficiaries in the region of study.

2.4 Focus group discussion

Apart from the perception survey, six Focus Group Discussions (FGDs) were conducted, wherein scientists and subject experts (Annexure-3) from different institutions in NER were invited to discuss the feasibility and outcome of the recommendation of the past projects. The FGDs were conducted by the senior members of the TERI project team. The tools involved included in-depth interviews with individuals, FGDs with communities, dialogues, local consultations with relevant stakeholders, and personal observation. A set of qualitative questionnaires (Annexure-4) for interviewing the key stakeholders and FGDs was also designed separately to assess and evaluate the impact and implementation of the suggested recommendations in various studies on NER. The FGDs and on-to-one interviews were very useful in enriching the project team's understanding of the different types of project impacts and the factors that contribute to or hinder positive impact.



2.5 Analysis of the studies

The study analysis was divided mainly into two sections: (i) Sector-wise analysis and (ii) Report analysis.

2.5.1 Sector-wise analysis

In this section, the analysis was broadly done for 12 sectors as mentioned earlier. Quantitative and qualitative analyses of each sector was carried out based on data received through questionnaires that had been filled-up by the respective PIs or implementing institutions. This helped in understanding various sector-specific issues, implementation status, outcome of these projects, thrust necessary, etc. in a consolidated manner.

This section intends to identify and measure the status of recommendations, explore the barriers and enabling factors for better implementation (of recommendations), and estimate the level and pattern of impact (from implemented recommendations).

To address these objectives, the study has followed Census enumeration method along with FGD and key person interviews. Ideally, to explore the status of recommendations and measure the impact, primary survey with all the stakeholders concerned needs to be conducted. But, as per Term of Reference (ToR), the required information was collected only from the experience and perception of individual study principal investigators or their representatives (through census enumeration), which was then validated and complemented by inputs from FGD and key person interviews. The analysis and the conclusions drawn in this report are based on the perception study, which may differ from the ground reality; hence, an in-depth sector-wise survey is highly recommended to minimize the potential gap.

The study team prepared a detailed questionnaire for census enumeration consisting of experience and perception-related questions. For ease in estimation, excepting a few, most of the questions were close ended. All possible alternative responses were enlisted under each close-ended question to gauge the maximum available information from the respondents (here, study principal investigators or their representatives). Due to COVID-19, a physical census survey was not possible in all the situations. Hence, a combination of physical and online perception survey was conducted as and when felt necessary. The online questionnaire link was sent to all the respondents. Regular follow-up with the respondents through phone and email (and physical visits wherever necessary) was conducted by TERI team to ensure maximum response. However, with time being a constraint, responses that were available till end of November 2021 were considered for this analysis. During this period, 202 responses were obtained and finally used in the analysis. After cleaning of data available from both offline and online survey, descriptive analysis was performed in excel only. The percentage share of alternative responses in each question at total (all available responses) as well as 10 mutually exclusive and exhaustive sectors are reported in the next section.

2.5.2 Analysis of reports

To study and analyse the recommendations of various study reports, a detailed list of objectives and recommendations from each of the study reports were collected and compiled along with their implementing agencies name, project investigator's name, year of completion, and sector. Analysis of each study report has been carried out by consulting implementing institutions, perception survey, and referring to secondary literature, news, reports among others. Besides this, inputs received through beneficiaries, key stakeholders, and FGDs were also taken into consideration to assess and evaluate the impact and implementation of the suggested recommendations in various studies in NER.

3. Sector-wise Analysis

3.1 Analysis of perception survey responses

3.1.1 Sample characteristics

To measure the status of recommendations of various research studies, a questionnaire comprising various quantitative and qualitative questions were sent to all the study representatives (and the PI if available). However, after rigorous follow-up and visits, the study team received only 202 sample responses. The sample responses were segregated by 10 sectors: agriculture and allied, banking and finance, energy, environment, health and nutrition, human resource development, infrastructure, law and governance, rural development, and science and technology. No response was received from Commerce & Industry and Tourism sectors. Out of the total 202 sample responses, 31% studies belonged to agriculture and allied, 25% belonged to environment, and 12% belonged to health and nutrition. Law and governance had lowest share (1%) among the received responses. Figure 3.1 gives the share of representation of various types of studies in 202 submitted sample responses.

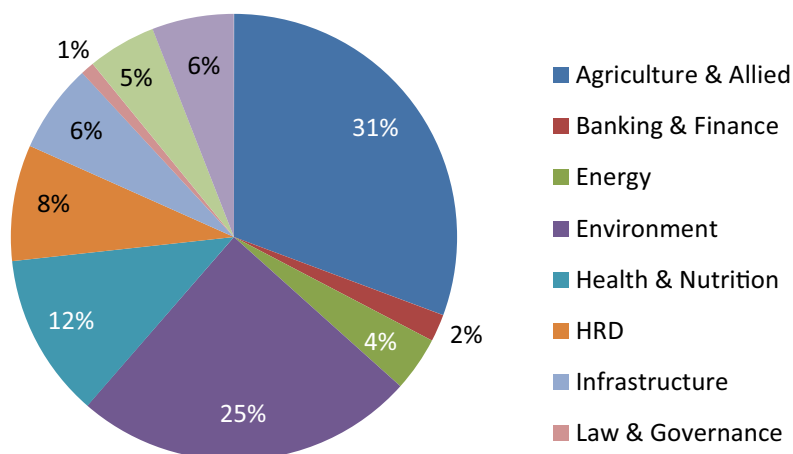


Figure 3.1: Representation of various types of studies in 2020 submitted responses

3.1.2 Gender of principal investigator

When sample responses were categorized on the basis of gender of the study lead (principal investigator), it was found that about one-fifth (19.3%) of the surveyed studies (202 sample responses) had female principal investigators. As indicated in Figure 3.2, in agriculture and allied and environmental studies, female principal investigators led by about one-fifth. In the case of law and governance studies, female principal investigators led one of the two, and this was one-fourth in banking and finance as well as health and nutrition studies. But infrastructure and energy studies were conspicuous by the absence of female principal investigators. On the other hand, 35.3% of human resource development studies had female principal investigators, and only 16.7% and 10% of science and technology and rural development studies respectively, were led by female principal investigators.



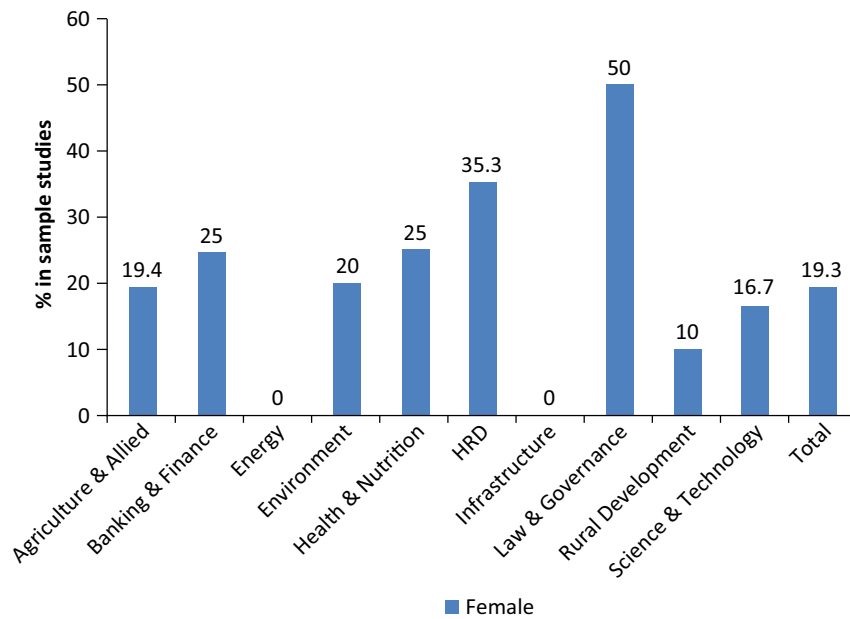


Figure 3.2: Segregation of sample studies by gender of principal investigators

3.1.3 Presence of gender aspect in study

To integrate gender dimension in the studies, specific questions were framed in this aspect. The survey revealed that out of the total 202 samples, only 4% studies were fully gender specific (as evident from Figure 3.3) while another 5.4% were partially gender specific. Gender specificity in law and governance studies was 50% fully and 8.3% fully in health and nutrition studies, 5.9% human resource development, 4.8% of agriculture and allied and 2% of environmental studies were fully gender specific. On the other hand, 11.8% of human resource development, 7.7% infrastructure, 6.5% of agriculture and allied and 2% of environmental studies were fully gender specific.

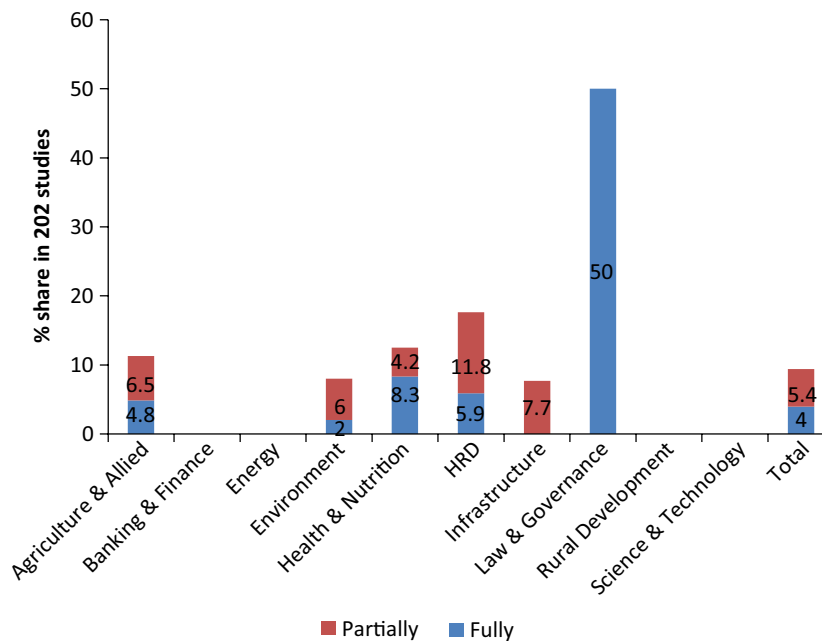


Figure 3.3: Share of 202 studies reporting presence of gender aspect

3.2.4 Presence of cross-cutting issue

To further examine the nature of the study, the respondents were also asked about the presence of cross-cutting issues in the studies. From the submitted responses one can see that 38.6% of the 202 responses confirmed the presence of cross-cutting issues. Of these, 100% of the law and governance studies, 92.3% of the infrastructure studies, 62.5% of the energy studies, and 50% of the environment and banking and finance studies had cross-cutting issues. 35.3% of human resource development, one-third of science and technology, 30% of rural development, 24.2% of agriculture & allied and 16.7% of health and nutrition related studies have cross cutting issues as indicated by submitted responses.

3.1.5 Project duration of studies

To segregate the studies based on project duration and classify them as short-term and relatively long-term studies, the respondents were also asked about project initiation and completion dates. As per available responses, out of 202 sample responses, 27.7% were short-term (duration up to one year) studies while 56.4% were relatively long-term studies (duration more than one year). In the case of banking and finance as well as law and governance-related studies, half of the studies (as indicated in Figure 3.4) were short term while the remaining half were of relatively long term in nature. Only in the case of infrastructure studies, majority (61.5%) were of short-term nature. On the other hand, less than 10% (8.3% in specific) of science and technology studies, 11.8% of human resource development studies, one-fourth of energy and environmental studies, 40% of health and nutrition and rural development studies, and 27% of agriculture and allied studies were short-term studies.

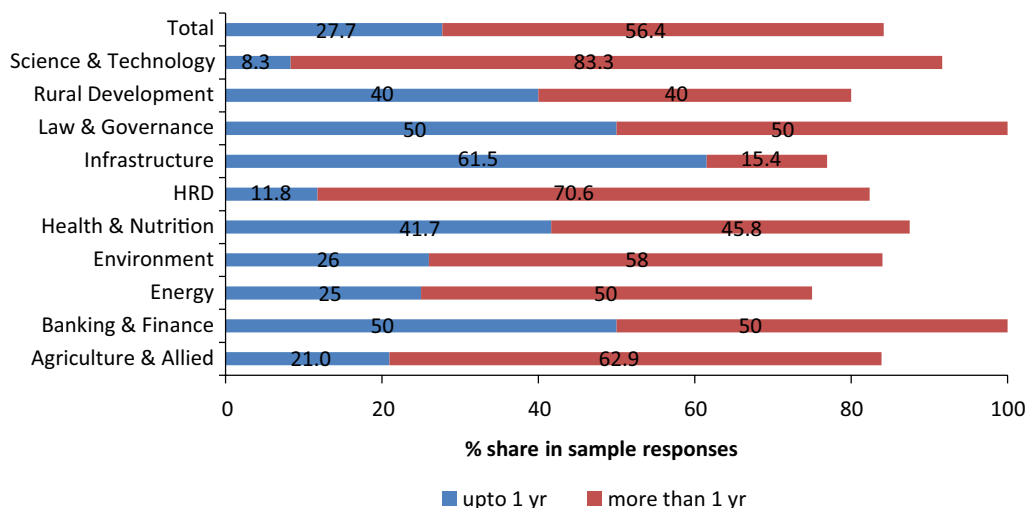


Figure 3.4: Segregation of sample studies by duration

3.1.6 Project cost

Sample studies were also segregated by project cost/budget. One-fifth (20.3%) of 202 sample studies (as indicated in Figure 3.5) were relatively low-cost studies (up to Rs 5 lakh) while 43.6% were relatively high budget (more than Rs 5 lakh) projects. From the responses it was found that none of infrastructure and law and governance studies were low-cost studies. All banking and finance studies, one-fifth of rural development studies, and one-fourth of energy studies were of low budget. Similarly, 4% of environmental studies, 35.5% of agriculture and allied studies, 16.7% of health and nutrition, 17.6% of human resource development, and 16.7% of science and technology studies were relatively low-budget studies. Half of environment and law & governance studies and majority of human resource development (58.8%), rural development (60%), and science and technology studies (75%) had relatively high budget.



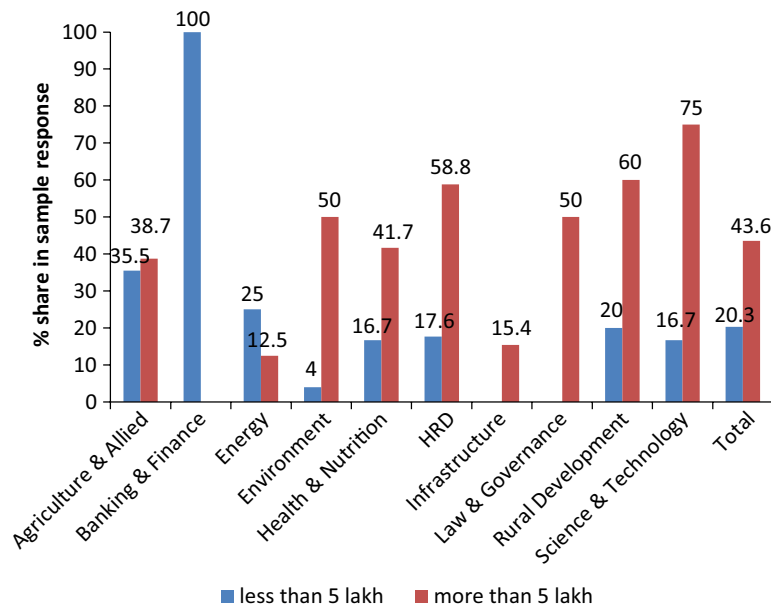


Figure 3.5: Classification of studies by project cost

3.1.7 Identify and measure status of recommendations

While the previous section briefly discussed about the sample (202 received responses) characteristics, in this section we will explore the primary objective of the study, i.e. identify and estimate the current status of recommendations of various studies and their impact on target issue/groups. It was revealed from the survey (as indicated in Figure 3.6) that in 21.8% of the studies, the recommendations were fully implemented while partial implementation was done in 30.7% of the studies. Another one-fifth (20.8%) of the responses indicated that recommendations were not implemented and 26.7% of received responses failed to identify the status of the implementation. Recommendations were fully implemented in one-third (33.3%) of the science and technology studies, 30% of the rural development studies, and 29.2% of the health and nutrition studies. As per the responses, in half of the rural development studies the recommendations were partly implemented. In banking and finance studies, partial implementation of the recommendations was done in half of the studies, while fully implemented in one-fourth of the studies. Recommendations were partly implemented in 62.5% of the energy studies, 42% of the environment studies, and 35.3% of human resource development studies. Similarly, recommendations by one-fourth of health and nutrition studies, 24.2% of agriculture & allied studies, 24.2% of agriculture & allied studies, 24.2% of agriculture & allied studies and 16.7% of science & technology related studies were partly implemented. On the other hand, as indicated

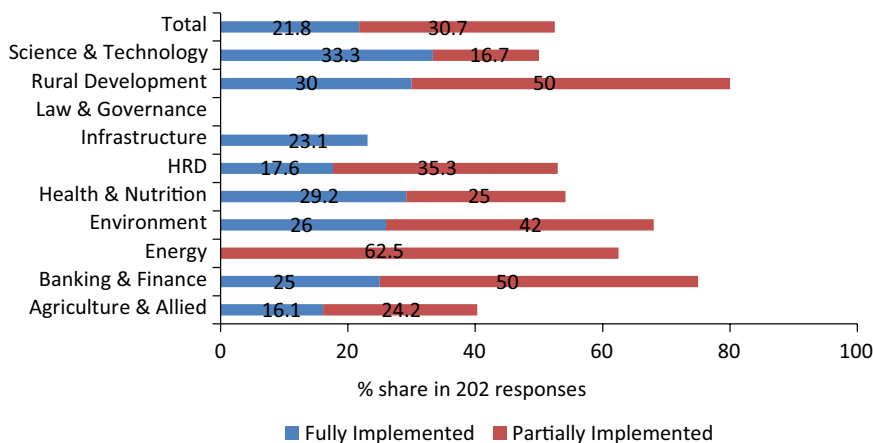


Figure 3.6: Status of implementation across sectors

by submitted responses recommendations by 26% of environmental studies, 23.1% of infrastructure related studies, 17.6% of human resource development and 16.1% of agriculture & allied studies were fully implemented.

Out of the 62 studies that recorded partial implementation of their respective recommendations in various fields, only three (one each in environment, human resource development, and rural development) studies confirmed that most of their recommendations had already been implemented. One study from human resource development indicated that only one recommendation had been actually implemented. In the remaining 58 studies with partial implementation, 13 studies (7 from environment, 3 from health and nutrition, 2 from science and technology, and 1 from energy) failed to specify the nature of the partial implementation. Finally, 45 studies, out of 62 studies with partial implementation, indicated that either part of one full recommendation or a few of the recommendations were implemented. In this category, 15 are from agriculture and allied, 12 from environment, 5 from human resource development, 4 from each of energy and rural development, 3 from health and nutrition, and 2 from banking and finance.

3.1.8 Reasons for partial/non-implementation

Respondents were asked about the various reasons for partial/non-implementation of their respective recommendations. Among the respondents who had indicated that their recommendations were either partially implemented or not at all, 40% blamed ‘administrative’ factors, 20% gave ‘finance’ as the reason, 18% thought ‘regulatory’ factors as responsible, 2% cited ‘judiciary’ as the reason, 3% believed ‘lack of awareness/knowledge’, and one-tenth of them cited various other reasons (as indicated in Figure 3.7). ‘Lack of community participation’ and ‘site-specific issues’ were some of the other factors indicated by respondents as reasons for partial/non-implementation of recommendations. ‘Administrative’ factors was blamed for partial/non-implementation of their respective recommendations by 80% of the respondents of infrastructure studies, 67% of the respondents of rural development studies, 50% of the respondents of banking and finance studies, 40% of the respondents of environment and health and nutrition studies, and the only respondent of law and governance study. On the other hand, ‘administrative’ factors were cited as the reason for complete failure of full implementation of the recommendations by 37% of energy studies, 35% of agriculture and allied studies, and 22% of human resource development studies. ‘Judiciary’ factor was cited by only one-third of rural development studies for non-implementation of their respective

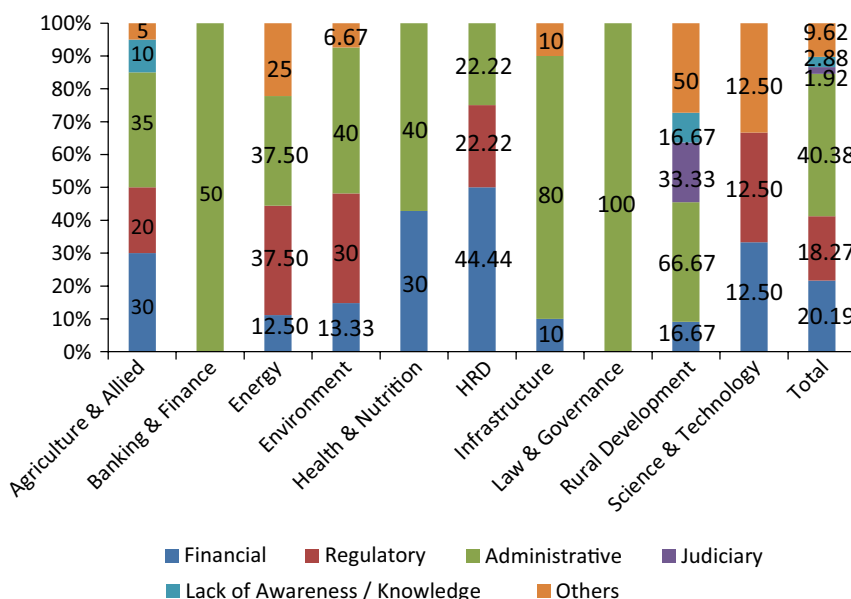


Figure 3.7: Reason for partial/non-implementation of recommendations



recommendations. On the other hand, 'lack of awareness/knowledge' was indicated by 10% of agriculture and allied studies and 17% of rural development studies. 'Financial' issues, as the reason for partial/non-implementation of respective recommendations, were cited by 30% of agriculture and allied studies, one-eighth of energy studies, 13% of environment studies, 30% of health and nutrition studies, 44% of human resource development studies, 10% of infrastructure studies, 17% of rural development studies, and one-eighth of science and technology studies. 'Regulatory' issues as the reason for partial/non-implementation of their respective recommendations were cited by 20% of agriculture and allied, 37.5% of energy, 30% of environment, 22% of human resource development, and one-eighth of science and technology studies.

3.1.9 Level of impact if implemented

For further exploration of implementation status of recommendations and its impact on target group, study representatives, who recorded full or partial implementation, were asked to measure/quantify the level of impact. As actual estimation of the impact was not in the ToR, perception (about the level of impact) of the study representatives were only noted and considered. Out of the 106 responses who indicated partial/full implementation of their study recommendations, 31.1% perceived that the implementation of study recommendations resulted in significant positive impact (as indicated in Figure 3.8). While negligible (1.9%) share of 106 responses indicated there was no significant impact, 12.3% indicated that there sufficient time had not lapsed to measure the impact and a possibility existed that the impact may be realized in the future. While half of science and technology studies, who had already recorded partial/full implementation of recommendations, indicated significant positive impact, corresponding figure for health and nutrition, agriculture and allied, rural development, and infrastructure types of studies are 46.2%, 40%, 37.5% and 33.3%, respectively. Similarly, 26.5% of environment studies and 11.1% of human resource development studies, who recorded partial/full implementation of study recommendations, perceived that there has been a significant positive impact. None of the banking and finance and energy studies indicated significant positive impact while none of the law and governance studies has recorded partial/full implementation. On the other hand, lack of sufficient time to measure the impact was indicated by one-third of the banking and finance as well as infrastructure types of studies and 23.1% of health and nutrition, 16.7% of science and technology, 16% of agriculture and allied, 11.1% of human resource development and 5.9% of environment studies (among those who had already recorded partial/full implementation of study recommendations).

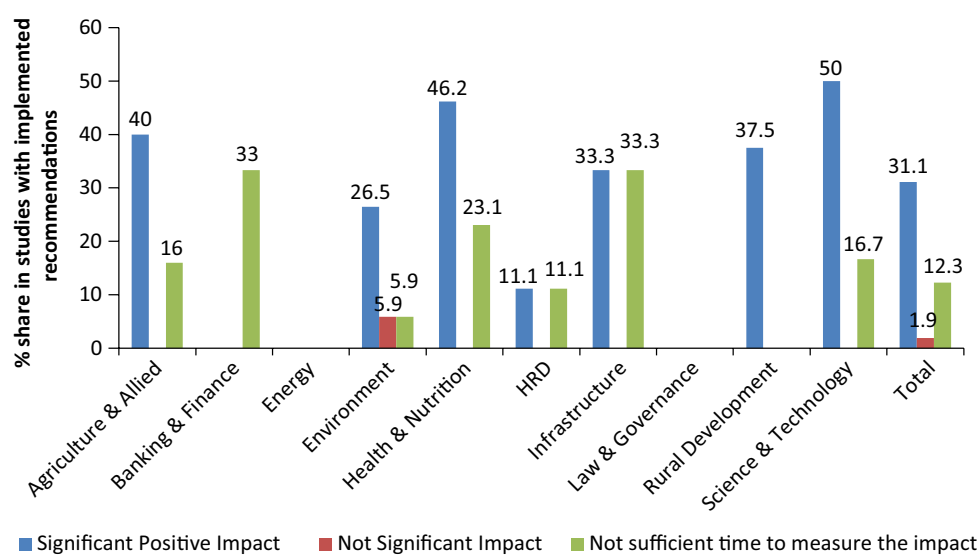


Figure 3.8: Scale of impact from implementation of study recommendations

3.1.10 Nature of impact

Once the level of impact was measured by perception of study representatives, the respondents were further asked to indicate the nature of impact from their perception. Various developmental aspects that can result from the implementation of the recommendations were also analysed from the available responses. Based on the information provided by 106 respondents (who have already recorded partial/full implementation of their study recommendations), it became clear that 22.6% of the studies (among the studies for which recommendations were already implemented) (as indicated in Figure 3.9) had a high impact (another 22.6% indicated medium impact) on employment generation as a result of the implementation of their recommendations. This becomes clearer when we study and analyse each of the projects in the next section. While 10.4% of the studies perceived high impact on women empowerment, 35.8% said that the implementation resulted in medium impact on women empowerment. Similarly, 32.1% of the studies perceived medium impact and 19.8% perceived high impact on income opportunity. In the case of infrastructure development, 22.6% of the studies found high impact and 17.9% found medium impact. For access to market and finance, 19.8% and 15.1% studies reported high and medium impact. While 26.4% and 23.6% reported high and medium impact on access to resources, 30.2% and 27.4% reported high and medium impact on livelihood improvement. On the other hand, 31.1% and 22.6% perceived high and medium impact on increase in productivity and 29.2% and 24.5% stipulated high and medium impact on skill development.

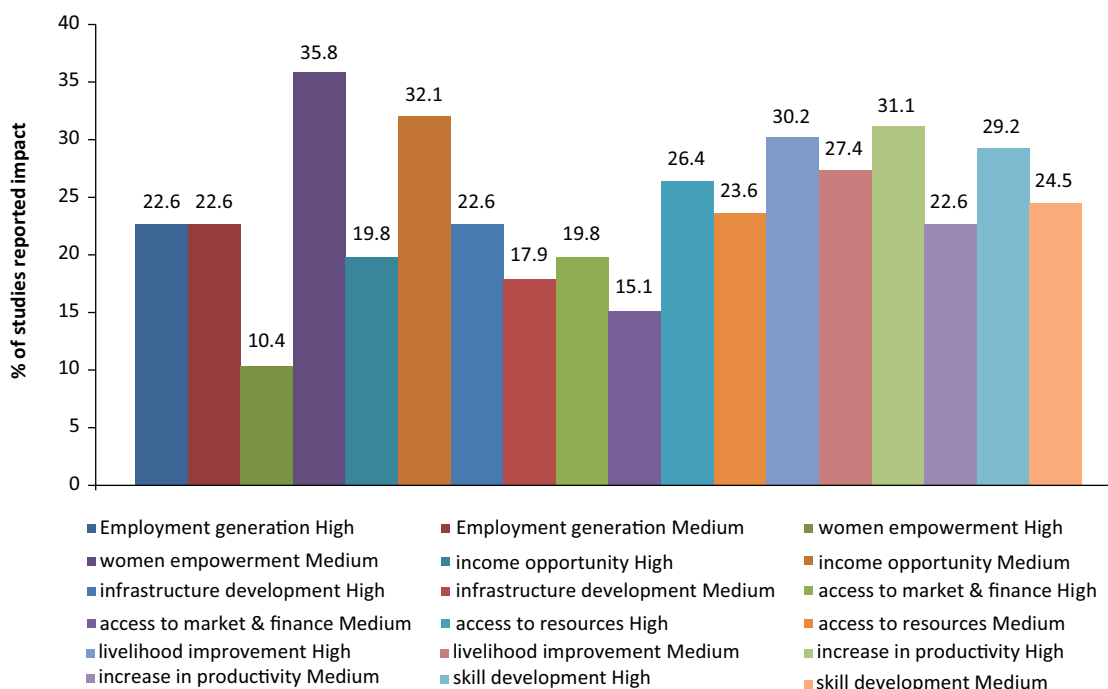


Figure 3.9: Impact of implementation of recommendation of 202 studies

3.2 Agriculture and allied

As evident from Figure 3.10, 20.0% of agriculture and allied studies reported high impact on employment generation, 28% reported high impact on women empowerment, 32% reported high impact on income opportunity, and only 12% reported high impact on infrastructure development. On the other hand, 16% and 8% of agriculture and allied studies reported high impact on access to market and finance and access to resources. While 24% of agriculture and allied studies reported high impact on livelihood improvement, 24% and 40% reported high impact on increase in productivity and skill development, respectively.



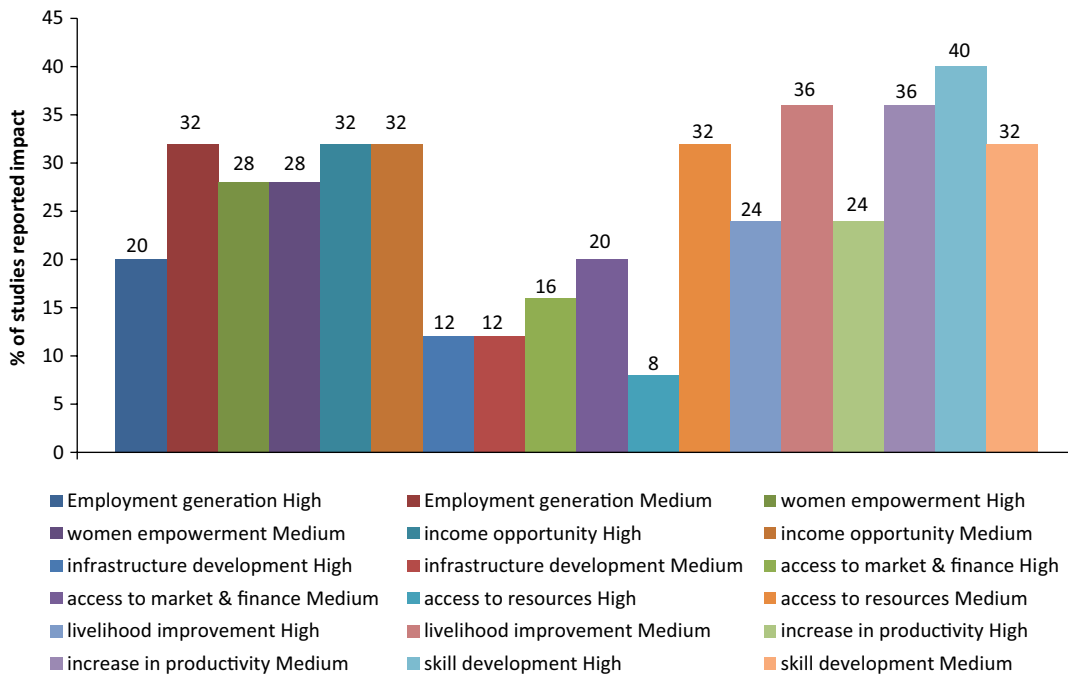


Figure 3.10: Impact of implementation of recommendation for agriculture and allied-related studies

3.3 Banking and finance

In the banking and finance studies, one-third (33.3%) of them reported high impact on employment generation, one-third (33.3%) reported high impact on income opportunity, and one-third (33.3%) reported high impact on infrastructure development (as indicated in Figure 3.11). None reported high impact on women

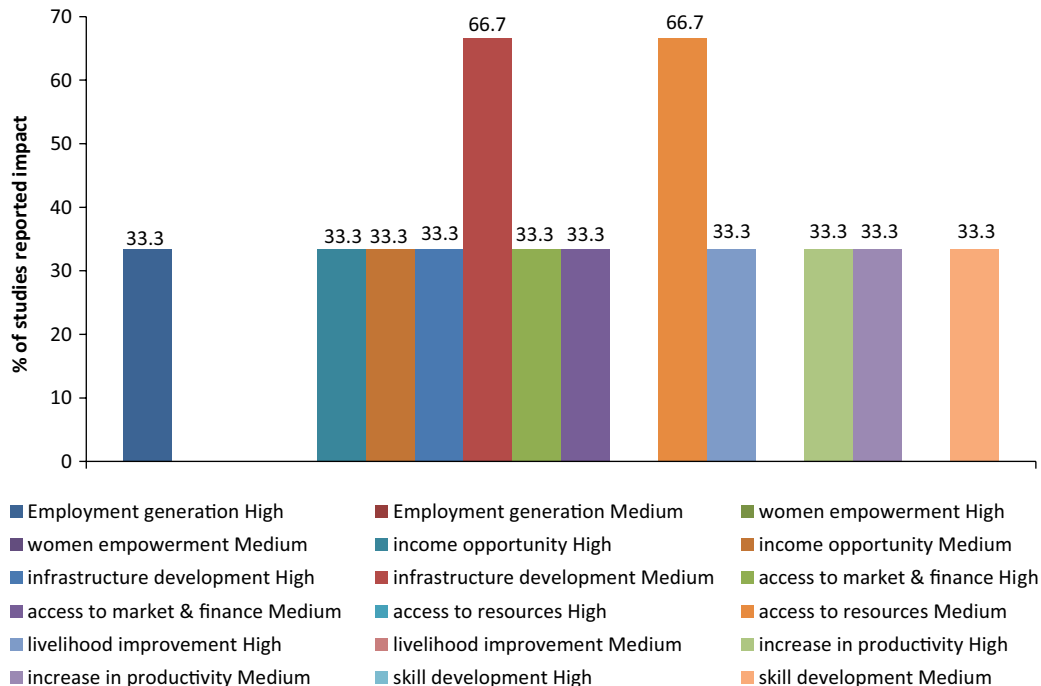


Figure 3.11: Impact of implementation of recommendation for banking and finance-related studies

empowerment and access to resources or skill development. Similarly, 33.3% of banking and finance studies reported high impact on access to market and finance, livelihood improvement, and increase in productivity.

3.4 Energy

As large as 80% of energy studies (as indicated in Figure 3.12) reported high impact on employment generation, one-fifth (20%) reported high impact on income opportunity, 60% of them reported high impact on infrastructure development, three-fifth (60%) reported high impact on access to market and finance improvement, and four-fifth (80%) reported high impact on access to livelihood improvement. Finally, 80% of the studies reported high impact on increase in productivity and 20% reported high impact on skill development. On the other hand, all of the studies, which demanded implementation of their recommendations, reported that there has been high impact on access to resources. But no energy studies reported high impact on women empowerment and 60% of them reported medium impact on women empowerment.

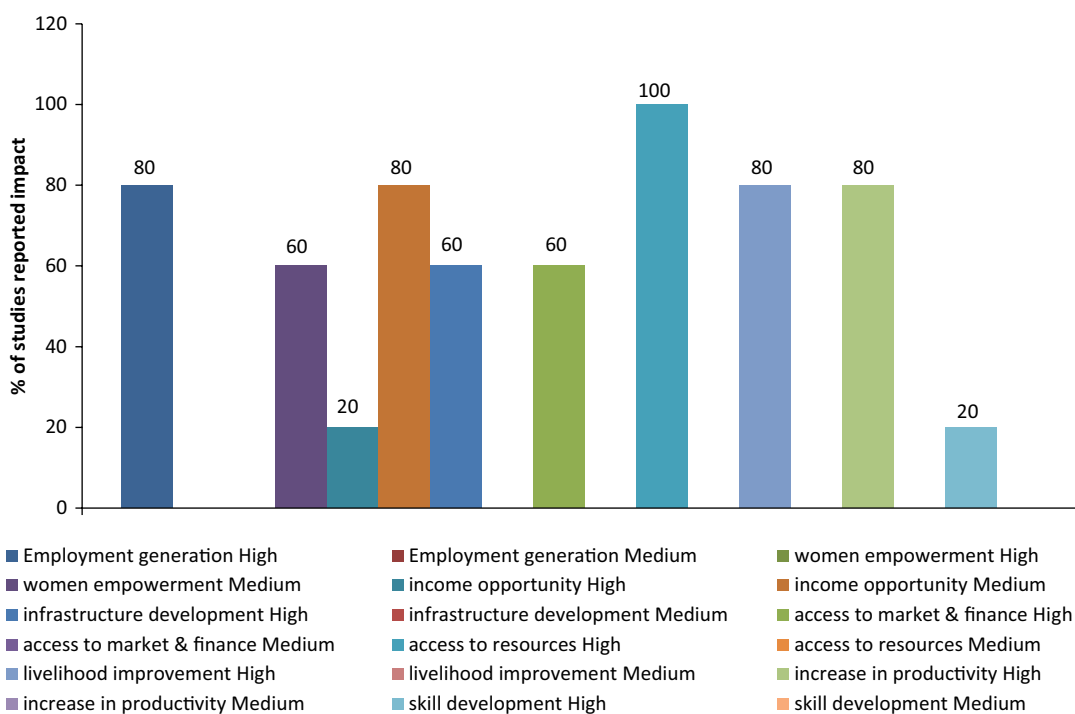


Figure 3.12: Impact of implementation of recommendation for energy-related studies

3.5 Environment

In the studies related to environment (as indicated in Figure 3.13), 29.4% reported high impact on employment generation, 5.9% reported high impact on women empowerment, 11.8% reported high impact on income opportunity, 26.5% reported high impact on infrastructure development, 26.5% reported high impact on access to market and finance, 41.2% reported high impact on access to resources, 38.2% reported high impact on livelihood improvement, 41.2% reported high impact on increase in productivity, and 20.6% reported high impact on skill development, respectively.



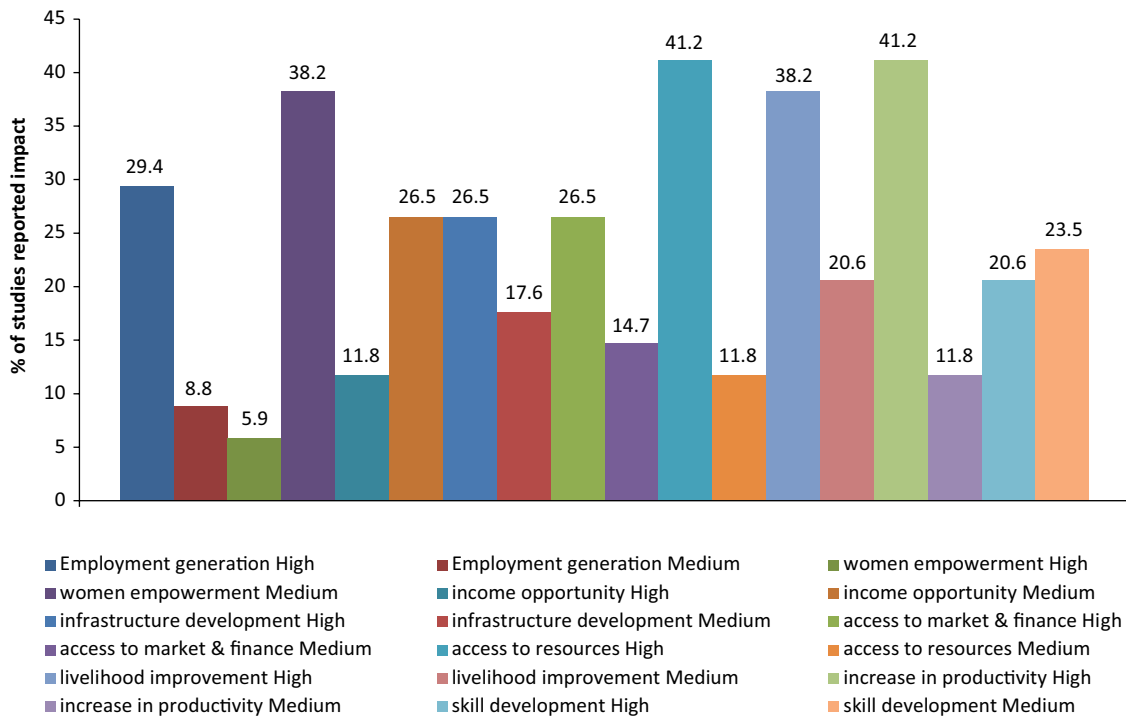


Figure 3.13: Impact of implementation of recommendation for environment-related studies

3.6 Health and nutrition

From Figure 3.14 we can see that in the health and nutrition study segment, 7.7% reported high impact on employment generation, 23.1% reported high impact on income opportunity, 7.7% reported high impact on women empowerment, 15.4% reported high impact on infrastructure development, 23.1% reported high impact on livelihood improvement, and 30.8% reported increase in productivity. For high impact on access to resources, high impact on access to market and finance, and skill development, the numbers are 15.4%, 7.7%, and 15.4%, respectively.

3.7 Human resource development

Referring to Figure 3.15, it becomes clear that 22.2% of human resource development studies reported high impact on employment generation, 11.1% reported high impact on women empowerment, one-third (33.3%) reported high impact on access to resources, and 22.2% reported high impact on infrastructure development. For high impact on access to market and finance, and income opportunity, the numbers were 11.1% and 22.2%, respectively. On the other hand, two-thirds (66.7%) of human resource development studies reported high impact on skill development, 22.2% and 33.3% reported high impact on increase in productivity and livelihood improvement, respectively.

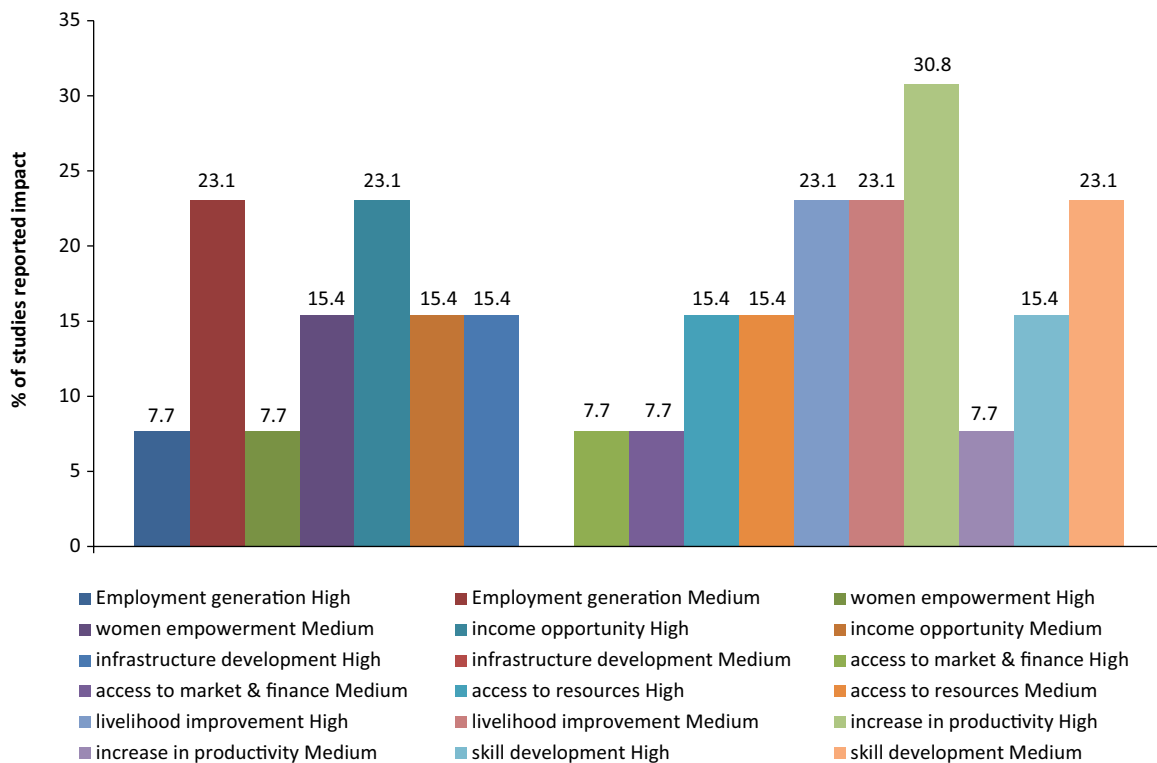


Figure 3.14: Impact of implementation of recommendation for health and nutrition-related studies

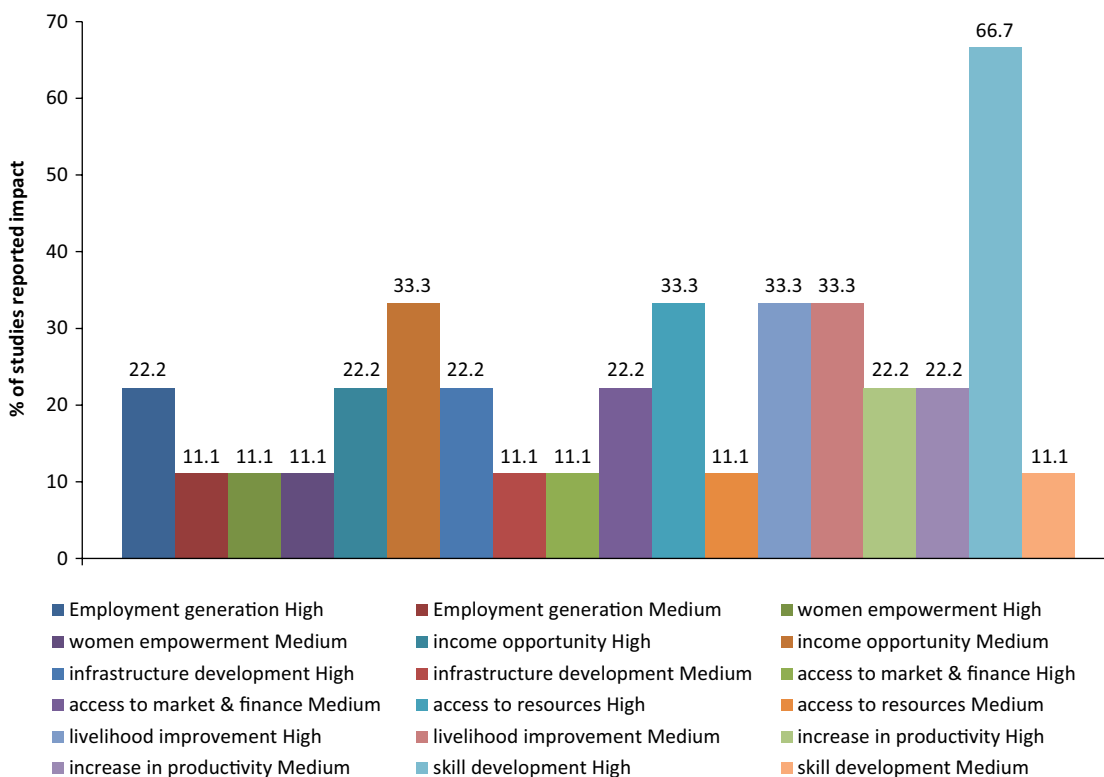


Figure 3.15: Impact of implementation of recommendation for human resource development-related studies



3.8 Infrastructure

On closely analysing Figure 3.16, it can be seen that one-third (33.3%) of infrastructure studies reported high impact on employment generation. The same number of studies reported high impact on access to market and finance as well. As the studies were infrastructure related, high impact on infrastructure development was reported by all studies in this group who recorded implementation of recommendations. None of the infrastructure studies reported high impact on any other indicators. However, for those indicators, 33–66% of the infrastructure studies reported medium impacts.

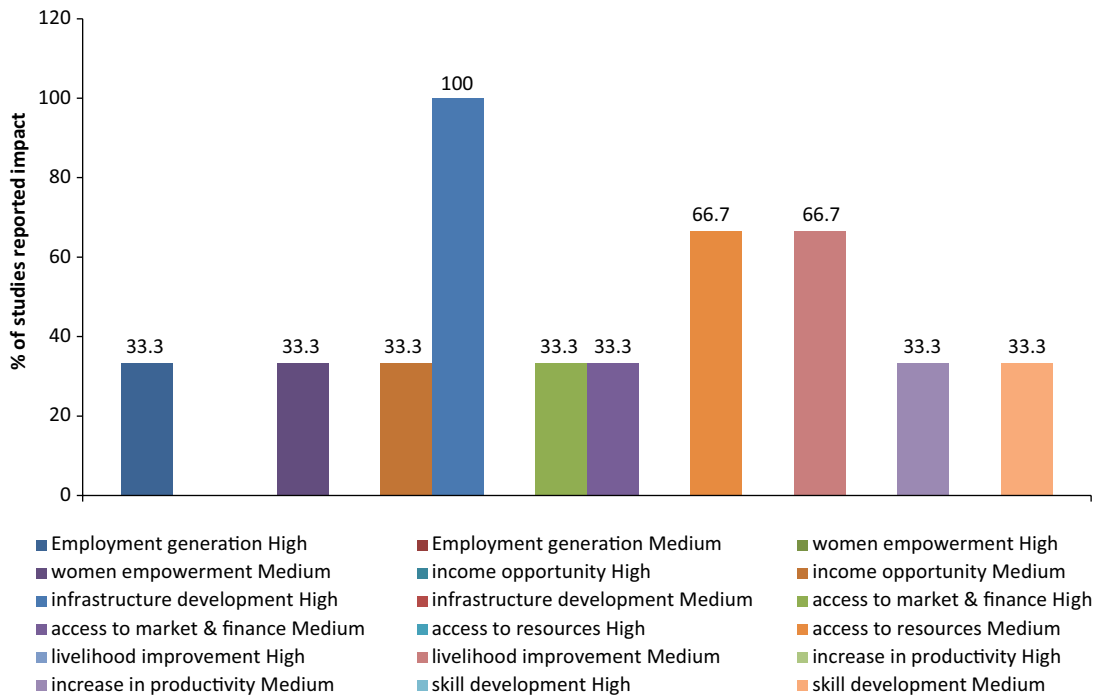


Figure 3.16: Impact of implementation of recommendation for infrastructure-related studies

3.9 Law and governance

None of the law and governance studies reported implementation of their recommendations.

3.10 Rural development

In rural development studies, 12.5% reported (as indicated in Figure 3.17) high impact on each of income opportunity, access to marker and finance, access to resources, livelihood improvement, increase in productivity while 25% of rural development studies reported high impact on skill development. However, none of the rural development studies reported high impact on employment generation, women empowerment, and infrastructure development. Moreover, majority (62.5% or more) of rural development studies reported medium impacts on such indicators except for skill development where half of the studies reported medium impact and access to market and finance. Medium impact was not observed by any rural development studies.

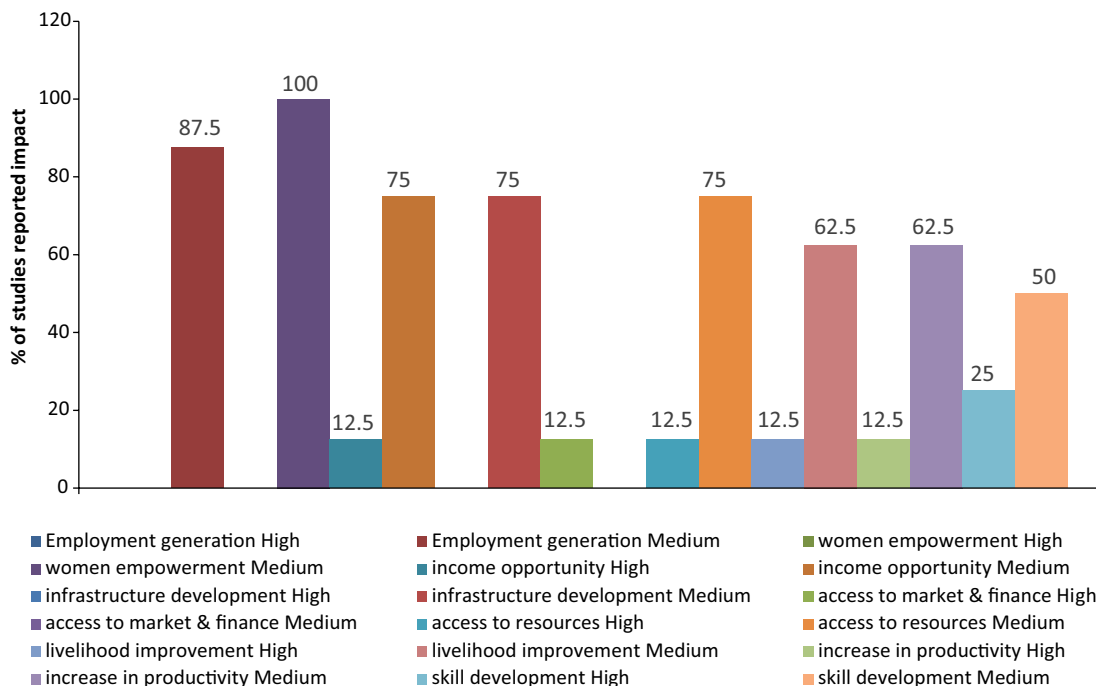


Figure 3.17: Impact of implementation of recommendation for rural development-related studies

3.11 Science and technology

On the basis of Figure 3.18, we can see that 50% of science and technology studies reported high impact on skill development, 16.7% of them reported high impact on income opportunity, infrastructure development, access to resources, livelihood improvement, and increase in productivity, respectively. On the other hand, none of the science and technology studies reported high impact on employment generation, women empowerment, or access to market and finances.

3.12 Temporal variation in impact

Once the nature of impact is explored, it is important to know the variation of impact over time. Impact may increase or decrease over time based on nature of target group/issue and/or nature of intervention. Out of 106 responses who had recorded partial/full implementation of their study recommendations, about three-fourth (76.4%) of such respondents had perceived that impact may increase over time while 4.7% perceived that level of impact can reduce over time (as indicated in Figure 3.19). All respondents from banking and finance, energy and rural development types of studies indicated that impact to be increased over time. Similarly, 92% of agriculture and allied studies who indicated partial/full implementation of their recommendations, perceived that impact to be increase over time, 70.6% of environmental studies, two-third of infrastructure as well as science and technology studies, 53.8% of health and nutrition studies and 55.6% of human resource development studies (in each case % calculated among those studies who indicated partial/full implementation of their recommendations) also perceived the same. However, impacts were perceived to decrease over time by 16.7% in science and technology and 11.8% of environment studies; these were from respondents who had already recorded partial/full implementation of respective study recommendations. As none of law and governance sample studies indicated partial/full implementation of recommendations, no response regarding this aspect was available from that type of studies.



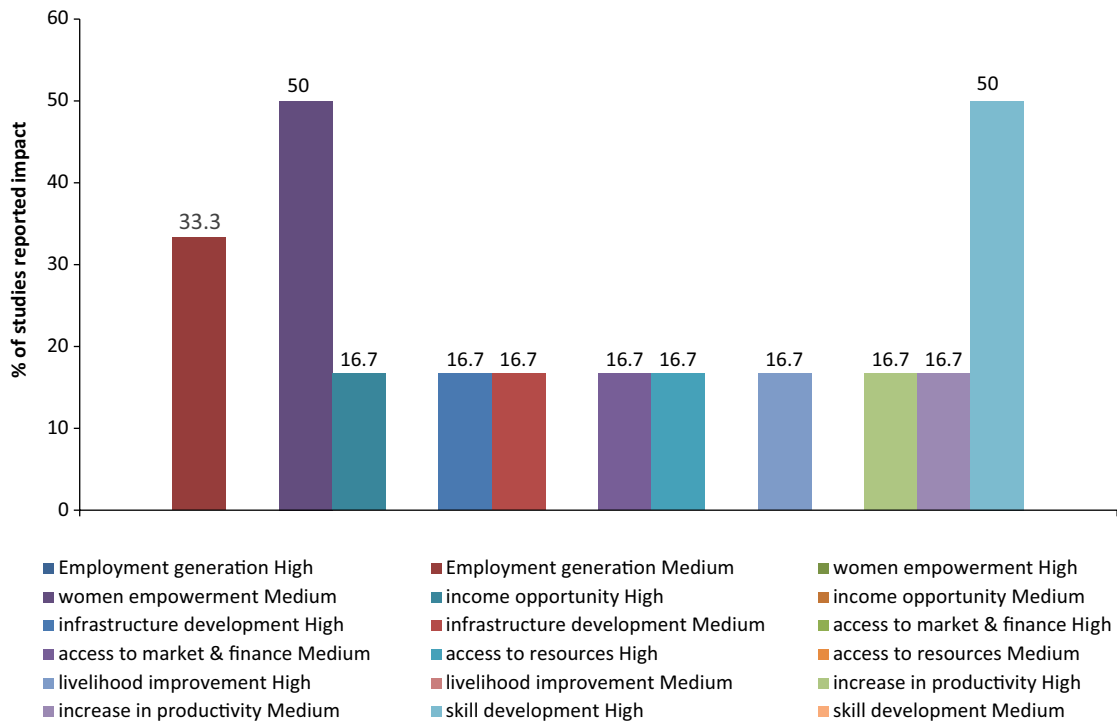


Figure 3.18: Impact of implementation of recommendation for science and technology-related studies

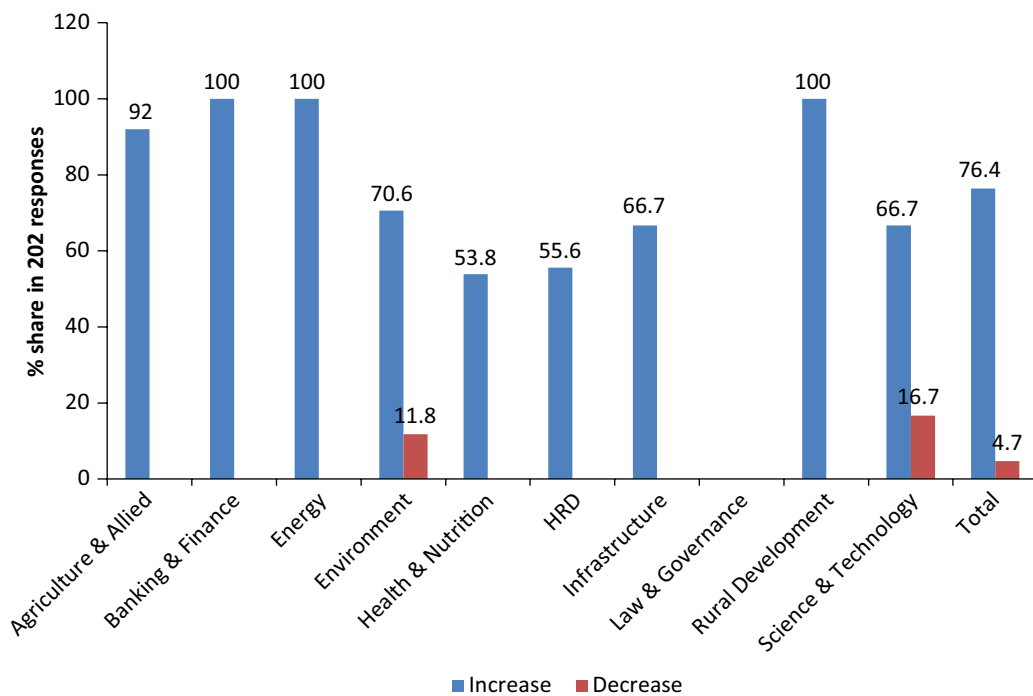


Figure 3.19: Expected change in impact over time

3.13 Suggestions for better implementation

Respondents were asked to suggest some measures (can suggest more than one measure) that may be important for better implementation of respective recommendations. ‘Better coordination among various government departments’, ‘Effective coordination among all stakeholders’, and ‘Pro-active local government’ were suggested by 54.95%, 52.97%, and 43.56% respondents, respectively (as indicated in Figure 3.20). On the other hand, 30.20%, 28.71%, and 27.72% of the respondents indicated measures such as ‘Enthusiasm from target group (such as association)’, ‘Public-private partnership’, and ‘More engagement of social institutions (such as NGO, SHGs)’, respectively.

Disaggregation of the suggestive measures across sectors reveals that ‘Better coordination among various government departments’ was suggested by 12 out of 13 infrastructure studies, three-fourth of banking and finance studies, 70% of rural development studies, 64% of environment studies, half of energy studies, and one-third of health and nutrition studies. Similarly, importance of ‘Pro-active local government’ was highlighted by half of agriculture and allied and banking and finance studies, 84.62% of infrastructure studies, 48% of environment studies, and 47.06% of human resource development studies. ‘Effective coordination among all stakeholders’ was pointed out by 90% of rural development studies, 84.62% of infrastructure studies, 62.5% of energy studies, 56% of environment studies, 54.84% of agriculture and allied studies, and half of banking and finance studies. On the other hand, 35.48%, 33.87%, and 32.26% of agriculture and allied studies suggested that ‘Enthusiasm from target group (like association)’, ‘More engagement of social institutions (such as NGO, SHGs)’, and ‘Public-private partnership’ factors can play an important role in effective implementation of their recommendations.

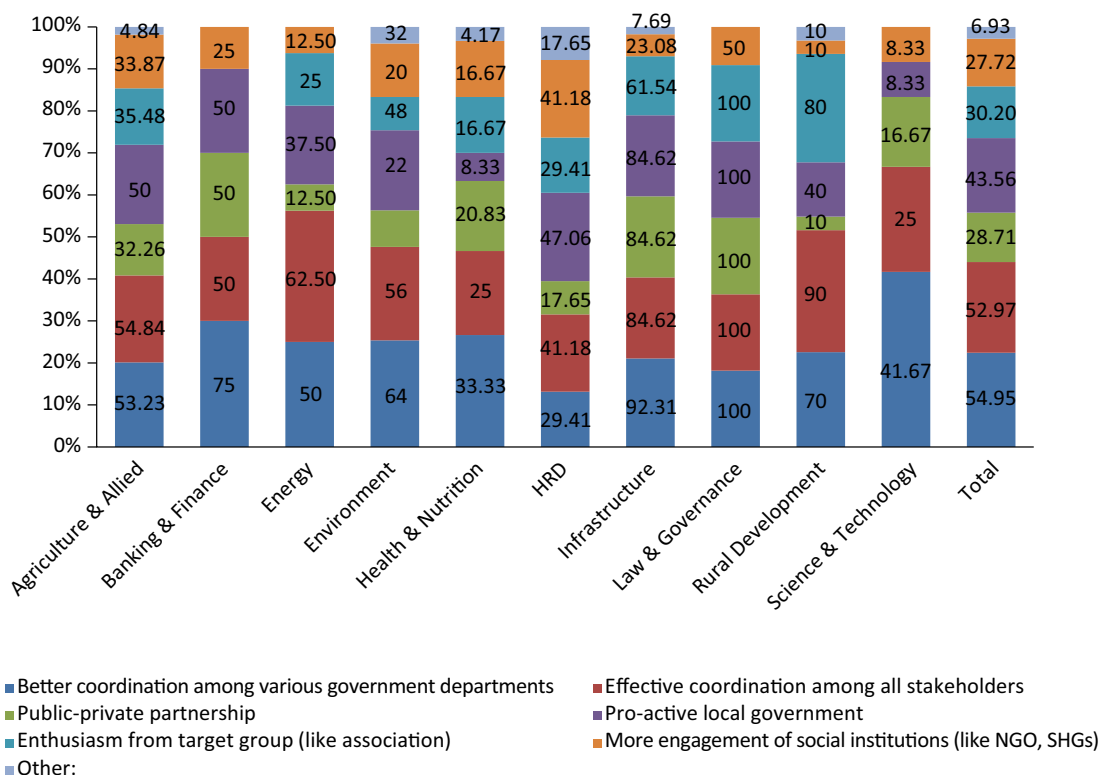


Figure 3.20: Suggestion for better implementation



Half of banking and finance studies suggested 'Public-private partnership' and one-fourth suggested 'More engagement of social institutions (like NGO, SHGs)' for better implementation of recommendations. Similarly, one-fourth of energy studies suggested 'Enthusiasm from target group (such as association)' while 'More engagement of social institutions (such as NGO, SHGs)', and 'Public-private partnership' were suggested by 12.5% and 12.5% of energy studies, respectively. In the case of environment studies, 32% had suggested 'More engagement of social institutions (such as NGO, SHGs)', 22% suggested 'Public-private partnership', and 20% suggested 'Enthusiasm from target group (such as association)', respectively. On the other hand, 'More engagement of social institutions (such as NGO, SHGs)', 'Public-private partnership', and 'Enthusiasm from target group (such as association)' were suggested by 16.67%, 20.83%, and 16.67% of health and nutrition studies, 41.18%, 17.65%, and 29.41% of human resource development studies, 23.08%, 84.62%, and 61.54% of infrastructure studies, and 10%, 10%, and 80% of rural development studies, respectively.

Both the law and governance study representatives had suggested all the above factors except 'More engagement of social institutions (such as NGO, SHGs)', which was suggested by only one of them.

3.14 Generalization Potential

It is important for policymakers to understand whether the learning/experience from a study can be generalized for similar issues/groups/regions. To explore this aspect, respondents were asked to reveal their view on generalization potential of their recommendations. About one-third (32.2%) of all studies (202 in total who submitted their responses) perceived that the output of their study can be generalized to a great extent (as indicated in Figure 4.1) while 38.6% perceived that generalization is possible only to some extent. While 35.5% of agriculture and allied studies perceived that their study findings can be generalized to a great extent, about one-third of each of environment, health and nutrition, and science and technology studies perceived the same. While one out of two studies in law and governance sector perceived generalization to a great extent, about 40% of human resource development and rural development studies also perceived the same. On the other hand, 92.3% of infrastructure studies and three-fourth of banking and finance studies perceived that generalization is possible to some extent.

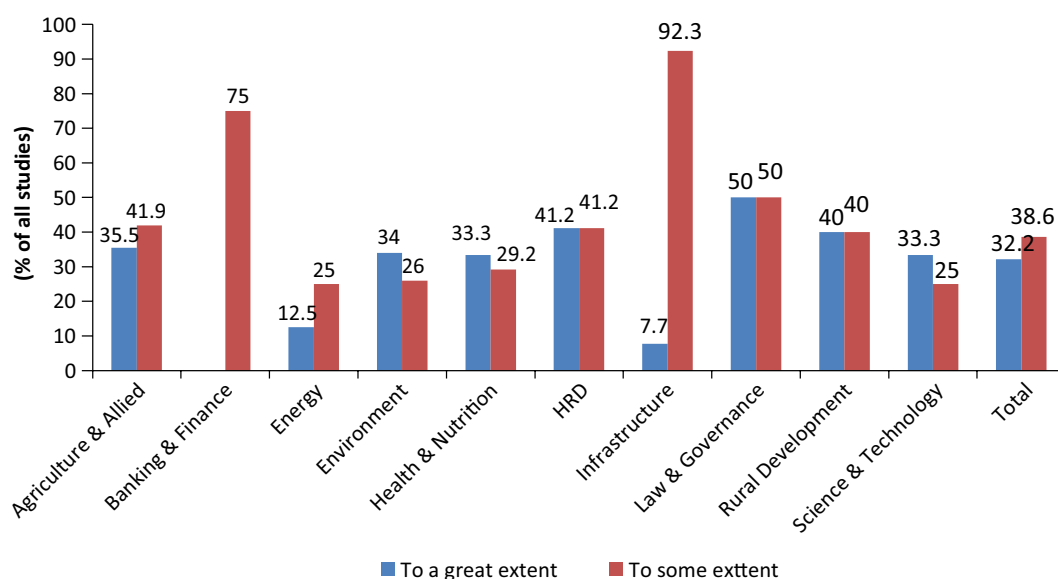


Figure 3.21: Perception about generalization of study findings

4. Linkages with SDGs

The 17 Sustainable Development Goals (SDGs), adopted by the UN General Assembly, which essentially provide the building blocks of development strategies to be implemented globally to make economic development sustainable. Keeping this in view, the 12 sectors extracted from the 833 study reports have been mapped based on their aims and objectives.

The Table 4.1 presents mapping of 12 sectors with 16 goals of SDG charter. The representation is in two ways, i.e., each column indicates various sectors associated with each goal while each row indicates various SDGs associated with each sector. For example, studies related to agriculture and allied sector may have direct or indirect forward or backward connection with SDG 1, SDG 2, SDG7, SDG 8, SDG 9, SDG 10, SDG 12, SDG 13 and SDG 15.

To elucidate on this fact, **poverty alleviation (SDG 1) or hunger redressal (SDG 2)**, measures are related with better production or productivity of agricultural sector. There are 127 studies connected to agricultural sector which mainly focus on livelihood development for farmers through technology intervention, awareness and training programs. The end result of such studies helps to achieve SDG 2 (zero hunger); on the other hand, the use of fertilizers and chemicals in agriculture also influence the lives on the land i.e. SDG 15.

SDG 7: Affordable and clean energy development can be linked with agricultural sector through bio-fuel production from selected agricultural products or agro-residue as well as use of clean and affordable energy for crop production with less negative impact on environment.

Table 4.1: Mapping of SDG & Study Sectors

Sustainable Development Goals (SDGs)	Sectors											
	Agriculture & Allied	Banking & Finance	Commerce & Industry	Energy	Environment	Health & Nutrition	HRD	Infrastructure	Law & Governance	Rural Development	Science & Technology	Tourism
SDG 1: No Poverty	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SDG 2: Zero Hunger	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	
SDG 3: Good Health and Well-being				✓	✓	✓	✓	✓	✓	✓	✓	✓
SDG 4: Quality Education					✓		✓	✓	✓	✓	✓	
SDG 5: Gender Equality		✓		✓	✓	✓	✓	✓	✓	✓		
SDG 6: Clean Water and Sanitation					✓	✓		✓	✓	✓	✓	
SDG 7: Affordable and Clean Energy	✓			✓	✓	✓		✓	✓	✓	✓	
SDG 8: Decent Work and Economic Growth	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SDG 9: Industry, Innovation and Infrastructure	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
SDG 10: Reduced Inequalities	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	
SDG 11: Sustainable Cities and Communities		✓	✓	✓	✓			✓	✓		✓	
SDG 12: Responsible Consumption and Production	✓		✓	✓	✓			✓	✓	✓	✓	
SDG 13: Climate Action	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SDG 14: Life Below Water					✓			✓			✓	
SDG 15: Life on Land	✓			✓	✓			✓			✓	
SDG 16: Peace, Justice and Strong Institutions									✓			
SDG 17: Partnerships to achieve the Goal												



Studies focusing on sectors viz. energy, environment, health & nutrition, HRD, infrastructure, law & governance are associated with SDG3 (Good Health & Well-bing) as the outcome of these studies directly or indirectly influences the health and well-being of individuals and populations which help to achieve the **SDG3**.

SDG 4: quality education is linked with sectors such as human resource development, infrastructure, law & governance, rural development and science & technology. To give an example, quality education is a primary condition for human resource development while better infrastructure in terms of building, laboratory, communication to school etc. or appropriate law & governance (e.g. Education for All) can be considered as a pre-requisite for the SDG 4 (quality of education). Similarly, in a post-pandemic world, science & technology plays a key role in ensuring quality education through introduction of online education method.

Most of the 344 studies related to environment sector focused on topics related to climate change, natural disasters, environmental impact assessment, forestry etc. These studies help achieve **SDG 13 (Climate Action)**.

In this way, the inter-linkage between sectors and goals of SDG charter are mapped in the above table and below mentioned diagram.

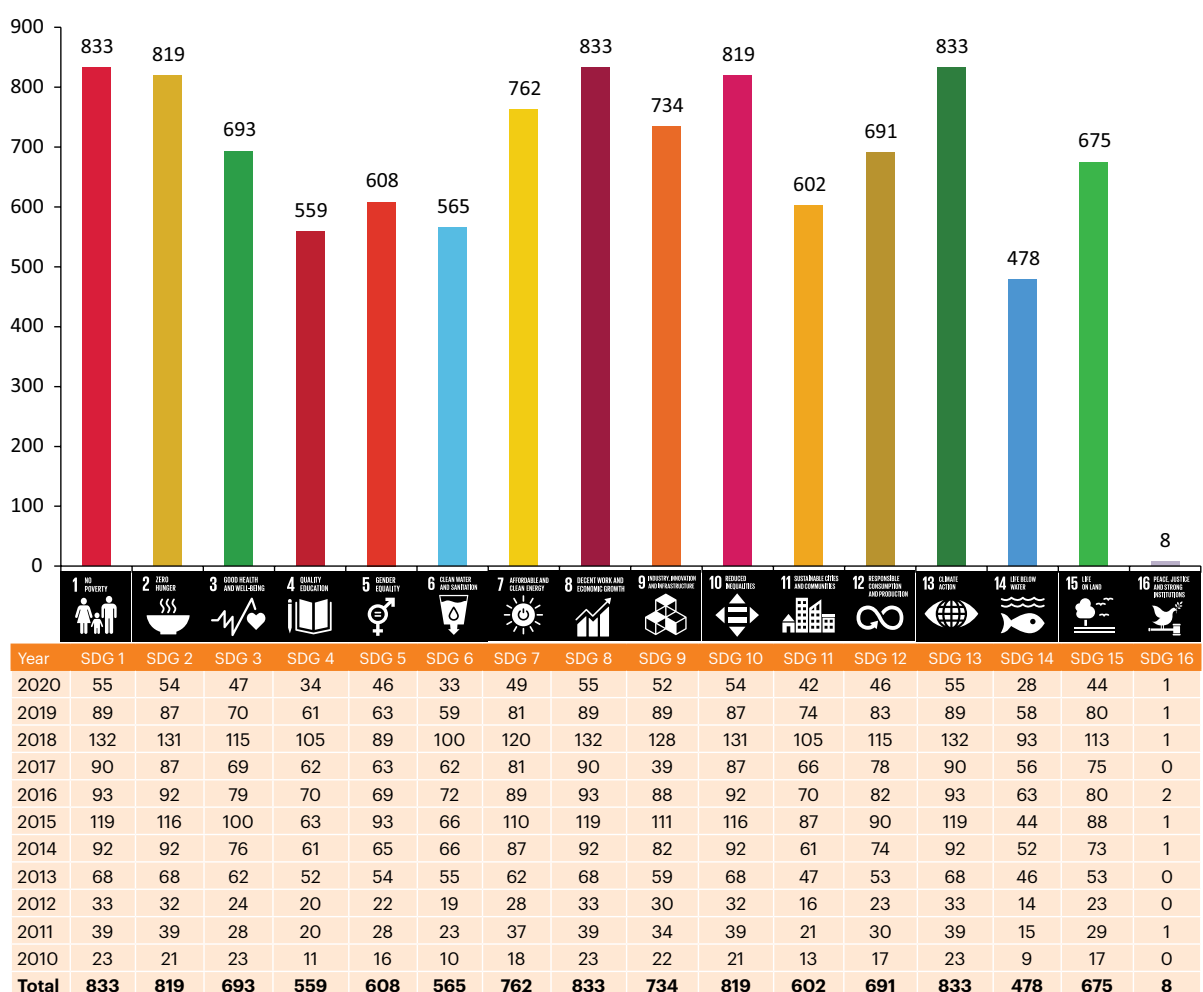


Figure 4.1: SDG mapping of study reports

Based on the SDG mapping with the 12 study sectors (as indicated in table 4.1), all the 833 studies conducted during 2010 to 2020 have been further classified under the 16 SDGs. The bar chart in the Figure 4.1 shows that significant number of studies, were directly or indirectly linked to, SDG 1 (No Poverty: 833), SDG 8 (Decent Work and Economic Growth: 833), SDG 13 (Climate Action: 833) followed by SDG 2, SDG 10, SDG 7, and SDG 9, however there were less number of studies related to SDG 16 (Peace and Justice Strong Institutions: 8) and SDG 14 (Life Below Water: 478).

5. Conclusion and Recommendations:

The study of studies has analyzed research studies of multiple sectors conducted in NER states and drawn conclusion based on i) sector specific inputs received from analysis of studies, ii) perception survey, iii) literature survey and iv) project PIs & stakeholders discussions.

It was observed that studies have reported key recommendations; however, their implementations were uneven across various sectors. Conclusion summarizes selective sector specific findings and suggested a few major recommendations to enhance implementation rate in these areas.

1. Agriculture and Allied: Agricultural practices in the North-East India are mostly subsistence in nature, and *jhum* cultivation being one of them. It is very crucial to find alternative and productive methods of agriculture practices for the region. This requires developing new techniques, tools, and machineries that suit the terrain of the region. While horticulture, floriculture, forestry, and other husbandries offer alternatives livelihood generation potential to agriculture, and hence it is important to preserve rich agricultural or genetic diversity of the region. This calls for due research to preserve the heritage of rich genetic pool endowed in the region. In addition, the agricultural produces both cultivated and wild such as goose berries, wild apple, king chilly, tree tomatoes, cherry tomatoes, wild persimmon, plumb, peaches, and berries, etc., found in the region are not capitalized due to lack of infrastructure and marketing channels. It is recommended that due attention must be given to set up food processing industries and cold-storage facilities in the strategic locations to enhance the growth of the sector and income of the farming communities.

Agriculture in NER is plagued with several multi-sectoral and multidimensional problems, some of them to be mentioned are natural and some others are manmade. Some of the issues directly relating to the agricultural sector are- small and fragmented landholdings, lack of quality seed and planting materials, imbalance or no use of fertilizers, natural factors/ disasters, limited irrigation facility, lack of mechanization, disease, and pest problems etc. Besides, all these problems, a significant portion of harvested produces in NER perishes due to lack of post-harvest management infrastructure, viz., adequate storage and processing facilities as well as absence of sound marketing facilities and lack of farm gate post-harvest management practices.

Lack of awareness about the benefits of high-value agriculture, inadequate hands-on training programmes for farmers etc. are some of the challenges for agricultural development in north-eastern part of India. However, despite of these challenges, the North-east region is endowed with a varied topography and agro-climatic conditions which offer scope for development of agriculture, horticulture, and forestry sectors in the region.

All the eight north eastern states of India have different resources and developmental prospects to support their efforts in contributing to the state as well as national economy. In order to improve the contribution of the agricultural and allied sector to the overall development of the North-east India, there is a need to devise some appropriate and regionally differentiated strategies. Crop intensification and diversification with multiple cropping such as- intercropping, mixed cropping, multi-storied cropping system, agroforestry etc. are the need of the hours to meet the challenges of natural hazardous and climate change effect. Terrace cropping, contour bunding, Sloping Agricultural Land Technology (SALT), cover crops etc. are the practical options for increasing the agricultural production in hilly areas and also for sustaining the natural resource base. Integrated Farming Systems hold special position as it integrates livestock and crop production and helps poor small farmers with very small land holding for crop production. This helps to diversify farm production, increase cash income, improve quality and quantity of food produced and exploration of unutilized and underutilized resources.



Horticulture plays a significant role in income generation activities in most of the hilly states of Northeast India and in last couple of years, horticulture has registered a compound annual growth rate of more than 5% in the region.

Some of the activities which has good prospect in NER are:

- » Cultivation of high value horticultural crops and seed production
- » Hi-tech horticulture for efficient use of inputs at the appropriate time and quantity for maximization of yield and quality in different horticultural crops.
- » Commercial floriculture
- » Post-harvest supply chain management and value addition
- » Horticulture based farming system to conserve, utilize and manage the resources for optimizing production on sustainable basis.

Strategies for development of horticulture in NER

The following are some of the strategies which may be adopted by the state governments of the NER states to support rapid development in horticulture sector.

- Mapping of various resources including areas covered under different horticultural crops by using GIS/ Spatial data service so as to prepare a solid annual plan of activities in different horticultural crops.
- Creation of platform for production of seed, quality planting materials and organic inputs with buy back arrangement to ensure availability of quality inputs at appropriate time.
- Growing of commercially important fruits, vegetables, spices, flowers, and medicinal and aromatic plants through cluster approach.
- Promotion of medicinal plants, spices, and citrus crops in clusters with appropriate post-harvest management infrastructural facilities through mission mode programmes.
- Promotion of seed spices like cumin, coriander, fenugreek in Char areas in the state of Assam in clusters with appropriate processing and packaging facilities.
- Establishment of small-scale packaging and processing centers in strategic locations of the production catchment areas.
- Establishment of Horticulture Incubation Hub having the facilities for sales counter of seeds, planting materials, farm machineries, agro-chemicals and organic inputs with machinery repairing centre, plant clinics for testing and plant protection.
- Reviving of traditional home garden concept for regular supply of fruits and vegetables to the household to address the food security and nutritional diversity issues.
- Aggregation of the small quantity of the farmers in one banner for the profitable marketing by taking the advantage of ICT and formation of marketing cooperatives, strengthening access to markets and government intervention through various schemes on Agriculture marketing, viz., National Agriculture Market (eNAM), National Mission for Sustainable Agriculture (NMSA), Gramin Bhandaran Yojana
- Strengthening of Information and Communication Technology (ICT) to bring agriculture revolution in North East India.

Livestock and poultry development have received little attention in the NER of the country. Though the livestock improvement strategy has been laid down by the Government of India at national level, but it is hard to implement at state level where the animals are being reared in small herd size of 2-3 animals by small, marginal, and landless farmers of different socio-economic strata.

Some of the major constraints in livestock and poultry development in the region are as follows:

- Absence of quality breeds of livestock and all the animals and birds are nondescript types resulting in poor livestock productivity.
- The effective technology intervention on Artificial Insemination (AI) in cattle has not been fully put into gear. Except cows, other species of animals have not been covered under AI programme resulting in indiscriminate breeding practices through community boar, bulls, and goat.
- Traditional and unscientific system of animals and poultry rearing.
- Shortage of feed concentrate, and green fodder leading to the poor performance of the animals.

The **fishery sector** is another important sector for socio-economic development of Northeast region. Northeast India has witnessed an impressive growth in fish production during last few years, though it is not uniform across the states mainly due to diverse topography and availability of water resources.

The region is still deficient in fish production to meet the growing demand of the consumer. There are areas that require management interventions to achieve higher fish yields and some of them are:

- Non-availability of quality fish seed in adequate number.
- Floods are one of the major constraints to aquaculture development on a commercial scale in the region especially in Assam and Tripura.
- Fish diseases in aquaculture system have emerged as a notable problem. There is no fish disease laboratory in the entire Northeast to diagnose the etiology of fish disease.
- Depletion of stocks of major fishes in most rivers and its associated wetlands of the region due to over-exploitation.
- Reduction in productive Beel area because of inclusion under wildlife sanctuaries; encroachment in Beel areas, lack of alternative employment opportunities for fishers.

However, potentialities are there to develop the fishery sector and raise the fish production by adopting strategies for efficient management of the natural water bodies, developing culture-based fisheries in the beels and reservoirs and utilizing the proven aquaculture technologies.

The following are the issues which need attention from all the stakeholders.

- Pen culture in beels of Assam has proven itself to be economically viable with positive benefit cost ratios. Therefore, the respective state government may emphasize for development of pen culture across the beels and wetlands of the region.
- A judicious use of artificial feeds in fish culture systems of NER may be promoted to increase the productivity.
- Regulation of fishing requires formulation of practical conservation methods suiting the local conditions.

The following are some of the recommendations that may be considered for the growth and development of Agriculture and allied sector in NER.

- Increasing production of pulses through area expansion and productivity enhancement programme/scheme in a sustainable manner in the identified districts of the states based on land suitability criteria through mission mode project like National Food Security Mission - Pulses (NFSM Pulses),



- Adoption of crop specific approaches, like inclusion of short duration varieties of pulses as inter and/or catch crop especially in rice/ maize fallow areas, development of multiple disease-pest resistant and high biological N fixation varieties to increase area, production, and productivity of pulses in the region.
- Mapping of various resources including areas covered under different horticultural crops by using GIS/ Spatial data service so as to prepare crop and location specific actionable annual plan of activities in different horticultural crops.
- Crops with hardy nature and long shelf life should be promoted against perishable nature commodities to sustain distant transportation. Production of disease-free quality planting material of horticulture crops through tissue culture may be focused for improving yields and profitability on sustainable basis.
- Use of grafted/ budded seedlings in fruit crops should be given top priority
- Promotion of supporting industry like packaging material and labeling to reduce the manufacturing cost of the agricultural and other products such as animal husbandry, handloom, and handicraft products.
- Developing commercial poultry production in the region by setting up Poultry Park with one mother unit of birds and block level satellite units and that may be taken up as a model at district level and block level respectively.
- Categorization of potential agribusiness and entrepreneurship venture as production, processing, input, and agro-allied services on account of increasing access to agricultural resources and presence of a wide demand supply gaps.
- A framework can be worked out for NER keeping in mind the requirements, physical and infrastructural background, and constraints of the farmers to disseminate the related information regarding agriculture related issues.
- Improvement in quality of project implementation, strengthening of project management and monitoring system for timely completion of projects so that cost can be minimized, and time overruns can be avoided.

2. Banking and Finance:

Financial intermediation has an important role to play in economic development of the north eastern region. For the region, this assumes importance as on one hand large areas are left out of the formal financial networks and on the other hand the region has a significant presence of micro-activities through which majority of the people earn their livelihoods. If banking has to be meaningful for the region, it has to reach and touch the majority of people in a sustainable manner. There is a need to strengthen the Regional Rural Banks and Urban Co-operative Banks to foster the banking services in the region. Due to the rigid nature of banking services and constraints on banking entities in the NER, microfinance is a powerful tool not only for financial inclusion but for poverty alleviation, enabling the poor to accumulate assets, boost their incomes, and reduce their economic vulnerability.

Since the launch of financial inclusion initiatives in India, financial inclusion in NER has consistently showed upward trends in terms of number of bank branches, credit and deposit growth. Small Industries Development Bank of India, North Eastern Development Finance Corporation Ltd (NEDFI), RGVN Microfinance Limited, NABARD and other agencies have supported the endeavours of the microfinance sector by developing the capacities of the microfinance institutions, providing resources and others. For proper financially inclusive growth of the north east region, there is a need of developing public-private initiative. Physical availability of financial services is still to meet the needs in north-eastern states compared to the national average^[367].

Providing financial services to remote locations especially in the hills becomes economically unviable. Hence, IT-enabled systems and technological innovations can play a major role where the costs to the bank are reduced while also reducing the transaction costs to the borrower. Thrust should be on

the initiatives to promote financial literacy and thereby ensuring active participation in using financial services.

Expansion of bank branches to semi-urban and rural areas along with infrastructure development can stimulate entrepreneurial and investment activities and ensure financial inclusiveness in the north-eastern states. In order to reach remote areas and provide financial access to many, it is vital that market-led financial services and products are expanded. Banks have been asked to create state-wise plans for northeastern states to help the logistics sector and exporters. A thrust to credit growth from such outreach efforts will also help the impetus set by the stimulus packages, which have been offered by the central government since the onset of the COVID-19 pandemic.

Based on the study and understanding of the scenario in the banking and finance sector in the NER during the past decade, it is recommended that intensive financial literacy and awareness campaign in vernacular languages in all the NER States needs to be strengthened further. The NER is having poor network of rural co-operatives. For effective financial inclusion, efforts may be initiated to increase the same in the region.

3. Commerce & Industries:

India's North Eastern Region (NER) shares 98% of its border with Bangladesh, Bhutan, China, Myanmar and Nepal and is seen a trade and commerce opportunity, that makes it beneficial to international trade.

Several studies have been sponsored by the central and state governments/multi-/ bi-lateral institutions, and have been undertaken by the various academic and research institutions in the past decade since 2010. Most notable among the studies included the Act East Policy (AEP) facilitating India-Myanmar border trade. Identification of thrust areas for growth opportunities in the region, setting up food processing industries, encouraging SMEs for investing in infrastructure were among other studies.

Besides these, a number of initiatives have been introduced by the central government, in an attempt to realign the NER with the economic goals of the country. Look East Policy (LEP) has been an integral part of North Eastern Region Vision 2020. Externally, India's 'Look East Policy' has become 'Act East Policy'. It has placed emphasis on India-ASEAN cooperation on infrastructure, manufacturing, trade, skills, urban renewal, smart cities, Make in India and other initiatives. Connectivity projects, cooperation in space, S&T and people-to-people exchanges could become a springboard for regional integration and prosperity.

Several steps have been taken for improvement in enabling environment and vibrant ecosystem to enable entrepreneurs to tap the potential of the region. Bamboo which has the potential to change the NE economy has got a boost with setting up of bio-refinery at Numaligarh, Assam; Bamboo Industrial Park at Dima Hasao, Assam. The institutional framework for promotion of entrepreneurship is provided by several institutes in NER to provide opportunity for skilling and nurturing young creative talent and design aspirants from North East Region and boost entrepreneurship. Krishi Udan Scheme to evacuate local produce, 586 Van Dhan Vikas Kendras and Zoram Mega Food Park etc. will boost entrepreneurship, trade and commerce.^[368]

Cold storage facility has been a major issue identified in cross trade and agricultural industry, which is essential for preserving the crops/products for trade.

Involvement of the private sector is also highly essential to strengthen the NER trade links in the areas of agriculture, telecommunications, information technology, steel, oil and natural gas and food processing. Foreign investment and collaboration can also help boost economic growth in the region.



4. Energy:

Over the past one decade – since 2010 - many research studies in the energy sector were primarily concerned with transmission and distribution (T&D) with grid expansion. These studies have been carried out by various academic, research institutions and government agencies to generate and distribute power using renewable resources which included micro/ mini hydel projects, solar hybrid and wind energy projects, and other energy efficiency technologies. A large number of un-electrified rural populations were benefitted through these projects by providing minimum need of electricity for their day-to-day requirement through renewable sources of energy.

The Cabinet Committee on Economic Affairs, in a major step towards economic development of the States of Arunachal Pradesh and Sikkim through strengthening of Intra-State Transmission and Distribution systems has approved the revised cost estimate of Rs 9123.32 crore.^[369] Another key initiative is the World Bank-funded North Eastern Region Power System Improvement Project for the states of Meghalaya, Mizoram, Manipur, Nagaland, Tripura and Assam at an estimated cost of Rs 51.11 billion, which is being implemented by Power Grid Corporation of India Limited.^[370]

According to the Central Electricity Authority, the region has an estimated total hydropower potential of 58971 MW (Arunachal Pradesh (50328 MW), Meghalaya (2394 MW), and Mizoram (2196 MW) have the large portion of potential); and solar power potential of 57360 MW (Assam, Manipur, and Mizoram with maximum share). As of 31 May 2022, the installed capacity (in MW) of power utilities (Thermal and Renewable) located in northeastern states were 4834 (Thermal 2386.86 MW; Renewable 2446.20 MW) have an installed renewable energy capacity of 2329 MW, of which about 80% of this capacity is accounted for by hydropower plants that have been set up across the region. This means that wind, solar, small hydro plants and bioenergy only represent 502 MW of the region's power mix. Assam, Tripura, and Manipur witnessed about 25% in their installed renewable energy capacity in 2019-20.^[371]

The increasing demand for electricity has demanded the establishment and modernization of the distribution infrastructure in the region. In this regard, the Prime Minister launched the Ministry of Power's flagship Revamped Distribution Sector Scheme which is aimed at improving the operational efficiencies and financial sustainability of Distribution Companies. With an outlay of Rs.3,03,758 crore over a period of five years from FY 2021-22 to FY 2025-26, the scheme aims to provide financial assistance to DISCOMs for modernization and strengthening of distribution infrastructure, aiming at improvement of the reliability and quality of supply to end consumers. It is also proposed to provide 25 crore Smart Prepaid meters to consumers all over the country.^[372]

It is also learned from the present study that problems in land acquisition were a big challenge calling for sustainable resettlement options to be developed both at central and state levels. The Standing Committee on Energy (SCE), in its 43rd Report on Hydropower, presented a 'regional government structure' to facilitate the land-acquisition, resettlement and rehabilitation processes. Rehabilitation and resettlement should be done in such a manner so as to ensure that project affected families are offered attractive compensation and are resettled well before the start of the project. This would help in reducing litigation and time delays associated with that and would also boost public confidence for future projects. With the help of awareness campaigns, local people should be made aware about the project benefits and they could be made to feel associated with the entire development process which would help improving the sense of belongingness among the locals towards the project being developed.^[373]

The implementation of the draft Environment Impact Assessment Notification 2020 could potentially see tap into the region's massive hydro power potential. It is recommended that distributed renewable energy along with energy storage can be explored as an affordable and efficient solution to ensure quality power supply in the region.

5. Environment:

Majority of the past research studies were found to be on environmental aspects. Environmental studies conducted in the past, primarily focused on disasters both natural and anthropogenic, biodiversity and ecology, water resource management and environmental impact on human lifestyle. The disaster related studies inferred on the significance of early warning system and monitoring for flood, earthquake, abnormal rainfall pattern, etc. and pointed out associated complications given the unique topography of the region. However, recommendations highlighted need for robust scientific guidelines and framework with city architecture based on site-specific baseline data.

North East Region is considered as 'biodiversity hotspot' in India with its rich natural heritage and is celebrated both in sacred writ, culture and traditions of the people. The studies underline how development brings with it the unprecedented choice of growth over environmental protection; hence one of the key challenges is to manage an orderly transition to slower but more balanced, equitable, and environmentally sustainable growth. These studies recommended need for developing environmentally conscious communities and institutions.

Studies on water resource management highlighted need for water conservation, drinking water access to all and recommended need for integrated planning and implementation strategy to leverage potential of rain water harvesting, irrigation technology adoption, flood water utilization, inter-linking of river to address acute water shortage. Also, past studies emphasized need for water sanitation and hygiene practices in some pockets of North East India to be scaled up and replicated in other parts of NER.

In NER, several issues were identified like expansion of township which is deteriorating the natural ecosystem and also inviting disastrous incidents like landslide. Therefore, the expansion should be done only in low susceptibility slopes. The future research and development should be focused on preparation of landslide susceptibility map which helps in assessment of Landslide hazard, urban planning and mitigation.

The NER is rich in mineral resources such as coal with high Sulphur and Mn, Ni, Cd, Cu, Pb, Fe, Mg, etc. For the identification of mineral, systematic geological mapping must be carried out. Mining of these minerals creates several environmental problems like deforestation, habitat loss, loss of biodiversity, soil erosion, damage of large scale landscape, and pollution. The report of the study recommended for sustainable use of coal and focus on clean energy development. The research and development should focus on the development of renewable energy.

The impact of climate change on forest and biodiversity was also investigated. The report suggested examining the feasibility of forest linking project. The forest management should be done in such a way which may reduce the fragmentation of forest. In addition, there is an urgent need to conserve the sacred groves present in NER.

The conservation of water must be done on priority basis for the maintenance of forest ecosystem and biodiversity. The development of low carbon technology map for the reduction of greenhouse gases must be focused by the researchers. In this connection the renewable energy resources and its capacity should be increased. For increasing the renewable energy resources, several hydro projects were developed which needed to be studied thoroughly with geotechnical investigation to identify their stability. An exhaustive research should be carried out in future for achieving the same. The study on watershed management should also be done to conserve and manage the soil, water and biomass resources in a sustainable manner.

All the developmental projects like exploration, hydro energy, mining, etc. must be going through an EIA study for identifying the possible social and environmental impact and its mitigation.



6. Health & Nutrition:

Health care services have been a challenge in the north eastern region due its geographical location, difficult terrain, rainfall, and large number of ethnic groups. However, large scale development in the healthcare and nutrition sector has taken place in the region in the last few years due the sustained efforts of the Central and state governments. The establishment of Ayushman Bharat Health and Wellness Centers in the north-eastern states has achieved considerable progress, thereby strengthening the primary healthcare system as envisaged under the initiative. A large number of health screenings are being performed in these centers. A total of 7246 Health and Wellness Centers have been proposed for the north-east till December 2022. The PM-Ayushman Bharat Health Infrastructure Mission, Ayushman Bharat – Digital Mission and Pradhan Mantri Jan Arogya Yojana has contributed to strengthening the public health infrastructure. These schemes envisage a new generation of reforms to integrate and strengthen health service delivery and public health action including health research so that the communities are Atmanirbhar in managing such pandemics or health crisis.

A new scheme, Prime Minister's Development Initiative for North East (PM-DevINE) has been announced in Union Budget 2022-23. One of the major projects identified under this scheme is the "Establishment of Dedicated Services for the Management of Pediatric and Adult Haematolymphoid Cancers in North-East India", to be located at Dr. B. Borooah Cancer Institute Guwahati. Assam Cancer Care Foundation, a joint venture of Government of Assam and Tata Trusts, is executing a project to build South Asia's largest affordable cancer care network with 17 cancer care hospitals spread across the state. AIIMS, Guwahati, is a part of the new prestigious institutions that were conceived under Pradhan Mantri Swasthya Suraksha Yojana.^[374]

According to Niti Aayog's fourth edition of the State Health Index 2021^[375] that ranks States based on the progress on health outcomes and health systems performance across the country, Assam is one of the top three ranking states among the 'Larger States', in terms of annual incremental performance. Among 'Smaller States', Mizoram and Meghalaya registered the maximum annual incremental progress.

Periodic evaluations of active programmes are required to assess nutrition and health status specifically for vulnerable communities. Studies have highlighted the fact that decision for disease burden and healthcare utilization in the north eastern region is not only influenced by the necessity and severity of diseases but also the socio-demographic background of individuals and the capacity to pay. Therefore, state governments need to priorities healthcare services in the rural areas, focusing mostly on disabilities and infectious diseases and at the same time keeping in mind the rising non-communicable disease, so as to reduce both untreated morbidities as well as the rural-urban health inequalities in the region.

Greater use of the technology in the healthcare sector, especially, setting up telemedicine centers, application of artificial intelligence and block-chain opportunities in the sector could lead to a paradigm shift in healthcare sector.

In addition, following the current trend of pandemic driven studies, implications of COVID-19 on public health should also be studied. Capacity building through training and mobilizing knowledge of health workers will play a vital role in improving delivery of healthcare services in the region.

Overall, the prospects of progress in the health and healthcare of the north eastern region are very high. The role of governments, at the central, state, regional and grass root levels and their funding will be very crucial in attaining a high standard of public health and human capital.

7. Human Resource Development:

Despite years of political unrest and long-term violence, several studies conducted in NER region on HRD sectors (primary to higher education) highlighted that literacy rate in NER states are quite high. Beside a few tribal communities where literacy rates are low, government initiatives and policy support have recently been seen for educational development. As on date, the literacy rate in NER is showing a positive increase, nullifying the damage created due to violence driven human displacement.

With the rich biodiversity, cultural heritage, exquisite indigenous knowledge and handicrafts industries in place, the region is at the threshold of a positive paradigm shift. However, NER has some specific issues which are recognized as major gaps towards the development of community empowerment, skill development and job creation. Because of the difficult mountain terrain and remoteness to reach to tribal populations, large industrial developments remain scanty in NER. Major emphasis was given on developing infrastructure facilities and skilling of populations in small scale industries utilizing biodiversity, cultural strengths of respective States. However, despite high potential of growth of economic activities in the region, low awareness of skilling benefits, wide-spread digital divide across the region, less number of skill based trainings conducted in several states, lack of integrated approach of schemes led by Central and State Departments, have resulted into relatively low job creation and self-employment in the region.

In recent year, some government initiatives have tried to bridge the wide gap of skilling and job creation. In this regard, the Cluster Development Approach adopted by Indian Institute of Entrepreneurship, an organization of Ministry of Micro, Small and Medium Enterprises to develop small enterprises in North Eastern Region of India to meet the challenging opportunities and threat in a global economy is praiseworthy. Cane & Bamboo Cluster, Dimapur and Imphal East Handloom Cluster are being implemented under this initiative. Further to this, the Handloom Cluster Development Programme (HCDDP) is a livelihood and income generation programmes for disadvantaged women in North East India initiated by North East Development Foundation focusing on design skills and strengthening the supply chain through online and offline market. HCDDP is running in Kamrup District of Assam.

One of the major drawbacks of the NER States was lacking training infrastructure and quality of market oriented trainings. The HRD infrastructure development and training & skill development programmes in NER are primarily conducted under Central and State government schemes. Among the regular central sponsored skilling schemes operational in NER, Pradhan Mantri Kaushal Vikas Yojana (PMKVY), Deen Dayal Upadhyay Grameen Kaushalya Yojana (DDU-GKY), Skill Training for promoting Self Employment through RSETI, Pradhan Mantri Mudra (Micro Units Development & Refinance Agency) Yojana, etc. have brought good results in job creation in NER. Ministry of Skill Development & Entrepreneurship has implemented a scheme in NER till March 2020 which envisaged creation of skill development infrastructure closer to the people of left wing extremism (LWE) affected 13 districts. Up-gradation of 22 ITIs, supplementing infrastructure deficiencies in another 28 ITIs and establishment of 34 new ITIs in 8 North Eastern States with 90% Central and 10% State funding were part of the programme.

As evident from the discussions, in most of the NER states central schemes and multiple government departments are carrying out education development, training and skill development programmes primarily to build self-entrepreneurship aptitude among the populations. This also includes creating mass awareness programmes among the communities and creation of jobs. It is important to note that National Policy on Skill Development and Entrepreneurship 2015 rightly observes that mainstreaming gender roles by skilling women in nontraditional roles and increasing gender sensitivity in the workplace will have a catalytic effect on productivity and be a smart economic decision. In this regard, women empowerment has also been considered as one of the priority area in livelihood generation initiatives and government schemes.



Creation of nodal skill development agencies in States and empowering them to coordinate cross-departmental trainings has brought good results. We strongly recommend to emphasize on this initiatives and coordinated approach towards skilling on the State specific strength areas identified in several studies. However, barring a few states such as Assam, Meghalaya, Arunachal Pradesh, centralized training and skill development agencies are absent. This has resulted into hindrances in reaching these programmes benefit to potential stakeholders. Awareness programmes become less effective, although there is a positive political will. There is an urgent need to establish dedicated training institutes (government/private) to carry out skill development programmes as identified in state-wise skill development reports so that competency level can be enhanced. The stakeholders also pointed out lack of good medical colleges, facilities for quality technical education, minimizing impact of gender disparity, and establishing good marketing system are immediate requirement of the region. Training and skill development should be aligned with the above mentioned requirements and industry demand.

Some States have undertaken district and block level specific skill mapping, which is a timely initiative to measure and leverage strengths of local people. The mapping would be of immense importance in successful handling the skill affair of North East Region. Skilling and up-skilling of youth should be taken in different tiers. Those don't possess any skill there should be guided to minimum employable skill, whereas, those who possess some kind of skill there should be up gradation. State Skill Development Missions of Northeast India in close collaboration with National Skill Development Mission have to carry forward the mission of harnessing demographic dividend through skill development of the youth. It is very vital to understand the job preference of the youth, their potentiality and to make them aware about new sectors (under the Digital India Mission, Make in India) with employment potential. Potential and aspiring youth should venture into new areas of skill training that are in demand in North East moving beyond the traditional paradigm of conventional skill.

In our opinion, besides central schemes and support, skill development missions of respective states of North Eastern States have important roles to play. Involving credible companies, institutions, NGOs and also bringing in fold the workers' organizations, employers' associations would be very much required for facilitating skill training activities, certification and ensuring placement of the youths, post placement tracking, evaluation along with awareness generation and sensitization. Meanwhile, quality of training, teaching pedagogy and effective delivery of course modules need to be ensured by all the stakeholders (Govt, NGOs and other private bodies). Government machineries need to work along with the social partners for reaching out the youths of geographically disadvantaged areas and hilly terrains. In such cases, local residents should extend support to the training providers for arranging basic infrastructure like training halls etc, which eventually benefit the community itself through enhanced employability. Social media and the local media's role is significant as well, which need to showcase best cases to drive a ripple effect among other aspirants.

8. Infrastructure:

The biggest constraint in the Northeast (NE) region has been the poor infrastructure, particularly roads, railways, waterways, and power. In NE states, there are huge development potentials in infrastructure like road connectivity, transformation in the tourism industry, and reformation in the power sector like mega hydropower projects etc. Improving the state's connectivity within the region and the rest of the country is key to its prosperity and growth. Inland rivers, air infrastructure and connection, power, and tourism have enormous promise in northeast states.

The Act East Policy and Bharatmala Pariyojana (BMP) are the government's programmes for building road infrastructure and connectivity. The NEC has focused on constructing highways, including interstate and economically significant roadways. Under several developmental schemes/ packages, 1,350 projects worth Rs.15,867.01 crore, including connectivity projects, have been sanctioned during the financial years 2014-15 to 2021-22^[376]. In air connectivity, one significant development was the Pakyong Airport in Sikkim, which cost roughly Rs. 605 crores to establish^[377]. A total of 28 projects were completed

from 2016-17 to 2021-22 with an approved cost of Rs. 975.58 crores and a completion cost of Rs. 979.07 crores^[376]. As of April 1, 2022, the Ministry of Railways had approved 19 projects totaling to Rs. 77,930 crores for 1,909 km in length that fell entirely or partially within the North Eastern Region. These projects, which included those approved since 2014, are in various stages of planning, approval, and execution. Of these, 409 km in length have already been put into service, costing Rs. 30,312 crores, as of March 2022^[376]. The broad-gauge railway line connecting the capital cities of the NE states, Bairabi and Sairang, is now under development and is anticipated to be completed by March 2023.

In 2016, by National Waterways Act, 2016, twenty waterways of NER were declared as National Waterways. These include one existing (NW2) and 19 new NWs. Of the new 19 NWs in North East India, River Barak (NW-16) is being developed, and feasibility studies for the remaining 18 NWs are underway. The navigable portion of Barak River in India is the 121 km stretch between Lakhimpur and Bhanga, declared as NW-16 in 2016. Implementation of various projects for infrastructure development on NW-16 has already been started^[376]. Better connectivity is being provided by developing national waterways on the Ganges, Brahmaputra, and Barak rivers.

The Ministry of Power has established and upgraded transmission and distribution networks and numerous hydro/thermal power-producing projects since 2014. Further, the transmission and distribution network has also been strengthened in these North Eastern States. Three Hydro Electric Projects (above 25 MW) totaling 740 MW have been undertaken in the North Eastern States. A gas-based power project in the state of Assam viz. Lakhwa Replacement Power Project of 69.755 MW capacity (7 x 9.965MW) was commissioned on 14.02.2018.

Further, the Government of India has launched various schemes to enable States, including augmentation of sub-transmission & distribution infrastructure along with metering and IT enablement of distribution infrastructures etc. Numerous national parks and animal sanctuaries are there in northeastern India. The ministry of tourism promotes plans like Swadesh Darshan. The Department of Telecommunications has introduced Bharat Net and Wi-Fi Connectivity for Village Panchayats in North East Region, to increase telecom connectivity. In the North Eastern States, 1,358 towers covering 1,246 villages have been installed and providing services^[376].

It is necessary to promote eco-tourism sites at various lakes, waterfalls, and caves in the hill districts. Urban solid waste management is a major problem and it is increasing day by day. Hence, there should be an urban solid waste management policy, including hospital waste management and accordingly infrastructure for managing the waste should be developed. National and international infrastructure development will be the best option for inclusive development in the NER.

9. Rural Development:

It has been observed from the past studies, discussions with the stakeholders and secondary literature surveys that there are many constraints e.g. rural infrastructure development, lacking coordinated approach among state government and government agencies, government funding etc, which come on the way of faster implementation of the Rural Infrastructure Development Fund (RIDF) on the North East region of India. These include delay in land acquisition for construction of canal, drainage, road and bridge and other infrastructure; delay in clearance from the concerned Environment Control Board; inadequate efforts towards capacity building; delay in procedural formalities within the state government and weak financial position of most of the state government departments. Moreover, inadequate functioning of NGOs, PRIs, and SHGs in the states of the region at the expected rate also recognized as a barrier to the implementation of recommendations of the studies. The study recommends that significant portion of the problems could be resolved easily if the concerned state governments and other stakeholders of the region jointly work towards the development of rural economy by developing rural infrastructure through RIDF, then it will be a boon for the rural development of the region.



Information Education Communication (IEC) activities under the MGNREGS need to be strengthened in the states. As per the discussion with the local people, it has been felt that annual training programme should be conducted in each block to ensure that the workers know their right to demand wage employment and also focus on creation of durable assets for economic development.

There are several Gol programmes facilitated for the benefit of differently-abled people to promote livelihood opportunities but still the gap in employment between differently-abled people and non-disabled people is a major cause of concern in the region. A proper plan of action needs to be prepared in order to resolve this issue.

10. Science and Technology:

NER being a biodiversity hotspot, is a great treasury for research and documentation of many plants and animals. The studies recommended a specialized Institute of Taxonomy be set up in the region. Simultaneously, this offers a scope for biodiversity rich of genetic pool for research at molecular and genetic level. This potential can be harnessed for different applications and purposes. One of such areas where due research is required in the application of plants derivatives and compounds in medicine and healthcare.

Geologically, the North-Eastern region also lies in a sensitive zone where the tectonics is still active. In view of this, there is a greater need to research especially, in human settlement and development processes to avert toll on human lives.

For the development of agriculture sector in NER, access to the information on recent agriculture development and location specific practices to the farmers is very essential. There is a need to develop information kiosk which should be a 'single window' access to knowledge base in the field of agriculture to facilitate the agricultural reform processes in each districts of NER.

11. Tourism:

As NER is known for its tourist destination in India, this requires substantial investment in studies for expansion of the activities and infrastructure development in tourism sector. As per the data collected in this study, only 6 studies have been conducted in the past 10 years in the tourism sector. More studies need to be carried out in this sector in NER. The sustainability of the tourism infrastructure development projects purely depends on the interest of the State level Tourism Development Corporation or the Department of Tourism. Local involvement need to be strengthened.

Tourism sector contributes 10% of global GDP, 7% of global exports and accounts for one in every 10 jobs worldwide among the largest and fastest growing sectors in the world. Its capacity to attract significant investment, generate jobs, increase exports and adopt new and emerging technologies makes it an important pillar for economic growth and development, particularly for least developed countries (LDCs) and Small Island developing states (SIDS) according to the United Nations Environment programme study.

The research has also indicated that the tourism sector's consumption of key resources such as energy, water, land and materials is growing commensurately with its generation of solid waste, sewage, loss of biodiversity, and greenhouse gas emissions. In a 'business-as-usual' scenario, tourism would generate through 2050 an increase of 154% in energy consumption, 131% in greenhouse gas emissions, 152% in water consumption and 251% in solid waste disposal. This is why sustainability must now define tourism development in the 21st century.

The tourism sector in India is an integral pillar of the Make in India programme. The tourism industry in India plays a role of significant economic multiplier and becomes critical since India has to grow at rapid rates and create jobs. India is currently ranked 54th in World Economic Forum's Travel & Tourism Development Index (2021). In 2020, the travel & tourism industry's contribution to the GDP was \$ 121.9 billion; this is expected to reach \$ 512 billion by 2028. In India, the industry's direct contribution to the

GDP is expected to record an annual growth rate of 10.35% between 2019 and 2028.

North East Region nestled under luscious verdure, rich flora and fauna has great potential for sustainable tourism. North East India is a very backward region in the whole country, yet it has the greatest potentiality to develop the region into a potent force through tourism industry, Gour Krishna Saha (2015). The region is also known for its unique and rich cultural, ethnic heritage making it a favourite tourist-spot. The flora of the region covers 43% of the total plants species and 39% of endemic species found in India making it a geographical 'gateway' for much of India's endemic flora as well as fauna.

There are about 77 National Parks and wildlife sanctuaries in North East Region which is also a major tourist attraction. The national park of Kaziranga, Assam housed the world famous one-horned rhinoceros. Manas riverine situated towards the western part of the district of Baksa covers almost an area of 519 sq. km and is home to the most endangered wildlife species such as Red Panda, Pygmy Hog, Golden Langur, the Hispid Hare, and the Assam Roofed Turtle. Pobitora Wildlife Sanctuary situated on the southern bank of the Brahmaputra in Morigaon district of Assam holds one of the largest Indian rhinoceros populations in Assam and Orang Wildlife Sanctuary has rich flora and fauna, including great Indian rhinoceros, pygmy hog, Asian elephant, and wild water buffalo and Bengal tiger. The sangai an endemic and endangered subspecies of Eld's deer is found only in Keibul Lamjao National Park, Manipur located in the southern parts of the Loktak Lake, which is the largest freshwater lake in eastern India. Bhalukpong town located in West Kameng district of Arunachal Pradesh is a popular tourist spot where Pakhui Game Sanctuary and Tipi Orchidarium is situated, which hosts over 2600 cultivated orchids from 80 different species. It has many tranquil lagoons and reverie locations that offer principal tourist activities like fish angling and river rafting, boating etc.

The mysterious Jatinga Hill is a great source of attraction for tourists where thousands and thousands of birds commit suicide every year. The world's largest river island 'Majuli' will encourage tourism industry in NE India to a great extent. The Shirui National Park, situated in Ukhrul, Manipur where the famous shirui lily (*Lilium maclineae*) grows naturally is also home to rare birds like blyth's tragopan and mrs. hume's bar-backed pheasant and animals like tiger and leopard. The main peak of Siroy abounds with flowers during the monsoon and it is a veritable paradise. Dzuko valley, Nagaland famous for its wide range of flowers in every season but the most famous one is the Dzūko Lily and it is found only in this valley. Besides it, the wooded hill stations like Haflong, Tawang, Shillong, Gangtok, etc. will attract the tourists for hiking, trekking and camping. Further, tea tourism and golf tourism of NE India will attract the tourists. Besides the animals and the birds of various kinds roaming singing and playing in the vast green forest, the region has many ornamental fishes, rare plants, medicinal herbs and exotic orchids.

There are various historical monuments and places like 'Rangghar', 'Karengghar', 'Joysagar', 'Joydoul', etc. which encourage tourism in NE India. Besides these, the various historical places like Sonitpur (at present Tezpur)-the capital of Ban Raja, Gargaon-the capital of the Ahoms, Jerangapathar-a place where Joymati sacrificed her life for her husband, etc. will attract the tourists.

Several religious places and temples like Kamakhya temple, the Umananda temple, the Agnigarh and the Mahabhairavi temples of Sonitpur etc. will encourage tourism industry in NE India. These sites can be further made accessible through the Pilgrimage Rejuvenation and Spiritual Augmentation Drive a special scheme of the tourism ministry.

It is imperative to mainstream sustainability into tourism development by demonstrating the economic, environmental and socio-cultural benefits of sustainable tourism. A sustainable travel model designed to support and uplifts the surrounding environment while providing leisure without exhausting its resources and putting pressure on it. Capacity Building for Service Provider (CBSP) scheme of the Ministry of Tourism that envisage to skill development and train human resources is an important component of the tourism infrastructure. This scheme can be scaled up to train various stakeholders to develop, advocate and promote sustainable tourism that delivers sustainable consumption and production patterns in the tourism value chain. Establish public and private partnerships, frame policies that encourage demand for sustainable tourism products and services.



This study has also analyzed responses of different PIs and stakeholders as part of the perception survey. The summary of our understanding shows that 52.5% of the recommendations of research and implementation studies commissioned by various government ministries, departments, foundations and private bodies, have fully or partially implemented. Implementation of recommendations remain poor among sectors like law & governance and infrastructure. Administrative factors were identified as the most important barrier against implementation of recommendations.

The stakeholders reported significant positive impact in science & technology (50%) and health & nutrition (46.2%) sectors where full/partial implementation has taken place. Besides, among the studies where recommendations are fully/partially implemented, 'high' impact was reported in increase in productivity (31.1% studies), livelihood improvement (30.2%), skill development (29.2%), access to resources (26.4%), infrastructure development (22.6%). Reasonable impact was noticed in 'income opportunity' (19.8%), 'access to market/finance' (19.8%) and 'women empowerment' (10.4%).

The perception survey and stakeholders consultation pointed out following specific suggestions:

1. Most of the agricultural research institutes and various boards, including Spices Board, Rubber Board in different parts of NER are doing routine activities based on their own capacity. There is a need to strengthen the extension activities as their findings are not reaching to the farmers, which is resulting in lack of awareness among them.
2. When there are bumper crops, farmers are forced to sell them at low price. It is estimated that 45% of crops are wasted due to lack of cold storage facility and relevant food processing industries. Creating post-harvest cold storage facility with low-cost technology should be taken on priority basis to enable farmers to sell agro-products when there is demand. Farmers losses can be minimized through good infrastructure e.g. cold storage facilities, establishing food processing industries and identifying and strengthening marketing channels.
3. Plantation business and horticulture practices require high capital, which the local people can't afford. Even banks do not give the loan to the tribal people because of non-authentication of land. Role of VLW (village-level workers) and Panchayat system/Village Development Council have to be made more prominent in order to ensure proper distribution of government funds. State government should take action as a facilitator of any production process for creating better supply chain.
4. Considering NER as the wildlife and biodiversity hotspot, efforts should be made to prioritize environmental preservation by integrating eco-friendly behaviour, choices and lifestyle in the very fabric of the society. One step up approach could be through awareness building and training the inhabitants.
5. More emphasis should be given on implementation and measuring impact of government R&D schemes, development of infrastructure and adoption of new technologies in renewable energy sector.
6. There are high potentialities of renewable energy in NER but lack of skilled manpower is a constraint in smooth implementation of any project in the region. Local people should be involved in maintaining the equipment and properly trained for competency development for operation and maintenance of the equipments or system.

7. There is urgent need to establish dedicated training institutes (government/private) and adequate funding to carry out job-oriented skill development programmes on several areas as identified in state- wise skill development reports.
8. Better collaboration among government department initiatives and implementation strategies, and coordination among stakeholders were suggested by majority of the PIs and participants of FGDs for successful implementation of recommendations. The study team felt that for better implementation of recommendations, the above aspects play important role in NE states and hence require urgent attention.
9. Lack of government and private investments in academic and R&D infrastructures is recognized as primary barrier to S&T sector development. The study team recommends proper attention be given in this aspect.
10. Rural infrastructure development is seriously lacking in NER region. Past studies and stakeholders consultation have suggested that a coordinated approach among state government agencies and adequate government funding are major bottleneck in this regard. However, significant portion of the problems could be resolved easily through joint work towards the development of ruraleconomy.
11. More studies need to be carried out in the tourism sector in NER. The sustainability of the tourism infrastructure development projects need adequate emphasis.
12. Duplication of researches is a real possibility hence there is a need to accumulate all the findings as research publication.

It is heartening to note that government agencies are now going digital for review and monitoring. Most of the ministries and state government departments have already implemented their knowledge management system in this regard. TERI has been actively working with DST, DBT, and Government of Madhya Pradesh etc to develop such systems. It is also suggested that MDoNER may consider to develop a searchable web- enabled database for a regular access to full-text studies and establish a user-friendly monitoring system.



6. Evaluation of Compiled Studies Reports

6.1 Introduction

The essence of the present study is to evaluate recommendation of the completed studies/projects by way of survey and interaction with beneficiaries, and record the outcomes/output from the evaluated studies/projects.

In this chapter, each study report has been studied and detailed information about each study report has been collected. Thereafter the analysis of recommendations of each report has been carried out based on the inputs from perception survey, focus group discussions (FGDs), government reports, and literature review. Each report consists of the following information fields: (i) Study title, (ii) Implementing institution; (iii) Project investigator; (iv) Project completion Year; (v) Sector; (vi) Project location (State); (vii) Objective; (viii) Recommendations; (ix) Analysis and outcome of study.





6.2 AGRICULTURE AND ALLIED

Study Title

Assam Agri-business and Rural Transformation Project (APART)

Implementing Institution

Assam Rural Infrastructure and
Agricultural Services Society (ARIAS)

Project Location/Completion Year

Assam, 2017

Objective

Increase the value-added and improve resilience in the production and processing of selected agriculture value chains, focusing on small farmers and agri-entrepreneurs in targeted districts of Assam.

Study Recommendation

A major requirement of entrepreneurs is training and capacity building. Improve the access to financial services in terms of credit facility, private investment, etc. Provide training on labour management, use of modern technologies, accounting, preparation of business plans, etc.

Analysis and Outcome

The PDO is proposed to be achieved by: (i) Promoting investments in agri-enterprises, reducing the business and transaction costs, facilitating access to finance for agri-business entrepreneurs, and, where appropriate, push for process, regulatory, and/or policy change; (ii) Supporting the development of a modern supply chain; improved information communication technologies (ICT) based farm information and intelligence services, and alternative marketing channels; (iii) Improving producer's access to knowledge, technologies, and infrastructure so that they are able to respond to market opportunities and climate variability.

The West Assam Milk Union Ltd (WAMUL), DIC, AHVD (Agriculture and Animal Husbandry and Veterinary), Assam Rural Infrastructure and Agricultural Services Society (ARIAS Society), Assam State Agriculture Marketing Board (ASAMB), Assam Agricultural University (AAU), and Assam Livestock and Poultry Corporation Ltd (ALPCO) are the potential agencies, along with local communities, that have been identified for implementation.

Study Title

Doubling Farmers' Income: Issues and Strategies for Assam

Implementing Institution

Institute of Livelihood Research and Training

Project Location/Completion Year

Assam, 2017

Objective

- Estimate the current income level of farmers in the state and its composition (in various agro-climatic zones, holding size-wise, social class wise, etc.).
- Understand constraints faced by the farming community (including the distress situations, their frequency) that are limiting opportunities to income enhancement of the farmers.
- Study the constraints, possibilities, and supports required for diversification of activities at farmer level, especially towards allied, off-farm and non-farm activities.
- Estimate farm economics and financial requirement (including bank loan) to double farm income (by 2022) and strategies to meet their financial requirement, if any.

Study Recommendation

- Sustainable construction and proper maintenance of embankments.
- Flood plain zoning is essential to minimize the vulnerability of flood.
- Flood forecasting.
- Large-scale afforestation is recommended to contain flooding caused due to silting on the river bed.
- Erect a heavy guard wall on both sides of the river so that the effect of floods could be minimized.

Analysis and Outcome

While sector-specific interventions have the potential to double the income of farmers, there are associated subjects which need equal attention. One of the fundamental areas of attention is the role of the government in doubling the income of farmers. The government needs to facilitate agencies such as the Assam State Agriculture Marketing Board (ASAMB) with financial and human resources in order to enable the agency to ensure adequate market connectivity for higher production levels that would result out of farmer collectives.

For financial inclusion, Regional Rural Banks (RRBs) should conceive appropriate credit-linkage strategies to increase outreach to the rural population. The Assam State Rural Livelihood Mission Society (ASRLMS) has been entrusted with the mandate of financial inclusion in the state and serves as a good opportunity for convergence with the RRBs too as there is immense scope and potential for financial inclusion.



Study Title

Impact Study on Agricultural Extension Services to Farmers by Agri-Clinics and Agri-Business Centres (ACABCs Scheme) in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2017

Objective

- Identify the benefits accrued to farmers through extension services by the ACABCs.
- Analyse the comparative effectiveness of extension services to the beneficiary farmers and non-beneficiary farmers of the same area.
- Assess the extent of effects on the income of beneficiary farmers through extension services and the income of non-beneficiary farmers.
- Examine the problems/factors hampering the effects of extension services on farmers.
- Explore measures and suggestions for strengthening extension services more effective to farmers.
- Suggest changes in imparting extension services to farmers under the ACABCs scheme.

Study Recommendation

- Ensure long-term viability and sustainability of the agri-enterprises; banks may engage business facilitators and provide technical/advisory services for the identification of potential enterprises and prospective borrowers.
- Comprehensive livestock development policy should be adopted to encourage the farmers to go for livestock enterprises, including dairies.
- Training programmes should be conducted by agripreneurs to educate and assist the farmers to avail the benefits of ACABC: advisory services, input support, and custom hiring services.
- Farmers should have easy access to credit at an affordable rate of interest, whenever necessary.
- The agripreneurs may be given preference over other applicants for the issuance of dealership license for fertilizers, pesticides, insecticides, etc.
- There is an urgent necessity of developing road communication and infrastructural facilities in the remote areas so that the agripreneurs can build up their ventures for the interest of the farmers.

Analysis and Outcome

The Agri-Clinics and Agri-Business Centres (ACABC) scheme was launched in 2002 by the Ministry of Agriculture, Government of India, in order to strengthen the agricultural extension services as well as to tap the potential of huge unemployed agriculture graduates and to provide them employment opportunities by making them entrepreneurs, with the support of the National Bank for Agriculture and Rural Development (NABARD).

This study comprised 100 beneficiaries and 50 non-beneficiary respondents of Kamrup and Nagaon districts in Assam. The findings of the study show that the ACABC Scheme had a positive impact on different activities under different services like proper agriculture, allied agriculture, and other services.

The study has identified MANAGE, NABARD, department of agriculture, Nodal Training Institutes (NTIs), and Commercial Banks as potential agencies capable of implementing the recommendations of the study.

Study Title

Impact Assessment of *Jhuming* on Native Plant and Soil Microbiota and Restoration of Sustainable Jhum-Agro-Ecosystem in Northeast India—Nagaland Unit

Implementing Institution

Institute of Advance Study in Science and Technology (IASST), DST, Gol, Guwahati, Assam (multiple organizations)

Project Location/Completion Year

Nagaland, 2016

Objective

- Survey and document the changes in soil and plants species in traditional jhumpractices in 2 years cropping followed by different fallows (2–3years, 5–6years, and 9–10 years).
- Rehabilitate the degraded jhumfallows through boosting of natural regeneration of perennial plant species in agro-forestry principle.
- Eco restoration of jhumfields for sustainable crop production through compatible association of novel beneficial microbial strain with early regenerating plants and crop combinations.

Study Recommendation

- Documentation of native vegetation.
- Documentation on details traditional tribal Jhum practice and its ecosystem.
- Documentation on traditional cropping systems such as intercropping and sequential cropping, folklores and believes, community-based jhum calendar system, social activities connected to jhum.
- Jhum practices classification based on cropping patterns and agriecozone system has been recorded.

Analysis and Outcome

This project intends to address two important aspects of jhum, namely, improve the productivity of jhum and restoration of sustainable jhum agro-ecosystem. The project had four major work components: (1) survey of native vegetation (secondary succession forest) and field experiments, (2) isolation and screening of beneficial microbiota from early regenerating native plants and crops of different jhum fields, (3) soil fertility evaluation, and (4) development, testing, and demonstration of the effect of bioinoculant consortia on the crops of jhum fields.

The project has been fully implemented as of October 2021. Significant positive impact has been observed in terms of employment generation, women empowerment, income opportunity, access to resources, livelihood improvement, skill development, etc. In addition, PhD scholars have been produced several research papers and reports from the project.

In a follow-up, it was remarked that the jhuming system conserved more than 200 indigenous Indo-Myanmar agro-diversity crops involving more than at least 500 germplasms. Therefore, it is necessary and urgent to investigate in more details before the precious germplasms are lost. For a sustained impact, there needs to be better coordination among various government departments, and a proactive local government. It is further to be noted that the recommendations can be generalized for other regions/target groups.



Study Title

Performance of Local Rice Cultivars to Fertilizer Application under Upland Rain-fed Condition of Nagaland

Implementing Institution

Nagaland University

Project Location/Completion Year

Nagaland, 2016

Objective

- Find out the difference between traditional and scientific methods of rice cultivation.
- Find out the yielding potentiality of those local rice cultivars under best management practices.
- Screen out the most fertilizer-responsive local rice cultivars.
- Find out the other biotic and abiotic factors associated with this study.

Study Recommendation

- Among the different local rice cultivars, some cultivars are moderately responsive to NPK fertilizer application, for which a moderate dose of NPK fertilizer in the ratio of 60:30:30 kg/ha can be applied. The nitrogenous fertilizer should be applied at two to three split doses. As local cultivars are tall, sometime lodging may occur.
- Irrespective of fertilizer-responsive nature, a minimum NPK dose of 30:15:15 kg/ha can be applied to all rice cultivars as due to the continuous monoculture of rice in the state and decreasing soil fertility, the yield of rice is drastically reducing.
- So, to improve the productivity of rice, a minimum dose of NPK fertilizer should be recommended throughout the state.
- Most of the local rice cultivars are resistant to pests and diseases. Under upland condition, weed is a major problem, which can be controlled manually by hand weeding at 25 and 50 days after sowing. Later phase at maturity, birds are a major pest.

Analysis and Outcome

Five experiments were conducted under the project to fulfil the objectives. Out of which, three experiments were conducted during the year 2013 to screen out the suitable local rice cultivars for the next phase trial to find out most suitable fertilizer-responsive cultivars. This trial was conducted during the year 2014 and repeated during 2015 for conformity of the results.

The study found that among the different local rice cultivars, some cultivars are moderately responsive to NPK fertilizer application, for which a moderate dose of NPK fertilizer in the ratio of 60:30:30 kg/ha can be applied. The nitrogenous fertilizer should be applied at two to three split doses. Irrespective of the fertilizer-responsive nature, a minimum NPK dose of 30:15:15 kg/ha can be applied to all rice cultivars as due to the continuous monoculture of rice in the state and decreasing soil fertility, the yield of rice is drastically reducing. So, to improve the productivity of rice, a minimum dose of NPK fertilizer should be recommended throughout the state.

It was also found that most of the local rice cultivars are resistant to pests and diseases. Under upland condition, weed is a major problem, which can be controlled manually by hand weeding at 25 and 50 days after sowing. Later phase at maturity, birds are a major pest.

The study observed significant positive impact on women empowerment, income, livelihood, and productivity. It is suggested that the local government should continue to play a proactive role for sustained benefit.

Study Title

Molecular Analysis of Fruit Development and Ripening of *Hippophaesalicifolia* of Sikkim Himalayas using High Throughput Sequencing-Based Gene Profiling

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Sikkim, 2017

Objective

- High throughput RNA sequencing using NGS platform.
- Analysis of data for the identification and functional annotation of genes during fruit development and ripening.
- Analysis of data for the identification and functional annotation of differentially expressed genes during fruit development and ripening.
- Expression profiling of differentially expressed genes and validation.
- Study of fruit quality during the ripening stage of *H. salicifolia* berries in terms of vitamin C, soluble sugars, fatty acids, flavonoids, and carotenoid content in fruit pulp.

Study Recommendation

Recommendation has not been outlined in this report

Analysis and Outcome

Hippophae salicifolia plant were selected and identified through ITS sequencing (GenBank Accession No. KP272153) and sample collected at five stages of fruit development. From the fruit of each stage, total RNA extracted, mRNA isolated and TruSeq RNA library prepared and sequenced using Next Seq 500 platform of Illumina. The paired end raw reads thus generated for all libraries and quality checked using FastQC. De novo assembly of NextSeq 500 data of each library was performed using Trinity assembly software for default k-mers and resulted in 66987, 67027, 53231, 46462 and 62839 unigenes for library SB_S1, SB_S2, SB_S3, SB_S4 and SB_S5 respectively. Comprehensive annotation of all unigenes done using Viridiaeplantae mRNA database of NCBI. 65.72% (44030) unigenes from library SB_S1, 65.78% (44097) unigenes from library SB_S2, 73.83% (39304) unigenes from SB_S3, 46.62% (23379) unigenes from SB_S4 and 70% (47104) from SB_S5 library was annotated. Pathway analysis of all the unigenes of five libraries done using KAAS server. Identification and annotation of genes coding for transcription factors were done. Moreover, insilico mining of microsatellites for unigenes from all the five libraries were done which resulted in identification of 15651 SSR in library S1, 15621 SSR in library S2, 8408 SSR in library S3, 8917 SSR in library S4 and 8431 SSR in library S5. *H. salicifolia* genes involved in omega-3 and omega-6 fatty acid biosynthesis, phytosterol biosynthesis, carotenoid biosynthesis, ascorbic acid biosynthesis, phenylpropanoid biosynthesis were also identified. The accuracy of the RNA Seq data was validated by expression analysis of eight key genes involved in fatty acid biosynthesis. Organic acids (succinic acid and malic acid) were analyzed along with fatty acids (palmitic acid, palmitoleic acid, oleic acid, linoleic acid, linolenic acid) on dry weight basis. Organic acid content was higher in fresh fruit than dry fruit across all development stages whereas fatty acid content was higher in dry fruit. Ascorbic content ranged between 0.989 to 1.045% of fruit and were consistent through the ripening stages.



Study Title

Study of the Microbial Diversity and Biochemical Characteristics of the Selected Non-Alcoholic Fermented (Milk, Vegetable And Pulses) Food Product of Assam and Arunachal Pradesh

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2016

Objective

- Documentation and collection of selected fermented food products and their starter culture from Assam and Arunachal Pradesh
- Building database for commonly used fermented food products of Assam and Arunachal Pradesh
- Making of database on bacterial species found in the selected fermented food products of Assam and Arunachal Pradesh
- Isolation and identification of prominent/ dominant bacterial species from the fermented food products and starter culture

Study Recommendation

- Database of the fermented food to be prepared and launched.
- Total 16 isolates were found to possess good probiotic traits. Stain L. Lactis AMD17 which showed promising probiotic characteristic was found suitable for preparation of fermented milk. The texture and sensory profiles of curd prepared with this single stain shows that it can be used as ready to use starter culture for preparation of Dahi with functional properties.
- A potential probiotic B. amyloliquifaciens AMS1 isolated from fermented soybean found to have very good probiotic and cellulolytic activity. The bacterial strain was found suitable for improving cellulosic feed conversion rate.

Analysis and Outcome

The present studied was carried out on a total of four different types of fermented foods based on substrates utilized were studied from Assam and Arunachal Pradesh; fermented milk based products, fermented bamboo shoots, fermented cereals and fermented fruits and vegetables. 903 different microbial strains were isolated from different types of fermented food and were preserved at -80 degree. Fermented milk products were found to be dominated by Lactobacilli whereas fermented cereals were found to be dominated by Bacillus spp. Total 36 isolates were identified and their sequences were successfully submitted to GenBank. One major lead obtained through the present study for future was to check probiotic and other useful functional characteristics in all the uncharacterized (~480) microbial strains. The database of the fermented food was prepared and uploaded online. All the major objective and key recommendations of the study were successfully implemented

Study Title

Assessment and Analysis of the Plant Oil Feedstock Available in North-East India for Biodiesel Production

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2012

Objective

- Survey and screen the indigenous oil seed bearing plant species/plant oil feedstock available in the forest and other localities of North-East India.
- Determine oil content and oil quality as well as the physicochemical characteristic of the vegetable oil and biodiesel produced from collected seeds of the plant species.
- Examine the methanolysis of different vegetable oils using a variety of alkali catalysts giving special focus on higher biodiesel yield, purity, and storage stability.

Study Recommendation

In this present investigation, six oil seeds from six different oil seed bearing tree species—*Gmelinaarborea* (local name Gomari), *Sterculiavillosa Roxb* (local name Odal), *Acer laurinum Hasskarl* (local name Maple tree), *BiscofiajavanicaBlume* (local name Uriam), *Thevetiaperuviana* (local name Karabi), and *MesuaferreaLinn* (local name Nahar)—were collected from different localities and forest areas of Assam and foot hills of Arunachal Pradesh. After oil extraction from the collected oil seeds, it was found that the oil content of *Sterculiavillosa Roxb* and *Biscofiajavanica Blume* was not in the accepted range. Therefore, vegetable oil from *Gmelinaarborea*, *Acer laurinum Hasskarl*, *Thevetiaperuviana*, and *Mesuaferrea Linn* was taken for further investigation to explore the possibility of quality biodiesel production. Out of these, two species—*Gmelinaarborea* and *Thevetiaperuviana*—were recognized as potential feedstock for biodiesel production grown in this locality.

Analysis and Outcome

The present investigation has been undertaken to facilitate the assessment and analysis of oil seeds in North-East India to evaluate the best suitable plant oil feedstock for biodiesel production as an alternative to fossil fuels.

Though fuel characteristic studies of the plant oils of the above plant species studied showed their suitability as feedstock for biodiesel production, the project team recommends for engine performance and emission study of the methyl esters produced from the oils.

The study highlights the need for research and development and production of alternative sources of energy so that we may reduce our dependence on fossil fuels.

Potential institutes capable of implementing this kind project are ONGC, Assam Oil Corporation, Indian Oil Corporation, in collaboration with agro-forestry departments of the states.



Study Title

Quality Improvement of Traditional Method of Rice Beer Production by the Tribal People of North-East India

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2012

Objective

- Standardize the traditional method of rice beer preparation by the tribal people of North-East India.
- Biochemical characterization of the plants used as starter material during fermentation in the traditional method.
- Characterize the rice beer both microbiologically and biochemically collected from different tribal belts of North-East India.
- Replace rice grain with tapioca roots as raw material for the production of beer and its quality evaluation both microbiologically and biochemically.

Study Recommendation

- A commercial unit of the traditional fermented foods of the north-eastern states should be developed, which would in turn help in proper marketing of the products in packed form. This would contribute to subsistence of regional economy and provide a boost to the livelihood of the rural people.
- The technologies involved can be upgraded without damaging the existing form of product.
- Different kinds of nutraceuticals and novel compounds may be produced from fermented foods if proper research is carried out.
- A database can be developed listing all the fermented foods available in the region, along with their place of origin and production, raw materials used, microorganisms involved, nutritional value, and the cost involved.

Analysis and Outcome

This study documents the various methodology of fermentation of rice beer carried out by different North eastern tribes of India. It was observed that the fermentation process is almost the same, except that the difference comes from the different types of plant species used in the starter culture preparation.

The biochemical parameters of the samples showed that rice beer produced in NER India can be a good source of nutrition along with mild intoxication.

This study highlights the importance of indigenous or tribal beverage and its socio-cultural practices.

Tourism departments of the states and the Ministry of Tourism and Culture along with the Ministry of Food and Agriculture and research institutes, especially, food technology and biotechnology can take effective steps to promote and preserve the tribal food of the region.

Study Title

Species Recovery Programme for *Nepenthes khasiana*, *Mantisia spathulata*, *Mantisia wengeri*

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

More than one state, 2011

Objective

- In-vitro mass propagation of the selected plants using seeds or suitable explants.
- Hardening and establishment of the in-vitroraised plantlets and their re-introduction in nature.
- Genetic diversity of populations and the reproductive success in the introduced plants so as to assess the fate of introduction.
- Recovery studies based on the field performance of the introduced plants and their interactions with other life forms.
- Molecular characterization of the in-vitroraised plants and their comparison with plants collected from nature.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

The project has been undertaken to preserve and conserve three endemic plant species, namely, *Nepenthes khasiana*, *Mantisia spathulata*, and *Mantisia wengeri* through in-vitro mass propagation of the selected plants using seeds or suitable explants.

A study of this sort is important both environmentally and genetically to maintain ecological balance and genetic diversity. Simultaneously, it offers medicinal and aesthetic value to the community.

Academic institutions such as NEHU, Mizoram University, the states' forest departments along with local population where the plant is endemic can strive together to restore, preserve, and conserve these special plant species. The study highlights the importance of ecological balance and diversity. It also educates the people, especially those dependent on nature, about the importance of nature and the role of plants in maintaining the environment.



Study Title

Preparation of a Master Plan for Integrated Development of Agriculture and Allied Sectors in Arunachal Pradesh

Implementing Institution

WAPCOS Ltd

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

Bring dynamism and vibrancy into the systems associated with the development of the agriculture sector encompassing crops, animals, fishes, and so on.

Study Recommendation

- Set up a Centre of Excellence on Integrated Farming System in all districts as a centre for technology for new generation farmers/agri-entrepreneurs, which will make Arunachal Pradesh one of the leading agri-horti state of India.
- Establish seed banks to supply quality seeds to the farmers.
- For horticulture: strengthen production by intensive intervention, massive orientation and exposure of the target groups to the sites of technology, showcase input support, improved management practices, scientific pre- and post-harvest handling and finally value addition and marketing.
- For livestock: breed improvement, feed, fodder, and health management.
- For fishery: development and creation of 7527 ha of potential water bodies; establishment of 47 fish hatcheries, 4 feed mills, 25 fish markets besides setting up of 97 units of ornamental fish-breeding units.

Analysis and Outcome

The study is aimed at bringing dynamism and vibrancy into the systems associated with the development of the agriculture sector encompassing crops, animals, fishes, and so on. It is a sectoral approach comprising horticulture, agriculture, water resources, animal husbandry, fishery, and plantation crops, namely, tea and rubber. This study was undertaken under the Techno Economic Development Fund (TEDF) of NEDFi. The study targets groups of farmers and farm women in each district followed by various strategies for their empowerment. The report highlights developmental initiatives taken so far over the years under various schemes, an analytical sectoral focus comprising integrated farming systems, agriculture, agriculture marketing, horticulture, animal husbandry, fishery, tea, rubber, and water resources. The study also presents district-wise developmental plans for all the aforesaid sectors with strategies, action plan, and road map and finally deliverables as an outcome of this whole exercise at the end of 5 years and post-project period.

The state's concerned departments are capable agencies for implementing development projects. In addition, agricultural research institutes and KVKs, like the ICAR, can play a crucial role. Banks such RRB and NABARD are also important agencies helping the target groups."

Study Title

Lower Dibang Valley District Inventory of Agriculture 2015

Implementing Institution

NABARD Consultancy Services

Project Location/Completion Year

Arunachal Pradesh, 2015

Objective

Develop an inventory of the agriculture in the Lower Dibang Valley District.

Study Recommendation

- Scientific technical know – how, use of local varieties, attack of stem borer, pink borer and incidence of banded leaf and sheath blight.
- Knowledge among the farmers towards value addition of milk or other livestock products
- Cold storage for storing and processing of livestock products.

Analysis and Outcome

The study attempted to compile all the available information on various developmental organizations relevant to the district's agriculture. It also provided the services and schemes offered by the organizations along with addresses for communication.

The study has highlighted various constraints affecting the productivity of the major crops in Lower Dibang Valley District. The information provided in this report is useful for the stakeholders.

This report is expected to be useful to policy planners, farmers, and all those who are concerned with the development of agriculture and related fields of the district.

Agencies responsible for implementation:

- Krishi Vigyan Kendra, Arunachal Pradesh
- The Indian Agricultural Research Institute, New Delhi



Study Title

Decision-Oriented Information Systems for Farmers: A Study of Kisan Call Centres (KCC), Kisan Knowledge Management System (KKMS), Farmers Portal and M-Kisan Portal in Assam

Implementing Institution

Assam Agricultural University, Agro-Economic Research Centre for North-East India

Project Location/Completion Year

Assam, 2017

Objective

To examine:

- The organizational set-up, infrastructure, information and communication technology (ICT), and system used, information content management, methods and information flows, types and abilities of the manpower involved, and the governance of the system.
- The record of the use of the system—the profile and patterns of the users, the use made of the system, including the number and nature of the calls and other means of communications and the response given.
- The performance of the systems from the point of view of the farmers/users, including the ease and usefulness of the systems, the decision-making and information needs of the farmers, and the extent to which these are solved, what they want, and what they get.
- How the system can be improved to make them more effective in serving the farmers, thereby enhancing farm performance and livelihoods and boosting the agriculture sector.

Study Recommendation

- Improve infrastructural facilities. This includes space and hardware and software technologies.
- Provide technical training for the farm tele advisors (FTAs).
- Strengthen the database for market, price, and government schemes related information.
- Change work timing (from the 6:00 am to 10:00 pm timing to the 8:00 am to 8:00 pm timing).
- Coordinate among different line departments of the state government.
- Declare the Kisan Call Centres as a permanent scheme.
- Remove the existing policies of contractual appointment and replace them with regular employees

Analysis and Outcome

The study was conducted by the Agro-Economic Research Centre for North-East India, Jorhat, in Assam with the Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad as the coordinating unit in consonance with the guidelines of the Ministry of Agriculture and Farmers Welfare, Government of India. The study was based on both secondary and primary data.

The Kisan Call Centre (KCC) was established in January 2004 at Guwahati, Assam, covering the entire North-Eastern Region. The intention was to use all possible means of information and communication technology to respond to the farmers' queries and concerns in local languages. The findings of the study have clearly demonstrated that variety selection decisions, input purchase decisions, fertilizer/feed application decisions, weather/rainfall-related decisions, crop management decisions, insect/pest control decisions, disease control decisions, and weed control decisions constitute the major decision-making process, for which the sample farmers usually look forward to the KCCs. Although the impact of implementation of the recommendations of KCC could not be fully assessed, but over the years the KCC have become more and more popular among the farmers with a lot of positive impact all around.

The KCC, Guwahati is serving a large chunk of farmers of the entire North-Eastern Region by providing them with the required information on improved agriculture, encompassing all technical, operational, and economic issues. In spite of a number of limitations inherent to the system, the KCC programme should continue to serve the farmers with enabling policy support and generous funding from the government.

Study Title

Evaluation Study on Rashtriya Krishi Vikas Yojana

Implementing Institution

AMC Research Group Pvt Ltd

Project Location/Completion Year

Meghalaya, 2018

Objective

- Incentivize the states to increase public investment in agriculture and allied sectors.
- Provide flexibility and autonomy to states in the process of planning and executing agriculture and allied sector schemes.
- Ensure the preparation of agriculture plans for the districts and the states based on agro-climatic conditions, availability of technology and natural resources.
- Ensure that the local needs/crops/priorities are better reflected in the agricultural plans of the states.
- Achieve the goal of reducing the yield gaps in important crops, through focused interventions.
- Maximize returns to the farmers in agriculture and allied sectors.
- Bring about quantifiable changes in the production and productivity of various components of agriculture and allied sectors by addressing them in a holistic manner.

Study Recommendation

- There is need for new and sustained irrigation techniques, which will in turn prolong the crop growing season.
- There needs to be provision of corpus funds for the maintenance and renovations of constructions carried out under the scheme and increasing the cost norms from ₹1.5lakh/ha to ₹2.5 lakh/ha.
- There needs to be more emphasis towards catchment area development and more importance needs to be given for land development such as widening of cultivable land, terracing and improvement in waste land, etc.
- There needs to be constant monitoring and supervision of progress of sanctioned projects at the district level.
- There also needs to be more focus on schemes like land reclamation, compost pits, fencing for winter cropping, farm mechanization, etc.
- Capacity building and awareness component may perhaps be incorporated to enhance the receipt ability of the stakeholders.
- Creation of posts for field staff and appointment of permanent engineering staff at the district level under the agriculture department.
- The horti-hubs need to be provided with functional and administrative autonomy to develop them as localized centres of excellence.



Analysis and Outcome

The study evaluates the effectiveness of Rashtriya Krishi Vikas Yojana (RKVY) launched in seven districts of Meghalaya. The main objective of the study was to evaluate the performance, quality, benefits of the major works undertaken by different departments under the RKVY.

- **Water Resource Department:** Check dams, pipeline and distribution, earthen canal, retaining wall, pond, and RCC wall.
- **Soil and Water Conservation Department:** Peripheral bund, terracing, seed and manures, check dams, water-harvesting structure, erosion control, diversion dam, disposal channel, protection wall.
- **Agriculture Department:** Surface water pumping, mini check dams, land development.
- **Horticulture Department:** Strengthening of horticulture hubs, post-harvest management, and subsidy to SHGs, carnation and low-cost poly house, construction of farmers training centre.
- **Fisheries Department:** Area expansion of ponds, supply of fish seeds.
- **Animal Husbandry and Veterinary Department:** Establishment of veterinary dispensaries, community livestock farming, etc.

The RKVY project has benefitted many with the aforementioned undertakings in Meghalaya. Yet the study further suggests the above-mentioned recommendations for better impact of the RKVY. It also suggests for a better coordination among various government departments, public-private partnership, a proactive local government, and more engagement of social institutions (like NGOs, SHGs).

As of October 2021, the implementation of the recommendations is not with the AMC Research Group; therefore, measuring the impact does not arise.

Study Title

Zawngin Village Community Development Plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2016

Objective

The overall objective of this project is to plan the livelihood development of Zawngin village.

Study Recommendation

28 activities which could be taken through North East Rural Livelihood Project (NERLP) support; these activities are selected after the consultation during PRA and the CDG meeting. Implementing these identified activities is very imperative and they are directly associated with their livelihood.

Analysis and Outcome

Zawngin comprises of 100% Mizo, there are 128 households. The total population is 706 of which male population is 356 and the remaining 350 are females. The village has formed the Executive Committee of Community Development Group (CDG) for implementation of the NERLP Project in the village. There are ten (10) actively participating Self Help Group at Zawngin village under NERLP.

The PRA highlighted the different problems faced by the villagers. All the problems mentioned in this meeting require long term interventions. They need a safe and well maintained school building for better education. The community faces a critical water supply during the dry season because the village does not have an enough reservoir; even per family do not have a sufficient water tank to store water for the dry season. They need a well-established community hall, even though they have a community hall. This hall does not accommodate the increasing population. They also need a clear side drain, as they do not have a proper side drain along the road. They have also asked for an agriculture linked road from the village to the Changzawl ram where most of the villagers have done their cultivation.



Study Title

Tripura Comprehensive State Agricultural Plan (C-SAP) 2015–2020

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Tripura, 2015

Objective

Make a comprehensive state agriculture plan (C-SAP) after detailed situational analysis of various parameters relating to the agriculture and allied sectors.

Study Recommendation

- **Agriculture:** Area expansion under HYV and HYB seeds for rice improvement; area expansion of paddy under SRI; promotion of seed treatment; strengthening of farm mechanization; establishment of bio-pesticide and bio-fertilizer production units, etc.
- **Horticulture and soil conservation:** Promotion of cultivation of new fruits, vegetables, and plantation crops; development of horticulture under protected cultivation; promotion of greenhouse and polyhouse cultivation for off-season varieties, etc.
- **Irrigation:** Establishment of rainwater-harvesting structures; development of check dam, etc.
- **Animal Resource Development Department:** Poultry-based farming system; goatry development; fodder production; promotion of cross-breed-based farming system, etc.
- **Fishery:** Pisciculture in newly created/reclaimed water bodies; skill upgradation of fish farmers; diversification of aqua culture; popularization of integrated fish farming, etc.
- **Infrastructure and credit plan:** Provision of post-harvest and marketing infrastructure, etc.
- **Sericulture:** Expansion of area under mulberry cultivation.
- **Research and development:** Setting up of research centres.
- **Capacity building:** Training and capacity building of VLWs, farmers, block officers, KVKs, PRIs, etc; establishment of farm advisory support system for weather forecasting, pest surveillance, market, etc.

Analysis and Outcome

The RKVY incentivizes states to draw up plans for their agriculture sector more comprehensively, taking agro-climatic conditions, natural resources, and technology into account, and integrating lives. The main problems encountered in the agricultural sector, namely, investment, gaps in the yields, production and productivity levels, infrastructure, technology and extension, interdependence of various sectors, etc., were analysed in detail. Appropriate suggestions are made for improvement in quality of the programmes based on the feedback from the users and the scientific and technological information available and the expertise of the local people. A detailed roadmap is prepared to achieve the desired results for the benefit of the entire state. Thus, the final output highlights the way forward in the next five years to achieve the stated goals. The state agriculture plan thus formulated will not act as light house to the policy makers but also for the members of the scientific community and the researchers akin.

Study Title

National e-Governance Programme (NeGP)

Implementing Institution

National Informatics Centre

Project Location/Completion Year

Assam, 2012

Objective

Describe the complete functional requirements like functionalities, user interfaces, user characteristics, sitemap, navigation, etc. of the proposed SAP related to the state of Assam. It will also cover non-functional requirements like performance, reliability, availability, security, maintainability, usability, etc.

Study Recommendation

- It is indicative that the PPP model would deliver a better result. As such the private sector brings with itself a large experience in providing services to the farming community at the field level.
- The government brings an in-depth knowledge of the bottlenecks that it may face during the delivery of the services.
- Creating a common platform for both public and private sector to assimilate their resources and create an exchange by means of which services can be provided to the farmers that would result in the natural success of the proposed initiative.

Analysis and Outcome

The NeGP-AMMP aims to address the needs of the farming community and its other related stakeholders, by providing relevant information and services through the various delivery channels available in their vicinity for assisting them in making rational decision for increasing farm productivity and farm income. In the first phase, the project was implemented in seven pilot states, including Assam.

Twelve cluster of services were identified under this project covering information on pesticides, fertilizers and seeds, soil health, crops, farm machinery, training, and good agricultural practices (GAPs), forecasted weather and agro-met advisory, prices, arrivals, procurement points, an interaction platform, electronic certification for exports and imports, marketing infrastructure, monitoring implementation/evaluation of schemes and programmes, fisheries, irrigation infrastructure, drought relief and management, and livestock management.

This study describes the software requirements specification for the State Agricultural Portal (SAP) for Assam.

The success of the SAP lies in the efficient delivery of services to the farmers. In measuring efficiency, it is important to understand the processes within and outside the government framework. The private sector brings with itself a large experience in providing services to the farming community at the field level; and the government brings an in-depth knowledge of the bottlenecks that it may face during the delivery of the services. Creating a common platform for both public and private sectors to assimilate their resources and create an exchange by means of which services can be provided to the farmers would lead to natural success of the proposed initiative.



Study Title

Gene Pool Conservation of Indigenous Rice Varieties under Traditional Integrated Rotational Farming System (Jhum Optimization) for Promoting Livelihood and Food Security as Climate Change Adaptation Strategy in Nagaland

Implementing Institution

Agriculture Department, Government of Nagaland

Project Location/Completion Year

Nagaland, 2020

Objective

- Increase farmers' resilience against climate change by increasing the number of crop varieties grown by farmers to reduce their production risk.
- Preserve existing agro-biodiversity of rice for future generations.
- Optimize rice yield for farmers as they move from place to place under shifting cultivation by matching specific site conditions (altitude, soil quality, water availability, etc.) with traits of different rice varieties.
- Enhance farmers' understanding of impact of climate change (increase in temperature) and enabling selection of rice varieties with resultant altitude drop (+20°C next 40 years; 0.50°C each 10 years = 75m altitude drop).
- Increase the number of complementary traditional varieties grown by farmers for stabilizing long-term farm production against risk of pest infestation, drought, excessive rain, etc.
- Reinforce traditional practices of farm management by community, firming up social networks and cultural ties where assets are managed as community resource rather than individual resource, thereby increasing their risk-taking capacity.
- Increase nutrition and food security especially among poor families as traditional rice varieties are more nutritious (protein, minerals, vitamins, etc.).
- Increase marketing options with increase in the number of marketable varieties with different (off-season) sowing, ripening, and harvesting times.

Study Recommendation

- The project is moderately scientific and technical in nature with long-term practical implication. It depends on synthesis of technical and traditional knowledge for the well-being of the community.
- Community needs to understand the concept of climate change and how their issues of food security, livelihood, and traditional farming practices, traditional wisdom can be handled simultaneously through a scientific approach. Evaluation of genetic variants through characterization studies is the fundamental part in the assessment of genetic resources.
- The true value of each genetic variant can only be determined through their characterization. Standard seed banking protocol will be followed and the germplasm stored at seed banks for ex-situ and in-situ conservation as active collection. Rice genotypes showing promising yield potential and wide adaptability will be processed for registration under National Bureau of Plant Genetics Resources (NBPGR).

Analysis and Outcome

The study proposes that genetic resources of traditional rice varieties are conserved and increased number of crop varieties are propagated under integrated rotational farming systems for nutrition and food security, resilience to climate change, and reduced production risk. The study also proposes enhancement of the understanding and capacity of people dependent on jhum in the management of genetic and other natural resources under the climate change scenario. The study benefitted 1000 families (primary beneficiary) and approximately 34,000 people (secondary beneficiary) in 10 villages in five districts of Nagaland.

Study Title

Socio-economic and Ecological Impact Study of GEF-UNDP-Government of Nagaland Project- Sustainable Land and Ecosystem Management in Shifting Cultivation Areas of Nagaland for Ecological and Livelihood Security

Implementing Institution

InsPIRE Network

Project Location/Completion Year

Nagaland, 2015

Objective

- Assess the impact of GEF-UNDP Government of Nagaland project “Sustainable Land and Ecosystem Management in Shifting Cultivation Areas of Nagaland for Ecological and Livelihood Security” on fallow management, soil productivity, soil erosion, agriculture pattern and productivity, and the livelihood scenarios of the communities in the project area.
- Assess the sociological impact of the project especially on the marginalized sections of the community, gender, and traditional institutions.
- Document the best practices evolved through the project and also the perceptions of the target community towards the project impact.
- Identify the policy and legal bottlenecks for upscaling and replicating the lessons learnt from the project.

Study Recommendation

- Initiate the second phase of the program selecting two–three villages per district to implement all the successfully demonstrated livelihood enhancement and ecosystem conservation options of the present phase.
- All the households in the selected villages need to be benefitted from the programme wherein the options can be identified in participatory manner through Land Use Committees (LUCs).
- The village councils should be mobilized to experimentally halt the slashing for 1year if livelihood improvement is significant.
- In order to make the soil conservation measures time efficient and lucrative, suitable mechanization needs to be introduced (tillers, etc.).

Analysis and Outcome

The project aims to address the issue of shifting cultivation by developing and demonstrating sustainable land management practices with an ecosystem approach. After 5 years of the project implementation, the UNDP commissioned the InsPIRE Network for Environment to carry out a socio-economic and ecological impact study of the project. The report is an outcome of the impact assessment carried out between September 2014 and January 2015.

The improvement in soil fertility in managed jhum cultivation areas is evident from the high productivity, which resulted from soil conservation activities. In case of biodiversity analysis, it was found that the managed fallow areas have better diversity than the unmanaged fallow areas. The project has precisely marked a positive impact on the biodiversity and fertility of both the fallow areas and also the jhum cultivation areas. The number of trees planted in the jhum cultivation areas, before leaving them fallow, has tremendously increased in all the targeted villages through awareness creation and sensitizing the community institutions. The project has also demonstrated a positive change in the quality, quantity, and variety of the agri-horticultural produce in the three project districts due to the project interventions.



Study Title

Sustainable Land and Ecosystem Management in Shifting Cultivation Areas of Nagaland for Ecological and Livelihood Security: Market Development Assessment for Organic Agri-Horticulture Produce 2014

Implementing Institution

United Nations Development Programme

Project Location/Completion Year

Nagaland, 2014

Objective

- Assess the impact of the GEF-UNDP Government of Nagaland project “Sustainable Land and Ecosystem Management in Shifting Cultivation Areas of Nagaland for Ecological and Livelihood Security” on fallow management, soil productivity, soil erosion, agriculture pattern, and productivity and the livelihood scenarios of the communities in the project area.
- Assess the sociological impact of the project especially on the marginalized sections of the community, gender, and traditional institutions.
- Document the best practices evolved through the project and also the perceptions of the target community towards the project impact.
- Identify the policy and legal bottlenecks for upscaling and replicating the lessons learnt from the project.

Study Recommendation

- Initiate the second phase of the programme selecting two–three villages per district to implement all the successfully demonstrated livelihood enhancement and ecosystem conservation options of the present phase.
- All the households in the selected villages need to be benefitted from the programme wherein the options can be identified in participatory manner through LUCs.
- The village councils should be mobilized to experimentally halt the slashing for 1year if livelihood improvement is significant.
- In order to make the soil conservation measures time efficient and lucrative, suitable mechanization needs to be introduced (tillers, etc.).

Analysis and Outcome

The project is to strengthen the livelihoods of communities that practice jhum, or shifting cultivation. The study was conducted in the three districts of Wokha, Mokokchung, and Mon, over the period of 6 months, from January to June 2014.

The survey found that lack of adequate marketing spaces is a significant problem, forcing farmers to sell their produce locally. Price fluctuation is another cause of concern. Poor infrastructure and transport facilities also cause damage to the agricultural produce.

Suggestions from farmers to enhance marketing systems include improved transport services, marketing complexes and storage sheds in the local markets, improved accessibility to jhum fields, more organized marketing to fetch better price for the produce, and training of farmers on various aspects. Traders emphasized on the need to promote products from Nagaland to increase their market demand, encourage the development of a network of buyers to collective, and the reduction in wholesale prices within Nagaland.

Additionally, the study found that there was a huge demand for local produce within Nagaland and marketing strategies should build upon this inherent strength.

A Farmer Produce Organization need to be promoted in an organized manner in order to take advantage of all the opportunities discussed above.

Study Title

Jhuming to Mainstream Farming as an Alternative Way of Livelihood among the Tribal Farmers of Tripura

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Tripura, 2019

Objective

- Study the trend of development of major agriculture and allied sectors— agriculture, horticulture, and piggery.
- Identify the success stories in the field of agriculture and allied activities in the selected districts as an alternative livelihood option among the Jhumias.
- Study the comparative economics of jhum and settled cultivation with piggery in terms of costs and returns.
- See the status of empowerment of tribal women.
- Examine the problems of replacement of the existing production patterns.

Study Recommendation

- **Recommendations for improvement of pig farming:** Variation in the prices of Cross-bred (CB) pigs and non-descript (ND) pigs may be taken care of by the government. Credit at a lower rate of interest may be arranged by the government to procure CB piglets. Subsidy may be given for infrastructure development of pig farms. The price of medicine for treatment of pigs may be subsidized or may be distributed free of cost. Visits of veterinary doctors at regular interval may be ensured in order to improve the health and growth of pigs/ piglets. Slaughtering of animals should be made more scientific and hygienic.
- **Recommendations for improvement of agriculture/horticulture:** Transport costs of the agricultural produce may be subsidized by the government. Private parties need to be encouraged for the establishment of more cold storages and fruit-processing units in the tribal areas. Small sheds for selling of agricultural produce in the roadside and market areas may be constructed. Also, private entrepreneurs may be encouraged to make mobile fruit stalls in selective areas. Appropriate participatory soil and water conservation measures need to be adopted. The ongoing rehabilitation programme may be further strengthened with new approaches by involving them in rubber plantation. The drip and sprinkler irrigation need to be introduced in tilla lands particularly, for horticultural crops. The “Tong Houses” in the vicinity of jhumfield may be constructed for settlement of the Jhumias.

Analysis and Outcome

The study was conducted on the basis of primary and secondary data. There are eight administrative districts in Tripura, and for the present study, only two jhum-dominated districts, namely, Dhalai and Gomati districts, were selected purposively.

The study reveals that the net return from settled cultivation is 1.56 times more than that from Jhum cultivation. Piggery, in general, is a profitable venture in the study area. The cross-bred (CB) pig rearing in the study area was 4.90 times more profitable than non-descript (ND) pig rearing. In the overall analysis, the total net returns from settled farming with CB pig rearing was found to be 3.51 times more profitable than that of Jhum cultivation with ND pig rearing.

The findings of the study clearly indicate that the adoption of settled crop cultivation with CB pig rearing played an important role in empowering the tribal women folk of the sample area, sensitizing them to take part in the decision-making process as that of their male counterparts.

The study will be useful to the researchers and to those who are involved in planning and policy formulations in the field of hills agriculture.



Study Title

Agricultural Extension Systems in Tripura

Implementing Institution

National Institute of Agricultural Extension Management (MANAGE)

Project Location/Completion Year

Tripura, 2017

Objective

Understand the current status of the extension systems in the state of Tripura.

Study Recommendation

- Skill development of the extension workers with a focus on both the technical and functional skills.
- Digitalization is the need of the hour and there should be an increased focus on ICT skills of the extension professionals.
- Documentation of many of the innovations has not been done because of either lack of documentation skills of the officials or lack of awareness about its importance. While the state government can put more emphasis on documentation of innovations and good practices, write shops can enhance the documentation skills.
- Online monitoring can reduce the heavy workload on field officials as well as makes the system more transparent. NIC/IT firms can be engaged to create online monitoring systems for easy upload of resource materials, for better archiving and retrieving.
- A dedicated extension mechanism is required in the state for higher effectiveness, and encouraging community extension or para-extension workers can be an effective way.
- Beneficiary selection under different projects across different sectors is often not transparent, and creation of a model village database for each village with all details of the residents will help in making the process transparent.

Analysis and Outcome

This study is the result of a field study conducted in Tripura during January 2017 and is based on the observations of and the interactions with officials from different extension stakeholders in the state in agriculture and allied sectors.

Till date (as of September 2021), the recommendations have been partially implemented; due to administrative reasons, recommendations have not been fully implemented.

From the implementations, it has generated employment, increased the income of farmers, improved infrastructure, better access to market and finance, improve the livelihood, and imparted skills development.

The major stakeholders in extension in agriculture and allied sector are the Department of Agriculture; College of Agriculture, Tripura; Department of Horticulture; Department of Fisheries; College of Fisheries, Central Agricultural University (CAU), Lembucherra; Animal Resource Development Department (ARDD); Department of Forestry; Rubber Board, Regional Office, Tripura; Tripura Forest Development and Plantation Corporation Ltd (TFDPC); Tripura Bamboo Mission (TBM); Indian Council of Agricultural Research (ICAR), Tripura Centre; Krishi Vigyan Kendra (KVK); Tripura State Agriculture Management and Extension Training Institute (T-SAMETI); Agricultural Technology Management Agency (ATMA); NABARD; the media (radio, TV, newspapers); input dealers; NGOs; and Panchayat T-SAMETI.

The study further vouchsafes for a better coordination among various government departments, effective coordination among all stakeholders, public-private partnership, a proactive local government, enthusiasm from target groups (like association), and more engagement of social institutions (like NGOs, SHGs).

Study Title

Fostering Climate-Resilient Upland Farming Systems in the North-East (FOCUS)

Implementing Institution

International Fund for Agricultural Development (IFAD)

Project Location/Completion Year

More than one state, 2018

Objective

- Increase agricultural income of 201,500 households.
- Enhance their resilience to climate change.

Study Recommendation

Recommendation has not been outlined in this report.

Analysis and Outcome

The project addressed the issues facing Jhum cultivation through: (1) better Jhum cultivation practices that will be both more productive and more sustainable creating an ecological balance; and (2) supporting jhumia households to adopt alternative farming systems, particularly, sedentary farming. The project was implemented by new societies to be established within the Agriculture Production Commissioner's Office (APC's Office) in Nagaland and within the Department of Agriculture (DoA) in Mizoram. A total of 201,500 households (137,000 households in Nagaland and 64,500 households in Mizoram) would directly benefit from the project. Wider benefits will accrue from the generation and dissemination of knowledge, and from the institution building of organizations at the village level.



Study Title

Shifting Cultivation: Towards Transformation Approach

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

More than one state, 2010

Objective

- Consolidate the learning on the magnitude of the problem.
- Identify viable best practices having upscale potential.
- Assessment of institutions (formal and traditional ones) and needs for transformation.
- Ascertain to what extent and which “co-benefits” could be delivered (to Jhumias and state agencies).
- Suggest action agenda (short, medium, and long term).

Study Recommendation

- **Remote sensing:** To determine the area affected and temporal changes in the areas under jhum. It may be done using remote sensing with adequate ground truthing.
- **Village survey:** The number of families and percentage of population dependent on shifting cultivation in an area. The unit of this survey shall be the village, and the officials to be made responsible shall be the village-level workers of the Rural Development Department, the Gram Sevak. This may also include the type of shifting cultivation—distorted or traditional and land tenure, i.e. community land, traditional chief’s land, clan land, private land, including the custodian of the land. Jhumias need to be categorized for their degree of dependence on jhum, i.e. 100%, 50–100%, <50%.
- Areas of unclassed state forests and unclassed forests should be declassified in favour of jhumias or the Village Council.
- Infrastructure development, settlement of the issues politically and better administration. Education extension programme for village leaders highlighting the ill effects of jhum and suggesting better alternatives and/or providing them support to improve their Jhum cultivation.
- The traditional crops must not be discouraged in favour of cash crops and high-yielding varieties as food preference do not change overnight.
- Promotion of home gardens will ensure secured tenure for all participating households, can safeguard native crop species (hence provide nutritional security, income with surplus), and reduce drudgery for women.

Analysis and Outcome

The focus of the report is to provide policy guidelines relating to forest, agricultural practices, especially shifting or Jhum cultivation, land use and management in the region.

The policy paper offers short-term, medium-term, and long-term action to manage shifting cultivation in the region. However, the recommendations given were not implemented (as of November 2021) due to the lack of regulatory, administrative, and interdepartmental coordination.

Whereas the report also identifies several potential agencies or institutions that will be capable of implementing the recommendations: National Remote Sensing Agency (NRSA); Forest Survey of India (FSI); State Department of Rural Development, BDO through Gram Sevak or similar village-level official under the control of BDO; Registrar of Census of India; Village Councils; State Forest Departments and MoEF and CC, NEC, MDoNER, Ministry of Agriculture of central government and state governments, etc.

Study Title

Agricultural Marketing System in Assam

Implementing Institution

National Institute of Agricultural Marketing
(NIAM)

Project Location/Completion Year

Assam, 2011

Objective

- Study the status of agricultural marketing in Assam.
- Study the ownership, operation, and management of existing markets in Assam.
- Study the problems in implementing the Agricultural Marketing Regulation Act in Assam.
- Assess the needs for improving the agricultural marketing system in Assam.

Study Recommendation

- The present marketing system needs to be revamped by improving the legislation framework and organizing the markets by developing functional.
- The markets need to be upgraded, minimum and basic facilities need to be provided.
- The markets on the rural and urban fringe should be given requisite technical support so that they can be used for effective credit delivery, input marketing, procurement, information kiosk.
- The large evasion of revenue require effective system to check the income from the markets and to ensure that revenue is utilized for developing basic facilities in market such as shops, parking, drainage , sheds, troughs for cattle, drinking water, public toilet.
- Grading as a voluntary measure needs to be encouraged and made mandatory in commodities which have potential for export market viz pineapple, orange and vegetables.
- Improving the credit system both formal and informal is also required so that farmers can be saved from unauthorized moneylenders who charge high rate of interest and are exploitative in nature.
- Developing marketing skills of the farmers and forming groups to consolidate the produce, motivating them for diversification, achieving higher production and getting better price is a prime requirement.
- The state needs to expedite the establishment of post harvest infrastructures along with authentic quality check laboratories to unleash the opportunities in Agribusiness ventures.

Analysis and Outcome

The present study on agricultural marketing system in Assam was assigned by the Committee of State Agriculture Marketing Ministers to the National Institute of Agricultural Marketing (NIAM). A comprehensive analysis of the existing status of the markets, ownership, and management has been done, which is based on primary data and supported by secondary data. The study suggests that markets need to be provided with basic infrastructure and the Assam Agricultural Marketing Board needs to play a proactive role in providing infrastructure, ensuring fair trading practices, and bringing changes in the collection of market fees and other charges. It is also realized that rural periodic markets also need to be upgraded and linked with the wholesale markets for better realization. The environment needs to be conducive to bring public-private partnership in creating value in training, extension, and creation of facilities.

The idea is not to have a parallel competitive system to the existing one, but to develop a professional and a modern system around it. The proposed action plan suggests and covers the key areas of market regulation, market infrastructure, marketing extension, agri-business and entrepreneurship, and rural innovations in Assam.



Study Title

Cassava Production, Marketing and Utilization in Meghalaya, India: Results of a Value Chain Assessment

Implementing Institution

Food Resilience through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific (FoodSTART+)

Project Location/Completion Year

Meghalaya, 2018

Objective

Identify major constraints in cassava production, marketing, and use, and opportunities for interventions that could significantly increase returns for farmers and processors; specifically studying all aspects of the cassava value chain in Meghalaya.

Study Recommendation

- Improving production: Replace old varieties with new high-yielding, climate-resilient ones with good culinary characters and suitable for frying by conducting trials and popularizing the best ones.
- Value addition enhancement: Strengthen the knowledge of farmers and entrepreneurs on cassava value addition through capacity building.
- Enhancing market demand: Create brand awareness for Meghalaya cassava as purely organic and facilitate marketing in metro cities.
- Government policy and interventions: Strengthen transportation infrastructure, facilitate the dissemination of market information.
- Information: Facilitating start-up production units on cassava value addition at the cottage/community level.

Analysis and Outcome

This study was conducted in September–October 2017 to analyse cassava value chains in order to identify major constraints in cassava production, marketing, use, and opportunities for interventions that could significantly increase returns for farmers and processors, and specifically study all aspects of the cassava value chain in Meghalaya.

Cassava is an integral part in the livelihood of Meghalaya farmers in terms of food security support, as animal feed, and as source of income. The cassava market is unorganized in Meghalaya and appears a closed one space-wise, mostly happening within a village or nearby villages and at maximum it goes up to district markets. The tubers are marketed in terms of bundles and not by weight or specific volume-based measures. Two types of processed food are sold: a major type is boiled tubers and an insignificant proportion of fried chips. The ICAR RC NEH has set up village-level cassava-based incubation centres (following the model established by the Central Tuber Crops Research Institute (CTCRI) at the Riha village in Manipur), in four locations in Meghalaya. The findings show that several challenges and constraints exist in the cassava value chain. Among other things include lack of information on improved methods of production, transportation cost, price fluctuation, lack of market information, poor support services, lack of value addition, and poor marketing infrastructures.

Study Title

Evaluation of Price Support and Market Intervention Scheme: A Brief Report on Mizoram

Implementing Institution

Mizoram Agricultural Marketing Corporation
(MAMCO)

Project Location/Completion Year

Mizoram, 2012

Objective

- Analyse the extent of coverage of MIS in Mizoram, especially of farmers of selected crops in the chosen districts.
- Study the effect of Market Intervention Scheme (MIS) on the market price of commodity in the targeted region.
- Ascertain the socio-economic factors that influence coverage of villages and farmers in MIS.
- Understand the problems of different stakeholders in operation of MIS.
- Assess efficiency of central agencies in the operation of MIS.
- Suggest policy measures to improve operations of MIS.

Study Recommendation

- There should be proper record of implementing the schemes like Minimum Support Price (MSP) and Price Support Scheme (PSS) in the state.
- The government should intervene in the marketing of different agricultural commodities in Mizoram. The MSP scheme in the state should be implemented for any crop in the state.
- There is a need to study the status and modus operandi of the MIS scheme with a view to assess the price behaviour of the targeted commodity and to suggest appropriate policies for better performance of the scheme.

Analysis and Outcome

The study evaluated the Price Support and Market Intervention Scheme of ginger in Mizoram. The study observed that non-availability of markets has been the prime reason for the lackadaisical attitude of the cultivators towards ginger in Mizoram in the recent years. Quite a good number of farmers have already started shifting to other crops. It was reported that even the cost of production of ginger was not covered for several years, not to speak of profit. The officials of the Mizoram Agricultural Marketing Corporation (MAMCO) are of the opinion that the government is putting constant effort to create marketing facilities for the resource-poor farmers of the state. It is also looking for ginger market elsewhere in the country in addition to neighbouring Bangladesh. The sources say that the present price of ginger in Bagha and Vairengte areas (both in Mizoram) is ₹4 per kg and there are no sufficient buyers around. On the basis of field visits and discussion with different government officials, it can be concluded that the Market Intervention Scheme is no longer in operation in Mizoram for any crops after 2008-09. But the government support, either in the form of MIS or other support price for the ginger/chilli, is very much essential in the sense that in the crop year 2010-11 alone, ginger occupied 6500 ha of area in Mizoram and its production was 31,950 MT.



Study Title

Status of Agricultural Markets and Value Chain in Tripura

Implementing Institution

National Institute of Agricultural Extension Management (MANAGE)

Project Location/Completion Year

Tripura, 2018

Objective

Understand the status and potential of market and value chain related to major commercial produce in agriculture and allied sectors of the state.

Study Recommendation

- Market-led production to help the farmers avoid distress sale predominant now and also help in streamlining agricultural as well as market-related activities.
- Entrepreneurship development riding on higher scope in agro-based development in the state compared to industrial development.
- A dedicated marketing cell in all the departments of agriculture and allied sectors to properly understand the production and marketing status and plan interventions based on the needs of the sector.
- Collaboration and partnership with APEDA as well as other agencies for the export of fruits like pineapple, orange, and jackfruit.
- Market and post-harvest infrastructure development along with focus on roads, warehouse, cold storage facilities for fruits, dairy products, and dressed meat.

Analysis and Outcome

This working paper is the result of a field study conducted in Tripura during January 2018 and is based on the observations of and the interactions with officials from different extension stakeholders in the state in agriculture and allied sectors.

This follow-up study emphasized diversification to horticulture, high-value fish and animal husbandry, and required technology and input availability.

Parts of recommendations are known to have been implemented; administrative constraints impede the full implementation. Certain positive impact could be seen, such as employment generation, income, infrastructure development, access to resources, livelihood, and skill development. The study has been published as a policy paper, which can be adapted to by other north-eastern states for guidance. The study highlights the need for a better coordination among various government departments, effective coordination among all stakeholders, public-private partnership, a proactive local government, enthusiasm from target groups (like associations), more engagement of social institutions (like NGOs, SHGs).

Study Title

Assam Agricultural Competitiveness Project and Its Additional Financing

Implementing Institution

Assam Rural Infrastructure and Agricultural Services Society (ARIAS)

Project Location/Completion Year

Assam, 2015

Objective

- The project development objective is to increase the productivity and market access of targeted farmers and community groups.
- Although the overriding objective is to stimulate growth of Assam's agricultural economy, project activities are predominantly pro-poor, directed primarily at small and marginal landholders, poor fishing communities, and the landless.

Study Recommendation

- Appropriate modifications and amendments to the existing legislative framework are underway to enable traditional fisher-folk communities to access common open water bodies to increase their income and to provide them secured tenure to these resources.
- A review of the Fisheries Rules and Regulations and laws applicable to the sector has been carried out, and the Government of Assam proposes to amend the existing legal framework in line with the review recommendations.

Analysis and Outcome

The Assam Agricultural Competitiveness Project (AACP) was initiated with a view to increase the productivity and market access of targeted farmers and community groups. A total worth of `858 crore, which include World Bank credit of \$154 million, was taken up from February 2005. In January 2012, the AACP got an additional financing (AF) of \$50 million from the World Bank. The key indicators of success envisaged as increased yields of crops, fish, and livestock products, complemented by an increase in the proportion of marketed surplus.

The project directly benefitted about 565,745 beneficiaries across sectors like agriculture, fishery, dairy, forestry, and livestock, as against the envisaged 410,000 beneficiaries. Small, marginal, and landless farmers consisted 96% of the direct beneficiaries under the project.

Project activities were grouped into three components—Component1: Investment Grant Scheme; Component2: Agricultural Services and Market Chain Development; and Component3: Infrastructure Development—and implemented by line departments of the state government: Public Works Roads, Agriculture, Fisheries, Animal Husbandry, and Forest, and Assam Agricultural University.



Study Title

Assessment of Pre- and Post-Harvest Losses of Paddy and Wheat in Assam

Implementing Institution

Assam Agricultural University, Agro-Economic Research Centre for North-East India

Project Location/Completion Year

Assam, 2013

Objective

Assess pre- and post-harvest losses of paddy and wheat in Assam

Study Recommendation

- Establishment of post-harvest cooperative farms.
- Construction of common godown.
- Introduction of food grain banks.

Analysis and Outcome

The study was conducted based on primary and secondary information/data. The secondary level analysis was based on the data available in the reports of the Commission for Agricultural Costs and Prices, Department of Agriculture and Cooperation, Government of India, and the data on the Area, production and yields (APY) of the mandated crops (paddy and wheat) published by the Directorate of Economics and Statistics, Government of Assam. For primary level data, two major paddy-growing districts were selected from two different agro-climatic zones. The districts of Sonitpur and Golaghat were selected from the North Bank Plain Zone and the Upper Brahmaputra Valley Zone, respectively. Similarly, two major wheat-growing districts—Morigaon from the Central Brahmaputra Valley Zone and Barpeta from the Lower Brahmaputra Valley Zone—were selected.

Pre-harvest losses are mainly caused by the attack of pest and diseases and the post-harvest losses are witnessed at different stages. Both the losses were estimated in terms of production and productivity of grains for the reference year. In the final analysis, the pre-harvest losses were recorded at 2.49 quintal/ha in the case of paddy and 2.96 quintal/ha in the case of wheat, while post-harvest losses were recorded at 2.55 quintal/ha in the case of paddy and 2.14 quintal/ha in the case of wheat. Total losses stood at 5.04 quintal/ha for paddy and 5.10 quintal/ha for wheat.

On that count, the estimated total losses of paddy and wheat for the state as a whole were worked out as 8.56 lakh MT and 0.20 lakh MT, respectively. This figure could have fed as many as 81.79 lakh people of Assam.

The report provides first-hand information on crop losses particularly of paddy and wheat and helps formulate appropriate policies to reduce the losses in the state.

Study Title

End-Term Evaluation Study/Appraisal in Respect of the Implementation of the Bringing Green Revolution to Eastern India (BGREI) Programme: A Study in Assam

Implementing Institution

Assam Agricultural University, Agro-Economic Research Centre for North-East India

Project Location/Completion Year

Assam, 2012

Objective

Study the implementation of the Bringing Green Revolution to Eastern India (BGREI) programme with respect to Assam.

Study Recommendation

- High potential for both HYV rice and ecology-based hybrid rice is observed.
- Removal of complexity in the procurement of inputs under the BGREI so that it can reach the farmers well on time.
- Timely release of funds for programme implementation; elimination of administrative blockage.
- Regular field visits by the appointed scientists and close monitoring of the activities of the farmers.
- Programme education and training of the farmers.
- Education about MSP and marketing.
- Political interference, especially in selecting the beneficiary farmers, should be discouraged.

Analysis and Outcome

The study was conducted based on primary and secondary information/data. The secondary level analysis was based on the data supplied by the BGREI cell of the Directorate of Agriculture, Government of Assam, while the primary level analysis was based on the information collected from the beneficiary and non-beneficiary farmers belonging to five selected sample districts—Kamrup, Udalguri, Golaghat, Karimganj, and Jorhat.

The study visualizes the impact of these programmes in terms of target and achievement, both physical and financial and productivity level attained by the crops under the clusters of demonstrations. However, the impact of a few activities, namely, asset-building activities and site-specific activities, could not be fully assessed because of the problems inherent to the system itself. Continuous assessment of the programmes undertaken is desired for the successful implementation of the flagship programme initiated by the government.

As of October 2021, the status of implementation of the recommendations is not known or could not be assessed since this is an old study conducted in 2011-12. Output in the form of policy formulation, a research paper has been published. If implemented, it should be followed by better coordination among various government departments, effective coordination among all stakeholders, and a proactive local government.



Study Title

Potential and Prospects of Rabi Crops Cultivation in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2011

Objective

- Provide food and fibres for an expanding economic transformation.
- Provide a direct increase in the rural welfare.
- Additional contributions to development from the agricultural sector are labour force for expanding the industrial sector and a market for the output of consumer goods and production supplies from the expanding industrial sector.

Study Recommendation

- Development of irrigation, dissemination of new technology, assured input supply, and strong marketing support.
- The officials of the state agriculture department and the scientists of the agricultural university should work in tandem to ensure that the fruits of technology reach the farmers at the grass roots.
- Unless farm power develops, agriculture cannot be developed; the scientists should go for location-specific and need-based solutions.

Analysis and Outcome

This study was undertaken with a focus on the potentiality of growing Rabi crops in the state. During monsoon, heavy rainfall causes extensive damage to summer and Kharif crops. Therefore, now the thrust has been shifted to the production of Rabi crops, which can be done in flood-free season. The emergence of Rabi crops is an opportunity to not only enhance production, but also reduce the burden of production loss due to floods. The study highlighted that major thrust should be given on the development of irrigation, dissemination of new technology, and assured input supply with strong marketing support.

In order to achieve the desired level of productivity of Rabi crops, the Government of Assam must create basic infrastructure facilities in coordination with related departments. A selective “area approach” has been considered more effective to consolidate the situation and to boost up the production of Rabi crops. In chronic flood-affected areas, special programmes should be taken up for oilseed, pulses, and summer rice cultivation in the Rabi seasons. It is necessary for the state government to make concerted efforts to bring all the potential areas under Rabi cultivation with suitable adjustment of cropping sequence to attain self-sufficiency in existing food grain production. However, it is desirable to involve the farmers in the decision-making for successful implementation of agriculture development programmes.

As of October 2021, the implementation of the recommendations is not known. Therefore, the impact of the study could not be measured. Thus, a better coordination among various government departments and effective coordination among all stakeholders have been suggested for the implementation of the recommendations. CAUs, SAUs such as the Assam Agricultural University, along other departments are potential agencies to implement the recommendations.

Study Title

Sustainable Agriculture Development through Expansion, Enhancement and Modelling in the State of Mizoram

Implementing Institution

Department of Agriculture, Government of Mizoram

Project Location/Completion Year

Mizoram, 2019

Objective

- Augment the livelihood of rural communities through enhancing resilience of agriculture covering crops, livestock, and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies.
- Demonstrate site-specific technology packages on farmers' fields for adapting to current climate risks. Select promising crop genotypes with greater tolerance to climatic stress.
- Promote the best practices for climate resilience through demonstration in three agro-climatic zones.
- Strengthen infrastructure at Krishi Vigyan Kendras (KVKs) for climatic change research activities; capacity building and training.

Study Recommendation

- Sensitization and capacity building at various levels of implementation.
- Risk mapping within the project boundaries using the various climate scenarios to cover all contingencies.
- Intensive monitoring mechanism and mid-term evaluation missions are proposed to prevent any unnecessary delay.
- Non-conventional energy (biomass gasification) should be made available to all remote locations where power grids are not possible.
- Hydro power and solar energy generation is a must. Mini hydropower plants at many places will have an impact on the local ecosystem and many life forms that add to the rich biodiversity of the state.
- Inclusion of more research works in the development of traditional indigenous rice varieties, e.g. Phulbuh, which have been found to have acclimatized climate change by retaining beneficial genes and enhancing the yield.
- Baseline households survey, finalization, and communication of adaptation interventions for each target community and household.

Analysis and Outcome

The study aims to make agriculture more productive, environment friendly, and sustainable, remunerative at the same time, by efficient use of water, and climate resilient by promoting location-specific integrated/composite farming systems with soil and moisture conservation and management practices. The project also aims to achieve "jhumoptimization" through catchment area protection, soil conservation, and management. The project is proposed to be implemented in four districts of the state, namely, Mamit, Aizawl, Kolasib, and Serchhip.



Study Title

A Study on Agricultural Production of Tripura

Implementing Institution

TSPCB-ENVIS Centre Tripura State Pollution
Control Board

Project Location/Completion Year

Tripura, 2015

Objective

Study the agricultural production of Tripura.

Study Recommendation

By way of suggestion, it has been recommended to educate farmers, introduce new technology, access to market, and improvement of resources, introduce fast track cells for farming.

Analysis and Outcome

The study highlights the challenges faced by Tripura farmers. This includes uncertain weather, uneven water availability, lesser yield, low quality crops, lack of soil nutrients, buyers' monopoly, less cash-in-hand, less scientific guidance during agriculture, less information regarding selection of crop seed, inadequate information of plant root moisture holding capacity, less information of scientific irrigation process for maximum yield, and less awareness of the market and growing technology.

Simultaneously, the study also suggests measures to be taken to make agriculture profitable, including farmers' education, poverty elimination, use of new technology, marketing, improvement in resources, farmers' helpline, partnership with the private sector, etc.

However, whether action taken or not is not known. Institutes like College of Agriculture, Tripura, Department of Agriculture and Farmers Welfare, and other Krishi Vigyan Kendras of the state can take initiative to implement the action plan of the study.

Study Title

Comprehensive Master Plan for Tapping the Export Potential of North-Eastern States

Implementing Institution

Sathguru Management Consultants Pvt Ltd

Project Location/Completion Year

More than one state, 2016

Objective

The primary objective of this project is to identify agricultural products that offer immense potential for improving exports from the NER and thereby prepare a comprehensive action plan to tap the potential.

Study Recommendation

- Focus on pineapple, orange, lemon, and banana as they can be easily promoted on the basis of organic production.
- Invest in awareness creation, training, and capacity building at least for the initial 2 years.
- Establish internal systems in place to expedite “organic certification” process.
- Establish an organic certification agency local to the region.
- Develop infrastructure for the production of organic inputs and promote organizations doing the same.
- Streamline supply chain and reach out to premium international markets.

Analysis and Outcome

This study attempts to understand in detail the bottlenecks that are hindering the progress of the NER and thereby prepare a comprehensive and actionable road map for tapping the export potential of the NER, India. The study has provided strategy and action plan and investments under five different themes to leverage and capture the potentials of the identified produces, namely, leveraging the organic potential; enhancing efficiency of rural supply chains; optimally utilizing huge marketable surplus; improving quality and reaching to international markets; and capacity building and skill development.

For the implementation of the recommendations, the study has identified potential stakeholders for each state. Some of them are NABARD, Assam Industrial Infrastructure Development Corporation (AIIDC), National Horticulture Board, Small Farmers Agri-business Consortium, Manipur Organic Mission Agency (MOMA), Exotic Juices Ltd, Department of Horticulture of the respective states, Nagaland Industrial Development Corporation Ltd, and several others.



Study Title

Impact of Macro-Management of Agriculture Scheme: A Study in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2010

Objective

- Assess the impact of the sub-schemes under the Macro-Management of Agriculture Scheme on the production and productivity of various crops with minimum cost.
- Analyse the impact of efforts made by the state in increasing the seed replacement rates, in terms of ensuring timely availability of good-quality seeds in sufficient quantity.
- Analyse the impact of the activities to promote Balance Integrated Nutrient Management to maintain soil fertility and environment.

Study Recommendation

- It was observed that the schemes were based on the “work plan” of the government, but the study revealed that more emphasis was often put on the targets and achievements without considering the weak points of the schemes and the problems of the farmers.
- These schemes often did not serve the real purpose of the needy farmers.
- Therefore, for making the agricultural development programmes successful in Assam, the development of infrastructure supports is necessary and it also requires efficient planning, monitoring, and sincere execution of the policies by the government agencies to make the schemes viable.

Analysis and Outcome

The study was conducted in the Nagaon district of Assam, which is better developed in agriculture. The field-level data indicated that in spite of efforts under the programme, the impacts were not very encouraging as the economic condition of the sample farmers did not improve as expected. The programme marginally benefitted the sample farmers as the net income after the implementation of the scheme was `728/Ha for ICDP rice and `426/Ha for SDJP jute, respectively, over the income before implementation of the schemes.

It was observed that the schemes were based on the “work plan” of the government, but the study revealed that more emphasis was often on the targets and achievements without considering the weak points of the schemes and the problems of the farmers. These schemes often did not serve the real purpose. The plans and policies of the governments were not good.

So, for making the agricultural development programmes successful in the state, the development of infrastructural support is necessary, and it also requires efficient planning and sincere execution of the policies by the government agencies to make the schemes viable.

Study Title

Performance Evaluation of Pradhan Mantri Fasal Bima Yojana (PMFBY) in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2019

Objective

- Provide financial support to farmers suffering from crop loss/damage arising out of unforeseen events.
- Stabilize the income of farmers to ensure their continuance in farming.
- Encourage farmers to adopt innovative and modern agricultural practices.
- Ensure flow of credit to the agriculture sector, which will contribute to food security, crop diversification, and enhanced growth and competitiveness of the agriculture sector besides protecting farmers from production risks.

Study Recommendation

- Should bring in more transparency in the implementation of the programme.
- Possibility may be explored for further reduction in the existing rate of premium.
- Massive awareness campaign is essential to motivate the farmers to go for crop insurance.
- The number of notified crops may be increased on the basis of area-specific cropping pattern.

Analysis and Outcome

The scheme was implemented in 26 districts of Assam for five notified crops—mustard, potato, summer paddy, wheat, and sugarcane for Rabi 2016–17. The scheme covered 8516 farmers across the districts, of which 8489 were loanee farmers and 27 were non-loanee farmers found in the Goalpara district only. The sum total of the insured area was about 4312.94 hectares.

The flagship programme of PMFBY is yet to acquire the desired momentum in Assam. However, it can be a unique programme to mitigate the plight of hardworking farmers if implemented in the true spirit of the guidelines.

Better coordination among various government departments and a proactive local government will ensure better implementation of the recommendations.



Study Title

Impact of the National Food Security Mission (NFSM) on Input Use, Production, Productivity, and Income in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2015

Objective

- Increasing production of rice through increase in area and productivity.
- Restoring soil fertility and productivity at the individual farm level.
- Enhancing farm-level economy to restore confidence among the farmers.
- Creation of employment opportunities.

Study Recommendation

- Introduction of HYV and hybrid seeds for Boro rice can enhance productivity.
- More demonstration plots for NFSM rice are needed for the farmers to acquaint with the new technology. Timely supply of seeds to avoid delay in sowing and thus loss in production should be ensured.
- For smooth service delivery, the entire responsibility should be entrusted to a separate wing of the state agriculture department to remove all the barriers in the distribution system.
- Ensuring timely availability of fertilizers and other nutrients is a critical component for enhancing productivity and, as such, need more attention.
- A balanced use of plant nutrients with respect to different agro-climatic regions of the state is a must for enhancing the crop productivity without any negative impact on the soil structure.
- Appropriate training programmes for farmers, farm women, seed growers, seed production personals in the public and private seed agencies, and extension functionaries of the state department of agriculture should be well thought of to impart knowledge and necessary skills for hybrid rice cultivation.
- Farmers should have easy access to credit at an affordable rate of interest, whenever necessary.
- The entire marketing system is required to be revamped so that each and every farmer can be an active player in the market for getting remunerative price for their produces.

Analysis and Outcome

The findings of the study show that the NFSM programme has helped the beneficiary farmers in raising their crop productivity and income from crop cultivation.

The implementation of the recommendations given in this study is not known as of September 2021. Therefore, action taken or impact could not be assessed. In this light, there should be better coordination among various government departments, effective coordination among all stakeholders, public-private partnership, proactive local government, enthusiasm from target group (like association), and more engagement of social institutions (like NGOs, SHGs).

The Krishi Vigyan Kendras, NABARD, National Agricultural Cooperative Marketing Federation (NAFED), Food Corporation of India, and other institutions like ICAR, CAUs, and the state's agricultural department and institutions are potential agencies to carry forward the recommendations.

Study Title

Impact of NREGA on Wage Rates, Food Security and Rural Urban Migration: A Study in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2011

Objective

- Measure the extent of manpower employment generated under NREGA, their various socio-economic characteristics, and gender variability in all the districts implementing NREGA since its inception in the selected states.
- Compare wage differentials between NREGA activities and other wage employment activities.
- Know the effect of NREGA on the pattern of migration from rural to urban areas.
- Find out the nature of assets created under NREGA and their durability.
- Identify factors determining the participation of people in NREGA and whether NREGA has been successful in ensuring better food security to the beneficiaries.
- Assess the implementation of NREGA, its functioning and suggest suitable policy measures to further strengthen the programme.

Study Recommendation

- The village administration should be brought down to the taluk level so that all the development programmes under NREGA can reach the villages situated at a distance from the Development Block. The starting of the NREGA programme must have parity with the free time of the farmers so that they can earn some additional income besides crop cultivation.
- The present target of 100 days employment per household should be increased to at least 150 days.
- Wage rate should have parity with outside rate and ongoing price hike, which would reduce the migration of labour from village to nearby township or city.
- Assam has abundant lands lying as cultivable wasteland under some departments. Such lands could be brought under cultivation through the NREGA programme.
- Auditing may be done through an extra-government agency in addition to Gram Panchayats to check mishandling of funds.
- Panchayats should be empowered financially, and job responsibility should be distributed to all the elected members.
- All natural water bodies and forest areas should be brought under the NREGA programme to make them income-generating units.



Analysis and Outcome

The present study was done at the primary and secondary levels. The secondary level analysis comprised 27 districts of Assam, based on the data available on the NREGA website of the state, while the primary level analysis covered only five sample districts: Sonitpur from the northern part, Cachar from the southern part, Dibrugarh from the eastern part, Nagaon from the central part, and Bongaigaon from the western part of the state. The study was done with 250 sample households (200 beneficiary and 50 non-beneficiary households), where 40 households as sample beneficiaries (job card holders) and 10 households as non-beneficiaries from each district.

The NREGA is a new lifeline for the rural people who earn their livelihood as wage earners. It removed the gender difference in wages. It provided hard cash to the needy people, and they were getting an opportunity to purchase other essential items for their food basket.

On the other hand, NREGA had an adverse effect on the availability of labourers for agricultural operations since labourers prefer to work under NREGA on account of less supervision and less work, that too in groups, with some other facilities. In the overall analysis, the study observed that the scheme could not keep its commitment of providing 100 days employment in a year to the rural workers and it failed to create assets, but it seemed to have paid good political dividends for the governments.

As of October 2021, the implementation of the recommendations is unknown and, therefore, measuring the impact does not arise.

Study Title

Impact of Credit on Agricultural Production with Special Reference to Crop Loan and KCC Scheme—
An Empirical Study in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2015

Objective

- Study the schemes in general and their status and pattern of utilization.
- Identify the problems faced by the farmers in obtaining the credit card and also to ascertain the problems, if any, in the flow of agricultural credit by different agencies.
- Examine the impact of economic achievement gained through the utilization of agricultural credit covering the KCC and Crop Loan scheme.
- Assess the recovery status against the scheme.
- Suggest policy implications.

Study Recommendation

- Synchronization of the activities of financial institutes, state department of agriculture, and the loanees is a must for success of the KCC scheme in true sense of the term. (Action: concerned banks and state agriculture department)
- Regular supervision and monitoring on the part of the financial institutes are an action forward to ensure proper utilization of loan obtained against the KCC.
- The agriculture department should be given responsibilities to see whether the borrowers are using the loan properly. (Action: concerned banks and state agriculture department)
- The farmers must be brought under the National Agricultural Insurance Scheme (NAIS) in order to protect them from crop losses on account of biotic and abiotic factors. (Action: State Agricultural Departments and the Ministry of Agriculture and Farmers Welfare, Government of India) Defaulters of loan should be treated as per rules of the land. (Action: concerned bank authority)
- Any bad elements in the system, right from credit sanctioning to credit distribution, should be eliminated and exemplary punishment/penalty should be imposed upon him/her who is found guilty. (Action: concerned bank authority)
- Introduction of proven varieties, provision of adequate irrigation water mechanization of some agricultural activities, and improvement in marketing infrastructure can help the farmers quite a lot to generate more income, thereby making them better off to repay the loaned amount at regular interval. (Action: state agriculture department, state irrigation department)
- Soil Health Cards may be issued to the KCC holders so that they can judiciously use soil nutrients (fertilizer, bio-fertilizer, FYM, green manure, micronutrient, lime, etc.) in the crop fields to raise the level of production and productivity. (Action: state agriculture department)
- The government may come forward to create an authentic database of the farmers with unique identity, which may benefit enormously in the long run during the implementation of the developmental programme meant for the farming community. (Action: state agriculture department)
- Relief may be given to the debt-ridden farmers in terms of interest-free loans at least for a few years. (Action: Ministry of Agriculture and Farmers Welfare, Government of India)
- Extensive capacity-building programmes should be launched to make the farmers aware of the intricacies of modern technology to reap a good harvest for repayment of loan on time. (Action: state agriculture department and Ministry of Agriculture and Farmers Welfare, Government of India)



Analysis and Outcome

The study was undertaken by the centre in the light of the issues identified by the meeting of the CCOS. The synopsis of the study was cleared by the ministry in the middle of 2014. The study refers to the crop year 2013–14. Data for the study include both primary and secondary sources. Six different sample districts—Barpeta, Cachar, Jorhat, Karbi Anglong, Nagaon, and Sonitpur, one from each agro-climatic zones of Assam—were chosen for the study. It covered a total of 300 sample farmers comprising 240 beneficiaries and 60 non-beneficiaries. From each of the sample districts, 40 beneficiaries and 10 non-beneficiaries were selected. The yield rate of all the crops in the Kharif and Rabi seasons in the study area was found to be higher for the beneficiary farmers compared to the non-beneficiary farmers. In case of subsidiary income from various agricultural and allied activities, non-beneficiary farmers surpassed the beneficiary farmers by 2.29%. In case of repayment status, in aggregate 83.33% of the respondents (240) were found under the category of “NPAs,” which is considered to be an alarming problem all around.

Concerning the implementation of the recommendations, it is unknown as of October 2021. Therefore, the impact of the study could not be measured. For the follow-up, it is suggested that there should be effective coordination among all stakeholders and a proactive role of the local government.

Agencies like NABARD, SBI, RRB, and other regional and cooperative banks are potential institutions to carry forward or implement the recommendations.

Study Title

Development of Continuous Wet Cum Dry Grinder for Grinding Waxy Rice for Use in the State of Assam

Implementing Institution

Central Food Technological Research Institute (CFTRI) and TEZU

Project Location/Completion Year

Assam, 2016

Objective

The main objective of the project is to design and develop table-top continuous wet cum dry grinding machines for grinding waxy rice for the preparation of *tilpitha* and other similar traditional sweets produced in the north-eastern states of India.

Study Recommendation

Make available table-top grinding devices for grinding waxy rice. Twenty-one industries have been contacted for commercializing the technology.

Analysis and Outcome

The study has been undertaken to develop an alternative and efficient grinder for waxy rice. Traditionally, in rural areas, for making *tilpitha*, waxy rice is soaked in excess water overnight. The next day, the water is drained and the soaked rice is allowed to surface dry. It is then ground into fine powder by a foot or hand pounder by a traditional device called *dheki*, and the powder is kept pressed and covered with a moist cloth until use. Alternative machines like mixture grinder were not found suitable because the heat generated while grinding destroys the sticky or waxy property of the rice.

The grinder developed under this DST-sponsored project was tested for making *tilpitha*. The changes in the physicochemical properties of the flour in the toasting process were also investigated.

A modern electrical grinder equivalent to a *dheki* was developed. It was observed that grinding of partially wet waxy rice was a real challenge, due to the formation of lumps during grinding. However, partially dried rice can be used for powdering in two stages from coarse to fine. Accordingly, if a table-top grinding device is made available for grinding of waxy rice, it will reduce drudgery on the part of the house wife and impart hygiene in the preparation of *tilpitha*. Further, based on the grinding capacity of the device, the traditional sweet can be produced in large scale for mass feeding.

In the overall analysis, the grinder developed is far superior or efficient than the traditional grinder (*dheki*) or the conventional household mixer-grinder. The machines developed under the project as described in this report have been thoroughly tested for the rated performance and endurance. The machine is covered by an IPR, patent number: 3211Dell12015.

Twenty-one industries have been contacted for commercializing the technology: Akshaya Grinder, TTK Prestige, Crompton Greaves Ltd, Jyoti Mixer, Phillips India Ltd, Butterfly, Usha, Jaipan, Warmex Home Appliance, Anjali Kitchen Ware, V-Guard Industries Ltd, Kovai Lakshmi Grinders, Anjalimix, Ultra Grinder, Havells Grinder, Santosh India, Kenstar, Pigeon, and Kelvinator.



Study Title

Impact of Climate Change with Reference to Low Rainfall on Sustainable Productivity of Pulse Crops in Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2014

Objective

- Study the impact of drought stress on the growth and metabolic aspects of pulse crops commonly grown in Assam.
- Identify potential biochemical and morpho-physiological stress indices in plant types.
- Screen drought-tolerant pulse genotypes for sustainable productivity under changing climatic condition.

Study Recommendation

- Remarkable impact of drought was observed on the biochemical, physiological, and morphological traits of the pulses studied, namely, green gram and black gram.
- The impact of drought was more pronounced in genotype KU 301 and SG 21-5 and higher drought tolerance was observed in T9 and Pratap.
- Leaf water potential, relative leaf water content, leaf proline, chlorophyll, total free amino acid contents, and nitrate reductase activity have been identified as marker traits for selecting drought-resistant genotypes of green gram and black gram.
- The early reproductive stage was found to be the most sensitive period to drought.
- The information can be used for the selection of drought-tolerant genotypes in the course of breeding, and farmers in water-stress region can choose them.

Analysis and Outcome

This study was undertaken to get an insight to gain information on biochemical changes taking place at the cellular level on exposure to various levels of water-deficit stress and its consequent relief in relation with growth rate, chlorophyll content, proline accumulation, nitrate reductase activity, concentration of total free amino acid, flavonoid, soluble protein, and finally the yield in the two major legumes, green gram (*Vigna radiate L.*) and black gram (*Vigna Mungo L.*). The study is perceived to help in developing plant types that sustain their productivity under drought-stress condition.

Blackgram is more tolerant to drought than green gram cultivars. For both the crops, the reproductive stage is most vulnerable to drought than the vegetative stage.

The study can be used for the selection of drought-tolerant genotypes in the course of breeding, and farmers in water-stress regions can choose them.

As of November 2021, only a part of the recommendation is known to have been implemented. The study, being conducted in a general university, did not have direct access to the farmers as an agricultural university would normally have through KVKs. However, the findings from the study have been published.

Study Title

Improvement of *Malbhog* a commercially important indigenous banana of Assam through mutation induction

Implementing Institution

Department of Science and Technology

Project Location/Completion Year

Assam, 2011

Objective

- Mutation breeding for dwarf genotype with more bunches and virus free plants

Study Recommendation

- Stress induction of banana suckers reduced contamination besides stretching inoculation period.
- Gamma radiation is useful physical mutagen that could be utilized for banana improvement.
- Visual screening of morphological symptoms for viral infection in the field for *Malbhog* banana is possible. If any virus-infected symptom in the banana leaves is observed in a garden/plantation it should be avoided as explants source for further propagation to avoid viral contamination.

Analysis and Outcome

Banana can be found in abundance in Assam mainly due to its fertile soil and favourable climatic conditions. Almost every household has one or two banana trees in their backyard. The farmers of Assam also cultivate bananas commercially due to its high profitability.

Malbhog is a medium tall, most preferred indigenous table banana variety (AAB genomic group) of Assam that bears fruit in 18 months, yields about 8-9 kg per bunch and is prone to disease infestation and pest attack. Banana bunchy top virus has threatened banana propagation, field production and germplasm conservation. This study aims to identify and establish virus free *Malbhog* germplasm bank. These materials would be useful as explant source for micro-propagation of virus free quality planting materials.

Gamma irradiation of in vitro raised micro shoots causes damage to the DNA strands in various locations depending on the dose exposed and radio sensitivity of the tissues. Simultaneous de novo DNA repair mechanism does not fully restore the original nucleotide sequences resulting a numbers changes in the DNA strand. The plantlets regenerated from the tissues containing altered DNA strand show a number of variation in morphology and reproduction. Some of this variation may be of commercially useful and some of research interest for breeding programme. Over and above this study provides a number of mutants of which some could be utilized for commercial gain.

Agencies responsible for implementation:

- Department of Agriculture & Horticulture, Govt. of Assam.



Study Title

Climate-Smart Agriculture: Impact Assessment of Technology Demonstrated under NICRA Project in Ri-Bhoi District of Meghalaya

Implementing Institution

Krishi Vigyan Kendra, Ri-Bhoi ICAR Research Complex for NEH Region

Project Location/Completion Year

Meghalaya, 2018

Objective

The objective of the integrated livestock cum fish farming system is to produce an optimum level of phytoplankton, zooplankton, and bacteria, which are protein-rich natural feed for fish by livestock excreta.

Study Recommendation

- Mechanization of agricultural operations through custom hiring centres.
- Timely availability of inputs and climate-resilient technologies.
- Soil-test-based farming.
- Increased awareness through various training programmes and extension activities.

Analysis and Outcome

Under technology demonstration, the KVK, Ri-Bhoi demonstrated the interventions according to the potential climatic vulnerabilities of Ri-Bhoi district: jalkund, vermi-composting units, in-situ moisture conservation in ginger, off-season vegetable production under low-cost poly house, backyard poultry farming with improved germplasm of Vanaraja poultry birds, scientific composite fish culture, improved shelter for animals and introduction of improved breeds of pigs and goats, oyster mushroom production, and integrated farming system under the National Innovations in Climate Resilient Agriculture (NICRA) project.

The present report emphasized the impact of climate-resilient technologies demonstrated at the NICRA village. Significant difference of cropping intensity through crop diversification during Kharif, Rabi, and summer seasons resulted in income savings of the NICRA beneficiaries. The yields of all the crops demonstrated at NICRA farms increased. This might be due to the implementation of climate-resilient improved varieties tied with better water and healthy soil management practices. Mechanization of agricultural operations through custom hiring centres, timely availability of inputs and climate-resilient technologies, soil-test-based farming, increased awareness through various training programmes, and extension activities might be the reasons for the significant findings of the study. All these findings exhibited an encouraging impact of the demonstrated technologies on the farmers' lives at the NICRA village.

Study Title

Mapping of Pork Value Chain Actors in Selected Districts of Assam

Implementing Institution

International Livestock Research
Institute

Project Location/Completion Year

Assam, 2018

Objective

- Provide background information about the piggery sector with focus on the status and dynamics of pig population and pork production for both the state of Assam and the APART districts.
- Identify and map market actors, including input suppliers, producers, pig and piglet traders, and butchers/pork retailers in the selected clusters of each APART district and establish linkage among the market actors.

Study Recommendation

- When performing APART interventions (conducting training to value chain actors), contiguous villages within a cluster should be prioritized, followed by villages at a distance from the cluster of villages.
- Those villages having the highest number of breeding farms should be prioritized for organizing training to comply with APART objectives. APART villages with a good number of butchers and traders should be prioritized as they may have a strongly established marketing network for the pigs and piglets.
- This will help achieve the training targets of all value chain actors. Among the APART clusters, those clusters having conducive socio-political situations should be prioritized over those that might have disturbed socio-political situations.
- The clusters or villages of conducive institutional environments should be taken up under the priority list. One may also consider the suitability of road infrastructure and environmental factors to realize a higher participation rate in the training intervention.

Analysis and Outcome

The pig sub-sector makes important contributions to livelihoods, nutrition, and the economy. However, traditional management practices continue to dominate the production system. This study identifies and maps, along with the background information, the market actors, including input suppliers, producers, pig and piglet traders, and butchers/pork retailers in the selected clusters of each APART district and establish linkage among the market actors.

To provide a more in-depth understanding of the pork production system and related issues, FGDs were conducted in almost 90% of the selected cluster villages in each district. Information regarding the remaining 10% of villages was obtained through either KIIs or FGDs by convergence.

Recommendations have been provided for each district according to the findings. As of November 2021, some recommendations have been implemented. Because of financial, administrative constraints and slow progress of field work during COVID-19, there was no sufficient time to measure the impact. The findings reveal that household women are more involved in piggery; therefore, it has been suggested to select at least 50% beneficiary from women. The study further suggests a better coordination among various government departments, effective coordination among all stakeholders, proactive local government, enthusiasm from target group (like association), more engagement of social institutions (like NGO, SHGs), and adequate financial allocation for greater impact of the study.



Study Title

Study and Action Plan on Post Bird Flu Scenario of Poultry Sector in Assam

Implementing Institution

FARMER (Fellowship for Agri Resource Management and Entrepreneurship Research)

Project Location/Completion Year

Assam, 2010

Objective

Analyse the events of bird flu outbreaks and their containment operation, and also their impact on poultry farmers in Assam.

Study Recommendation

- Conducting economic impact assessment of avian influenza control measures taken up in Assam to determine social and economic intervention priorities.
- Development of a dynamic database of the poultry sector of Assam and launching of a dynamic website for the sector of Assam.
- Revise and strengthen the compensation and rehabilitation programme, especially targeting the rural poor backyard farmers where most of the bird flu outbreaks were reported. This is to bring in effective containment operation on one hand and sustain livelihood of the rural poor on the other.
- Extensive awareness programmes at all levels are recommended to avoid the lack of coordination and delayed containment operation in the case of future bird flu outbreaks.

Analysis and Outcome

The study was on rapid appraisal of the poultry sector of Assam post 2008 outbreak of Highly Pathogenic Avian Influenza in Assam. FARMER (Fellowship for Agri-Resource Management and Entrepreneurship Research), a prominent socio-economic development, non-profit, non-governmental organization in the field of agriculture and allied sectors for the North-Eastern Region, the study.

The report has been prepared by analysing and collating information gathered through various focused group discussions, personal interviews, and direct observations. Information and statement from published documents by various national and international organizations are used wherever felt necessary.

The goal of the strategies adopted to combat bird flu is to prevent the spread of virus from infected premises (bio-containment) and the exclusion of infectious agents from the uninfected premises (bio-exclusion). Appropriate infrastructure and active participation of the different value chain actors in the national programme are prerequisites to achieve this goal. The strategies should be prepared based on the local wisdom and from the "bottom up" rather than the "top down", involving all stakeholders in the value chain. Based on the learnings from the fields, the study team put forward the above-mentioned recommendations and action plan for the effective containment of bird flu and business continuity in the poultry sector of Assam vis-à-vis North-Eastern India.

For the implementation of the recommendations, the proponent state, i.e. Assam, is responsible, and therefore the impact of the study could not be assessed. Departments or organizations like the ASCAD (Assistance to States for the Control of Animal Disease), ALPCO (Assam Livestock and Poultry Corporation Ltd), Central Disease Diagnostic Laboratory (CDDL), and NIV (National Institute of Virology) are capable institutions to implement the recommendations.

Study Title

Study of Due Diligence in the Value Chain: Livestock and Honey for the State of Meghalaya

Implementing Institution

NR Management Consultants India Pvt Ltd
(NRMCI)

Project Location/Completion Year

Meghalaya, 2018

Objective

Study the existing productivity of livestock (namely, dairy, piggery, and poultry) and honey in Meghalaya, and suggest measures to increase productivity

Study Recommendation

Under livestock, dairy, piggery, and poultry are covered. Separate recommendations have been made for each sector. The overall recommendations are as follows:

- Increase productivity.
- Produce or find alternative locally available feed.
- Replace with or use improved breed or seeds.
- Proper management and training.
- Establish cooperatives.

For honey or apiculture, the following recommendations have been made:

- Need to have a critical number of organized producers.
- Popularize bee keeping as a source of supplementary income generation activity in the state. A communication strategy targeting the educated youth should be devised.
- The focus of trainings should also be on improving the packaging of honey and making it more hygienic.
- A branding strategy should be devised for the honey produced in the state.
- Consumer education campaigns on promoting branded honey should be undertaken.

Analysis and Outcome

The study was completed using a mix of secondary review and primary data collection. The secondary review comprised analysis of relevant documents of the state and central government departments, ICAR institutions, NGOs, and other donor agencies working in the domain of the two sectors.

The above-mentioned recommendations were given from the study. For implementation, the NEDFi has been directed to work with the concerned state Meghalaya.



Study Title

Poultry Sub-sector in Meghalaya: A Review

Implementing Institution

Institute of Livelihood Research and Training

Project Location/Completion Year

Meghalaya, 2016

Objective

- Understand existing players and their practices/contribution for improvement in the sub-sector activities.
- Assess the gaps that are preventing effective performance with specific reference to the primary producer.
- Recommend implementable solutions to enhance the stake of primary producers in the sub-sector.

Study Recommendation

- The study recommends that traditional poultry farming needs immediate support of vaccination, deworming, and basic management improvement on the technical side of things.
- Produce and/or procure (poultry disease) vaccination and develop a cadre of vaccinators to provide door-step vaccination services to poultry farmers.
- Establish decentralized mini-hatcheries and village-level (poultry egg) incubators to accommodate poultry farmers' choice of birds and sustain diversity.
- Promote vendors for quality chick supply.
- Develop and standardize a package of practice for backyard poultry through amalgamation of traditional practice with modern poultry management.
- Train a cadre of livestock nursing and management professional through short- and long-term courses.
- Involve private players and work on the PPP model to strengthen broiler poultry farming.
- Promote village-based learning groups (similar to farmer field schools) to promote inter-learning of poultry farmers.
- Organize poultry farmers of the state into village- and cluster-level associations to strengthen business linkage.

Analysis and Outcome

The purpose of undertaking this study is to assess the opportunities to bring local communities into the fold of the sub-sector, so that the sub-sector gets strengthened and the livelihood choices are enhanced. The analysis focuses on eliciting the information on the (a) existing practices by different players at each level, (b) gaps, and (c) opportunities for interventions.

The traditional poultry farming needs immediate support of vaccination, deworming, and basic management improvement on the technical side of things. Poultry farmers aspire to keep highly productive coloured breed suitable for their backyard farming system with reduced mortality. Broiler and kuroiler farming can go hand-in-hand, but backyard desi poultry farming will remain in domination since it has been a traditional practice with smallholders.

Study Title

Baseline Study on Impact Assessment of Artificial Insemination in Pigs in Nagaland

Implementing Institution

International Livestock Research Institute

Project Location/Completion Year

Nagaland, 2018

Objective

- Understand the baseline status of pig production and management systems in Nagaland.
- Understand the baseline status of pig breeding and breeding services in Nagaland.
- Examine the technical, infrastructural, logistic, knowledge and attitudinal, and socio-economic factors that may influence the adoption of artificial insemination of pigs in Nagaland.

Study Recommendation

Introduce artificial insemination (AI) for smallholder pig farmers in Nagaland state.

Analysis and Outcome

The study provides the baseline status of pig farmers in the north-eastern state of Nagaland, including Dimapur and Phek districts. The farmers in Dimapur represent the larger farming community of the lowland areas of the district, while the farmers in Phek represent the farming community of the hill zone of the state. The results are a comparative assessment of the various farm and farmer characteristics between the two districts. The analyses of the primary data collected from the two districts draw conclusions and make recommendations for the introduction of artificial insemination (AI) to smallholder pig farmers in Nagaland state.

As of November 2021, part of one recommendation has been implemented. The reason being inadequate availability of pig semen straw and poor interest of the pig farmers to adopt AI technology. Marginal impact was observed on employment generation, income generation, access to resources, livelihood improvement, productivity, and skill development. Effective coordination among all stakeholders, a proactive local government, enthusiasm from target group (like association), more engagement of social institutions (like NGOs, SHGs), availability of quality pig semen locally full implementation of the recommendations.



Study Title

Pig Breeds, Breeding Systems and Supply and Demand for Genetic Materials in Nagaland, India

Implementing Institution

International Livestock Research Institute

Project Location/Completion Year

Nagaland, 2017

Objective

Depict different information on pig breeds and their distribution, supply to and demand from smallholders of genetic materials.

Study Recommendation

- **Improvement in germplasm quality:** The quality of boar and boar services need to be improved. A subsidy is needed for boar keepers to get good breeding boar with performance testing.
- **Improvement in germplasm accessibility:** Establishment of artificial insemination (AI) stations, both government and private.
- **Implementation of policies supporting and controlling pig breeding units and breeding operations:** Policies for encouraging and managing AI stations and boar services need to be implemented, also with financial support for high-quality breeding boars.
- **Policy in using breeding boars, both for artificial insemination and natural mating is required:** Conservation programmes be implemented in remote areas for local breeds; meat from these animals at a premium price. A certification system should be implemented step by step for better-quality breeding boars and sows for organized farms.
- **Improvement in breeding knowledge:** Training courses for key farmers as village veterinary workers on breed selection and breeding practices—including performing AI, disease treatment, and castrating pigs—need to take place for the availability of breeding services in villages.
- **Improvement in market linkage:** Short food supply chains of cross-bred pork/pigs and high price niche markets for specialty local pork with the formation of smallholder cooperatives of pig breeders and producers are suggested.

Analysis and Outcome

The study focuses on the mapping of pig breed types, identification of a breeding system, and supply and demand of breeding materials in Nagaland.

Given that a large number of piglets were locally supplied, only a small volume from breeding farms. Therefore, it is difficult to identify and control the quality of pigs. The establishment of great-grandparent, grandparent, and parent stock herds should be considered. The roles of breeding farms, both governmental and private sector with financial support, should be enhanced to improve the quality and quantity of breeding pigs. Enhancing the linkage of breeding units (government and private sector, from state to communal and village levels) is required. A programme making improved pig germplasm available for smallholders via the introduction of quality pig germplasm has been initiated by the ICAR under the Mega Seed Project on Pig at Nagaland through artificial insemination techniques.

Study Title

Availability and Nutritional Value of Wild Forages as Feed for Pigs and Mithun in Nagaland, India

Implementing Institution

International Livestock Research Institute

Project Location/Completion Year

Nagaland, 2015

Objective

Promote smallholder farmers to effectively incorporate locally available feed resources in the feeding regimes of their pigs and mithun by knowing the nutritional value and presence or absence of anti-nutritional factors in the different forages.

Study Recommendation

- Plants having higher levels of total phenolic compounds need to be assessed for their nutraceutical effects.
- The study concludes that all the tested forages available in the forests can be promoted among farmers for their use.
- Some of the promising species such as *Colocasia spp.*, *Debregeasia longifolia*, *Ficus hispida*, and *Trema orientalis* can also be cultivated in the backyard/homestead depending on the availability of space.

Analysis and Outcome

The study aims to promote smallholder farmers to effectively incorporate locally available feed resources in the feeding regimes of their pigs and mithun by knowing the nutritional value and presence or absence of anti-nutritional factors in the different forages. The study was carried out in four selected districts of Nagaland representing different altitudes, such as Mokokchung (low altitude), Wokha (medium altitude), Kohima and Tuensang (high altitude) in two seasons (July–August and January–February).

Most of the plants analysed were found to contain CP ranging from 6.61% to 29.97%. Neutral detergent fibre (NDF) and acid detergent fibre (ADF) are observed to be 55.15% and 37.97%, respectively. In-vitro organic matter digestibility (IVOMD) in selected forages was observed to vary between 46.78% and 66.52%. The total phenolic compounds (tannic acid equivalent) and cyanogenic glycosides content found to vary between 0.59–31.46% and 0.003–0.059%, respectively. The cyanogenic glycoside was observed only in 3.9% of the forages.

All the tested forages available in the forests can be promoted among farmers for their use. Some of the promising species such as *Colocasia spp.*, *Debregeasia longifolia*, *Ficus hispida*, and *Trema orientalis* can also be cultivated in the backyard/homestead depending on the availability of space.



Study Title

Pig Production, Management and Marketing in the North-East Indian State of Nagaland

Implementing Institution

Nagaland Empowerment of People through Economic Development

Project Location/Completion Year

Nagaland, 2010

Objective

- Establish the baseline conditions for pig management, production, productivity, and marketing in Nagaland.
- Establish the determinants of pig productivity.
- Determine the areas of intervention to enhance pig production, productivity, management, and marketing improvement.
- Determine the interventions for gender-related issues in pig-owning households.

Study Recommendation

Capacity building and improved access to services will need to be stepped up.

Analysis and Outcome

The Nagaland Empowerment of People through Economic Development-Sir Ratan Tata Trust (NEPED-SRTT) livelihood framework for the state of Nagaland through community-based piggery project addresses some of the basic constraints that limit the productivity and profitability of piggery. The study was conducted in four districts of Nagaland-Mokokchung, Wokha, Phek, and Kohima. A total of 253 households were interviewed, 116 selected randomly in project villages and 76 selected randomly from control (non-project) villages. Sixty-one households were breeder or propagation households already selected by the project.

Farmers kept different pig breeds. Fifty-four percent of the households kept the large black pig breed, 21% kept the indigenous/local breeds, and 13% kept the cross breeds. The main practice was sty feeding. The majority of the farmers housed their pigs all the time. The most common diseases and parasites affecting pigs were worms and swine fever across all households. More women were involved in feeding and cleaning the pigs while men were involved in medication and marketing. The total mean income for the four districts was `46,260.

This report provides the baseline situation of pig production, management, and marketing in Nagaland. The project interventions are timely. The improvement in housing, adoption of improved breeds, and improvement in feeding practices, which are the key interventions of the project, have shown that the project had a positive impact on productivity as measured by the number of piglets per sow.

Study Title

Study of Due Diligence in the Value Chain: Livestock and Honey for the State of Tripura

Implementing Institution

NR Management Consultants India Pvt Ltd
(NRMCM)

Project Location/Completion Year

Tripura, 2018

Objective

Study the existing productivity of livestock (namely, dairy, piggery, poultry) and honey in Tripura, and suggest measures to increase productivity.

Study Recommendation

Under livestock, dairy, pork, and poultry are covered. Separate recommendations have been made each sector. The overall recommendations are follows:

- Increase productivity.
- Produce or find alternative locally available feed.
- Replace with or use improved breed or seed.
- Proper management and training.
- Establishments of cooperatives.

For honey or apiculture, the following recommendations have been made:

- Need to have a critical number of organized producers.
- Popularize bee keeping as a source of supplementary income generation activity in the state. A communication strategy targeting the educated youth should be devised.
- The focus of trainings should also be on improving the packaging of honey and making it more hygienic.
- A branding strategy should be devised for the honey produced in the state.
- Consumer education campaigns on promoting branded honey should be undertaken.

Analysis and Outcome

The study was completed using a mix of secondary review and primary data collection. In Tripura, 159 value chain actors under livestock and 36 under honey were covered as part of the study, and interactions were held with officials of the Animal Resource Development Department (ARDD) and other officials from NABARD, biotechnology, ICAR institutions, and externally funded JICA project.

The overall sectoral impact of Animal Resources Development Department (ARDD) can be seen in the improved per capita availability of milk and the self-sufficiency achieved in meat. The total milk production in Tripura is not sufficient to meet the demand, and packaged milk and milk powder imports supplement local production. The honey sub-sector in the state is dominated by the unorganized sector players. Of the total production in the state, around 70% is sold as unprocessed/wild honey as it fetches a higher price, between ₹450/kg and ₹600/kg, compared to the price offered by TKVIB to the producer, which is ₹369/kg.

Specific recommendations have been given for each sector. In a follow-up implementation survey of the recommendations, it has been directed that the executing agency's role only upto submission of the report after which the implementation of the recommendations lies in the hands of the concerned state.



Study Title

Innovative Pig Development Project for North-East (IPDPNE) under National Livestock Mission

Implementing Institution

Department of Animal Husbandry and Dairying, Govt. of India

Project Location/Completion Year

More than one state, 2017

Objective

Increase the meat production per animal; cross breeding with imported germplasm is the key, which would at the same time help in increasing the farmers' income.

Study Recommendation

- Grandparent stock/germplasm of high merit value. These would be bred in nucleus farms across the eight states to produce grandparent stock/parent stock. These grandparent stocks/parent stocks produced are then to be reared and bred in multiplier farms with the intention of providing exotic parent stock and cross-bred stock to the farmer, entrepreneur, cooperative societies, etc. and also the boar stock for liquid semen processing laboratory.
- Type of breed recommended to import for each state is given: Hampshire or Large Black for the states of Arunachal, Assam, Manipur, Meghalaya, Nagaland, Sikkim.
- Large White Yorkshire for the states of Mizoram and Tripura.

Analysis and Outcome

It is envisaged to increase the available pig meat production by upgrading the earmarked population of nondescript pig through exotic germplasm by natural service and artificial insemination through liquid semen. Accordingly, it is envisaged that with the implementation of the IPDPNE, there will be an advantage of higher population of high genetic merit animals coupled with increased farmer income per animal and at the same time addressing the meat demand of the region.

Study Title

Incidence and Impact of Classical Swine Fever on Smallholder Pig Production Systems in North-East India

Implementing Institution

International Livestock Research Institute

Project Location/Completion Year

More than one state, 2012

Objective

Estimate incidence and impact of classical swine fever (CSF) among smallholder farmers in the North-East India.

Study Recommendation

- Development of the existing pig enterprises such providing proper feed and management practices, financing, and development of infrastructure.
- Capacity building of farmers through trainings. The government should urgently develop a CSF control programme.

Analysis and Outcome

The study was a preliminary participatory epidemiological study aimed at collating information on the incidence and impacts of classical swine fever (CSF) from farmers and a few key informants in the North-East India.

The study observed that many husbandry and behavioural practices need to be corrected, such as the use of untreated leftover food as pig feed, free ranging/tethering, selling off sicklings, etc. Farmers spent up to \$450,000 to treat the animals that contacted the disease, yet their uncoordinated interventions did not help in controlling such a trans-boundary disease that has high incidence and morbidity rates. Farmers in the area also incurred huge costs from mortality and productivity losses, and the government should urgently develop a CSF control programme.

Agricultural institutes such as the ICAR along with veterinary departments of the districts can play a crucial role for the effective management of piggeries in North-East India.



Study Title

Market Analysis of Bamboo Products in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2020

Objective

- Study the potentialities of bamboo products in Assam.
- Study the National Bamboo Mission (NBM) programmes in Assam.
- Find out the marketing channels of bamboo products in the sample districts.
- Identify the critical issues encountered by the producers in the marketing of bamboo products and suggest ameliorative policy measures.

Study Recommendation

- Proper promotional campaigns should be undertaken to make the artisans educated and aware of various schemes and programmes launched by the government, extending loans at concessional rates, etc.
- Continuous research and development efforts must be undertaken for the modernization of product processes and upgrade of techniques to meet the changing requirements of customers.
- The state and central governments should exempt bamboo products from excise duty and other taxes to promote their export.
- Adequate infrastructure facilities are prerequisite for any development process. As such, facilities like transport, communication, and power supply can give a boost to the livelihood of bamboo artisans.

Analysis and Outcome

The study included 160 bamboo artisans and 20 wholesalers of bamboo items in the Jorhat and Sivasagar districts of Assam. The findings of the study show that there lies an immense potential of growing bamboo plantation in Assam and so is the future of bamboo products. A comprehensive approach with a restructured NBM, ably supported by government policy, is a must for the growth and development of this sector. The critical issues as encountered by the bamboo artisans are needed to be addressed through government intervention, which may include market intelligence, market support, and an efficient price mechanism. A concerted effort, if made and executed in the true sense of the term, can open up a new vista for bamboo craft in Assam, which in turn will uplift a large chunk of people in terms of income and employment.

As of September 2021, the implementation of the recommendations is not known because it is not the responsibility of the agency; therefore, the impact of the study could not be assessed. If implemented, the study recommends a better coordination among various government departments, effective coordination among all stakeholders, public-private partnership, proactive local government, enthusiasm from target groups (like associations), and more engagement of social institutions (like NGOs, SHGs). The Cane and Bamboo Technology Centre, NEC, North-East Cane and Bamboo Development Council, National Rural Bamboo Mission and Research Institute, etc., have been identified as potential agencies for implementation.

Study Title

Bamboo Resource Mapping for Six Districts of Nagaland using Remote Sensing and GIS

Implementing Institution

North-Eastern Space Applications Centre,
Department of Space, Government of India

Project Location/Completion Year

Nagaland, 2010

Objective

Identify the bamboo-growing areas of the six districts of Nagaland, accordingly the statistics generated only for bamboo areas of the state.

Study Recommendation

Estimated bamboo-growing areas are: Mon—5681.4 ha, Longleng—2174.79 ha, Mokokchung—12155.78 ha, Wokha—15888.35 ha, Dimapur—2672.20 ha, and Peren—2578.63 ha.

Analysis and Outcome

The work was taken up by the North-Eastern Space Applications Centre (NESAC), Umiam with the specific request from the Nagaland Pulp and Paper Company Ltd (NPPCL), Tuli, Nagaland for mapping the bamboo-growing areas of six districts, namely, Mon, Longleng, Mokokchung, Wokha, Dimapur, and Peren of the state.

The total bamboo-growing area in the six districts of Nagaland is estimated as 41,151.15 ha as compared to the total geographic area of 849,600.00 ha of the districts. Wokha district has the largest share, i.e. 9.89% of the total geographic areas covered under bamboo followed by Mokokchung (7.52%) and Longleng (3.87%), Dimapur (3.29%), and Mon district (2.63%).

The study, per se, does not provide any recommendation. However, it is observed that Bamboo forestry has significant impact on the employment, income, livelihood, access to resources, etc.



Study Title

Desk Study on the Bamboo Sector in North-East India

Implementing Institution

International Bamboo and Rattan
Organisation/The Energy and Resources
Institute

Project Location/Completion Year

More than one state, 2016

Objective

Provide an overview of the bamboo sector for the region and best practices in the sector.

Study Recommendation

- There is a lack of consistent and reliable data on almost all aspects of bamboo, i.e. area, production, consumption, and trade. This gap has implications for planning and development of the sector in the region.
- An appropriate coordination of stakeholders in the bamboo sector at structural and implementation levels is not in place. Various stakeholders ranging from national to local level work for the development of the bamboo sector in the NER but hardly collaborate on their activities.
- Address existing extra-sectoral and sectoral issues that plague the growth of the bamboo sector, such as infrastructure, connectivity, skilled labour, and credit facilities. Important sectoral issues are low productivity, discouraging policies and tax structure, lack of technical know-how and innovation, and poor awareness and access to markets.
- Analysis of case studies indicate for urgency or need, compliance with market requirements, ease of the technology, appropriate institutional model and finance scheme, professional and strategic guidance and support, and access to information, to be essential for initiatives to be successful and that the government can play a crucial role to kick-start and take bamboo entrepreneurship forward.

Analysis and Outcome

The study is based upon many secondary data available in different literature or sources. It is observed that the North-Eastern Region (NER) is the "Bamboo hub" of India as it covers 28% of the geographical area and 66% of the growing stock of bamboo in the country. Arunachal Pradesh, Manipur, and Mizoram are the leading bamboo states with a large area under bamboo and substantial growing stock. Mizoram and Manipur have the largest area under pure bamboo brakes. The region has a stock of 62.5 million tonnes of green culms and 11.69 million tonnes of dry culms, and is rich in bamboo biodiversity as well. Out of the 29 genera and 148 species found in the country, 16 genera and 89 species are found in the NER. In addition, it is observed that bamboo constitutes an integral part of the socio-cultural and economic life in the NER. Bamboo is used for food, energy, house making, agriculture, and various other purposes. There is no current reliable data available on the annual harvest of bamboo from the region. However, as estimate of keeps between 5 and 8 million tonnes (dry weight) annually.

The National Bamboo Mission (NBM) under the Ministry of Agriculture is one of the main stakeholders promoting bamboo development activities across the country. At the regional level, MDoNER and NEC can carry on this mission. The Advanced Research Centre for Bamboo and Rattan (ARCBR), Aizawl, the Rain Forest Research Institute (RFRI), Jorhat, and the North-East Centre for Technology Application and Research (NECTAR), Shillong, can provide support to the development of the bamboo sector.

Study Title

Decent Work for Tea Plantation Workers in Assam: Constraints, Challenges, and Prospects

Implementing Institution

Tata Institute of Social Sciences,
Guwahati Campus

Project Location/Completion Year

Assam, 2019

Objective

- Examine the work and employment of tea plantation workers from the decent work perspective in terms of employment and income opportunities.
- Explore the vulnerabilities of workers across gender (men/women), age groups (child/adolescent/adult), and nature of employment (seasonal/contractual or permanent).
- Analyse the future of tea plantations, plantation workers, and their alternative livelihood options.
- Identify factors, constraints, and enablers that can facilitate the improvement of work and living conditions of tea plantation workers.

Study Recommendation

- The industry needs to work on the social upgrade of workers by strengthening welfare mechanisms, increasing wage, implementing proper statutory and non-statutory benefits under PLA and agreements, and reducing power relationship between management and labour and sardar and labour, rather than focusing solely on economic aspects.
- Cash-in-hand depends on the number of work days and overtime by the factory workers and the extra green plucked by the garden workers. This large share of workers in the negative wage gap category could be an indication of the huge discrepancy between the actual in-hand cash that a worker receives and the quoted wage rate in the payslip.
- The estate work is strictly timed, and payment is based on performances, which often leads workers to face wage cuts, more expenses on health, education, and house repairing.
- Workers should receive a “living wage” along with proper non-cash benefits and welfare services, which can help them achieve “decent living conditions”. This is so because unlike other work, plantation economies dwell heavily on labour for quality tea.

Analysis and Outcome

The study aims to examine the work and employment of tea plantation workers from the decent work perspective considering employment and income opportunities, rights at work, nature of employment, social protection, and social dialogue across gender, age groups, and so on. Second, it intends to highlight the future of plantation workers, prospects, and the way in which work and living conditions can be improved with the help of effective realization and intervention, both from the top and bottom.

The study strongly recommends that the government should take over the employers’ portion of contribution to the provident fund (PF) for a period of at least 3 years. Second, the study prohibits the expansion of tea areas. Third, the government should provide substantial funds for the generic promotion of tea in India. Fourth, a minimum reserve price for tea must be fixed based on the cost of production.

A study like this brings to light the problems faced by labourers, which are often ignored, suppressed, and unaddressed. Simultaneously, it provides remedial actions that need to be taken to improve the livelihood of this category of people.



Study Title

Study of Assam Tea Value Chains

Implementing Institution

Bureau for the Analysis of Societal Impacts
for Citizen Information (BASIC)

Project Location/Completion Year

Assam, 2019

Objective

The objective of this study commissioned by Oxfam and conducted by BASIC is to unpack the pricing of Assam tea and the distribution of value share across the whole supply chain, from large tea estates (plantations) and small tea growers in Assam to consumers in six different countries.

Study Recommendation

In essence, the study did not come up with any recommendation. Nevertheless, the prices and costs levels and trends calculated in this study provide a first comprehensive evaluation and a sound basis for discussion among actors and stakeholders of each of the value chains analysed.

Analysis and Outcome

This study is secondary research based on information from different literature and data sources. In the current scenario, the available data on value transition along the tea value chain are discrete and inadequate to connect the dots and understand the percentage of margins earned by each stakeholder for every cup of tea consumed by a consumer in the domestic and international markets. The study sought to understand “how has the distribution of value along tea value chains changed over the last 10–20 years, and why?”

The study did not come up with any recommendation; therefore, the question of implementation and measuring of impact does not arise. Nevertheless, the prices and cost levels and trends calculated in this study provide a first comprehensive evaluation and a sound basis for discussion among actors and stakeholders of each of the value chains analysed.

Study Title

Improving Conditions in Tea Plantations in Assam

Implementing Institution

Fairtrade International

Project Location/Completion Year

Assam, 2017

Objective

- Provide an overview of the sector, covering the main market actors, the supporting functions and rules that determine the performance of the market system.
- Conduct a rapid assessment of the main system level constraints and critical issues facing the tea industry in Assam, focusing on how the system impacts the poor, analysing points of influence with tea players and prioritize the most significant of these challenges.
- Suggest recommendations and potential interventions that could address these challenges at scale and in a sustainable manner.

Study Recommendation

- Increase worker productivity in tea plantations.
- Improve working conditions for workers on tea plantations.
- Improve income for communities living on tea plantations.
- Improve living conditions for workers and communities living on tea plantations.

Analysis and Outcome

This study aims to understand and analyse the key working and living conditions as well as challenges on and around plantations, and develop a set of recommendations. Field research took place on three Fairtrade-certified estates in Assam. These are large plantations that rely on a significant hired labour component to function. The programme intends to be reached beyond the present study field.

The study observes that a slow-down in growth in export markets, static tea market prices, increasing plantation costs, climate change, and poor labour productivity have all contributed to low investment by estates in wages and living conditions.

To address the constraints identified, potential intervention areas have been recommended. These cover increasing the adoption of good practices and products in worker management and health and safety; increased consumer and industry communication; industry coordination and collaboration; and increased income-earning opportunities for workers and residents.



Study Title

Stories Behind a Hot Cup of Assam tea: Listening to the Voices of Women Labourers in the Tea Gardens

Implementing Institution

Dibrugarh University

Project Location/Completion Year

Assam, 2017

Objective

- Understand the quality of life of tea garden workers through a socio-economic survey and suggest policy interventions.
- Examine gender dimensions in the tea plantations.
- Understand and reconstruct the history of women workers in tea gardens.
- Create an Oral History Archive for the voices of women workers in teagardens.

Study Recommendation

- The Plantations Labour Act 1951 and The Assam Plantation Labour Rules 1956: State intervention and probe to secure the interests of workers in the tea gardens.
- Increase the wages of workers, since the daily wage of ₹126 is found to be inadequate and insufficient for the daily sustenance of workers.
- Medical benefits should be provided to casual workers irrespective of their payroll.
- Maternity benefits with wages should be granted to both permanent and casual women workers. Pre-delivery maternity leave with wages must be granted to women.
- Toilet facilities must be provided in the plantation sites of the tea gardens, since it has been found that the absence of toilets has subjected women to vulnerable diseases such as urinary tract infections, reproductive tract infection, etc.
- To facilitate and promote the education of children in the gardens, the study recommends the need for more intervention by the state and tea companies.
- Workers should be provided with awareness programmes on gender issues and structures to eliminate the social constructions of patriarchy, violence, sexual division of labour, and other such gender constructs.

Analysis and Outcome

An improved socio-economic condition of workers is imperative for the well-being of workers. The well-being could fundamentally be achieved by taking into account the aforesaid recommendations of the study. Further, severe lack of awareness of rights and benefits is predominantly found among workers, which henceforth is found to be the major cause of exploitation of workers. Therefore, the study urges the need for state interventions. Further, the study finds the need for an integrated approach of government, management, workers unions, local bodies, voluntary organization, and women organization, for ensuring and safeguarding the rights and interest of workers.

Study Title

Feasibility Study for Oil Palm Cultivation in Bodoland Territorial Council Area of Assam, India

Implementing Institution

ICAR-Indian Institute of Oil Palm Research,
West Godavari District, Andhra Pradesh

Project Location/Completion Year

Assam, 2016

Objective

Examine the possibility of oil palm cultivation in the four districts of Bodoland Territorial Council in Assam

Study Recommendation

The team recommends the feasibility of oil palm cultivation in all the four districts of Bodol and Territorial Council in Assam, namely, Kokrajhar, Chirang, Baksa, and Udalguri.

Analysis and Outcome

A feasibility study was undertaken to examine the possibility of oil palm cultivation in the four districts—Kokrajhar, Chirang, Baksa, and Udalguri—of Bodoland Territorial Council (BTC) in Assam, situated in the north-eastern part of India.

A team of scientists visited all the four districts of BTC during November 2016, surveyed the areas, and interacted with the officials of the state department of agriculture, and other scientists and officials of agricultural institutes, and obtained information about the geography, climate, land use pattern, soils, climates, and cropping patterns of the farmers of the area. Soil and water samples were collected from different places in the BTC areas for analysis. The study recommends the feasibility of palm oil cultivation in the study area.

As of November 2021, the study recommendation has not been implemented. If implemented, the project will have high employment generation, women empowerment, income opportunity, improve livelihood, and increased productivity.

Technical feasibility was submitted to DAC&FW, New Delhi, which is the implementing agency. No fund assistance was received from DAC&FW.

For effective implementation, effective coordination among all stakeholders is suggested.



Study Title

A Type Study Report on the Economic Activities of Small Tea Growers in Assam

Implementing Institution

Directorate of Economics and Statistics,
Government of Assam

Project Location/Completion Year

Assam, 2015

Objective

- Conduct a survey to depict a picture of green leaf production, land-holding status, and number of small tea growers in Assam.
- Determine the status of the workforce, income, expenditure, and other socio-economic conditions of the small tea growers in Assam.

Study Recommendation

- The government needs to make sincere efforts and look into concerning land ownership and see small tea gardens as a new development initiative for the state.
- Landownership problems can be solved by minimizing the problem of finance.
- For the promotion of the tea industry of the small tea growers, the cooperative system of plantation can be promoted for better earning and production of the small tea growers. The MSP of the agricultural production of the small tea growers can be incorporated in support of their protection for the minimum return.
- The Tea Board of India, Tea Research Authority, and corporate tea producers should take the responsibility to train different aspects of tea plantation to the small tea growers.

Analysis and Outcome

This study was conducted on small tea growers (STGs) in 14 major tea-growing districts under the 13th Finance Commission Grants milestones. The study is significant as special emphasis is given to know about the economic activities of the STGs of Assam. No study of this kind has been done earlier.

The above recommendations have been given from the study. It is expected that the results of the study will go a long way in strengthening the database pertaining to the estimation of SDP in Assam besides other academic uses.

Study Title

Study on Contributing Factors of IMR and MMR in Tea Gardens of Assam 2015 Phase II

Implementing Institution

Regional Resource Centre for North-Eastern States, Ministry of Health and Family Welfare, Government of India, Guwahati

Project Location/Completion Year

Assam, 2015

Objective

- Assess the tea garden hospitals in terms of infrastructure, human resources with training, availability of different services with diagnostic facilities, equipment and drugs, etc.
- Assess the service delivery outcomes of tea garden hospitals.
- Assess the behaviour of pregnant mothers towards ANC, delivery, PNC, referral transport, and immunization.

Study Recommendation

- Make available trained manpower for providing health-care services.
- Keep proper records for case management, baseline data, and the performance of the facility.
- Train the available manpower, both in health-care delivery services and record keeping.
- Make robust IEC initiatives at the tea garden areas, targeting mainly the illiterate people for promoting healthy behaviour.
- Tea gardeners are advised to replace salt with jaggery or sugar while consuming red tea.
- Involve the tea garden hospital staff in the VHND.
- The tea garden management should support ASHA for providing their support to the beneficiaries.
- The tea garden authority should encourage the involvement of ASHA in tea garden areas. There should be relaxations for pregnant women and mothers with babies to avail ANC, PNC, and immunization services.
- Tea gardens with more female workers must create a creche where children upto 5 years can be kept.

Analysis and Outcome

This study was undertaken to assess the root cause of high maternal and infant deaths in the tea garden areas of Assam. In this second phase of the study, 400 tea gardens were covered, of which 390 tea gardens were surveyed. Ten tea gardens could not be surveyed due to some unavoidable circumstances. These 390 tea gardens were spread out in 16 districts of Assam. The target groups for the study were the tea garden hospitals and mothers who delivered a baby in the last 1 year during the survey period (October 2015 to December 2015).

Of the surveyed tea gardens, only 281 (72%) gardens have hospitals of their own, out of which 76 (around 27%) have a labour room. Of the available labour rooms, only around 63% are functional. Shortage of staff in the health sector of Assam is a big issue, which is also true for tea garden hospitals. Of the 281 health facilities, only 11 specialists (medicine or surgeon or O&G) are available in eight health facilities. In 91 facilities, general doctors (allopathic) are available. In addition, 40 facilities have weekly visiting doctors.

The respective health departments of the districts and health-care units like ASHA would play a crucial role in reducing the death rate among women and children. In addition, education and literacy programmes, health and nutrition awareness programmes should be conducted on a regular basis. The state government must improve the health infrastructure facilities in the tea garden areas.



Study Title

Mapping of Informal Dairy Value Chain Actors in Selected Districts of Assam

Implementing Institution

International Livestock Research
Institute

Project Location/Completion Year

Assam, 2018

Objective

- Give the background of the dairy sector of the state with a focus on the status and dynamics of bovine population and milk production for the state of Assam and in the project districts.
- Identify and map various market actors, including input suppliers, producers, traders/vendors, processors, and distributors in the selected clusters in each project district and establish linkages among the market actors.
- Give district-specific recommendations based on the findings of the primary survey in the project districts.

Study Recommendation

The study has given specific district-wise recommendations. While targeting for interventions under the Assam Agri-business and Rural Transformation Project (APART), various operational factors may be considered. These factors are presence of minimum number of value chain actors, flow of milk among the market actors, geographical proximity between clusters/villages (in the interest of clubbing two or three contiguous clusters/villages), access to inputs and veterinary services, presence of entrepreneurs, socio-political situation of the clusters, institutional environment, and infrastructure (e.g. roads). The clusters favoured by the presence of these factors should be prioritized in organizing training to value chain actors to obtain a better training outcome.

Analysis and Outcome

The study shows a macro-picture of the bovine population and milk production scenario of the state and in the project districts followed by a detailed analysis and presentation of the primary information gathered through the Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) in each cluster villages of the project districts.

Out of the total of about 0.22 million households in the APART cluster villages, 0.13 million households (almost 57%) own at least one dairy animal. The milk production across the APART districts is 0.36 million litres. Almost 53.53% of the total milk produced comes from the improved animal stock of the APART districts.

While targeting for interventions under the APART project, various operational factors may be considered. These factors are presence of minimum number of value chain actors, flow of milk among the market actors, geographical proximity between clusters/villages (in the interest of clubbing two or three contiguous clusters/villages), access to inputs and veterinary services, presence of entrepreneurs, socio-political situation of the clusters, institutional environment, and infrastructure (e.g. roads). The clusters favoured by the presence of these factors should be prioritized in organizing training to value chain actors to obtain a better training outcome.

There are several unions and cooperatives such as the District Milk Producers Cooperative Union Ltd (DMU), and other dairy cooperative societies, which can play a crucial role in the respective areas with the support of the Animal Husbandry and Veterinary Department, Government of Assam.

Study Title

Assessment of the Status of Dairying and Potential to Improve The Socio-Economic Status of the Milk Producers and Convergence of all Central and State Schemes at District Level in Assam

Implementing Institution

Project Location/Completion Year

Assam Agricultural University, Agro-Economic Research Centre for North-East India Assam, 2017

Objective

- Assess the present status of dairying with reference to animal distribution, milk production, consumption, and marketable surplus.
- Identify the constraints in dairy development from supply side, institutional deficiency, and processing infrastructure.
- Identify different central and state government schemes related to dairy development at the district level and document technical as well as operational details of the schemes and understand how convergence is ensured.
- Highlight the facilitating factors that could help promote dairy development to improve the socio-economic status of the milk producers.

Study Recommendation

- Prioritize the strategies for dairy development in the State Plan.
- Introduce an adequate number of cross-bred cows to accelerate and sustain production.
- Improve the genes of indigenous milch animals.
- Revive non-functional milk unions, such as EAMUL in Jorhat and CAMUL in Silchar.
- The Animal Husbandry and Veterinary Department should take up programmes for enhanced fodder production throughout the state.
- Establish cooperatives and strengthen market linkages.
- Properly monitor and implement dairy schemes/programmes.
- Provide assistance to breeders in terms of education or training, providing subsidies and insurance to cattle.
- Establish laboratories for testing and quality control.
- Improve accessibility to institutional credit; lower interest rate for loans.

Analysis and Outcome

The status of dairying in Assam is far from satisfactory in terms of production and coverage despite the fact that there lies enormous potential, which remains unrealized till date. Once the problems and difficulties encountered by all the stakeholders are addressed, a new vista would open for dairy development in the state of Assam. The development of dairy farming on a sustainable basis through the optimum utilization of natural resources, adequate health-care facilities for livestock, improvement of breeding programmes through artificial insemination, improvement in the present milk-marketing system, and timely vaccination can go a long way in bringing marked changes in the lives of the milk producers of this part of the country.

The implementation of the recommendations of the study is not known as this responsibility lies in the hands of the project proponent. For effective implementation of the recommendations, the following measures have been suggested: better coordination among various government departments; effective coordination among all stakeholders; public-private partnership; proactive local government; enthusiasm from target group (like association); and more engagement of social institutions (like NGOs, SHGs).



Study Title

Study on the Behaviour Biology of the Stored Grain Pests in Godown of Manipur and Their Control Measures Using Plant Extracts

Implementing Institution

DM College of Science

Project Location/Completion Year

Manipur, 2015

Objective

- Study the major and minor insect pests found in the storage godowns of Manipur.
- Record the seasonal fluctuations of storage pests.
- Study the effect of environmental conditions on the growth rate of stored grain pests.
- Evaluate the efficacy of certain plant extracts on the biology of these pests.
- Suggest suitable methods for improvement in storage conditions for the management of stored grain pests.

Study Recommendation

- The results suggested the possibility of using the powder of the following plants as toxicants, repellents, and antifeedent agents against the stored grain pests: *Zanthoxylum acanthopodium*, *Melia azedarach*, *Azadirachta indica*, *Phlogacanthus thysiflorus*, *Parthenium hysterophorus*, and *Vitex trifolia*. Leaves of all these plants possessed a strong pungent smell, which acts as pest repellent.
- The insecticidal effect of plant powder might reduce insect movement and also cause death through occlusion of their spiracles, thereby preventing respiration via trachea. *Z. acanthopodium*, *M. azedarach*, *A. indica*, *P.thysiflorus*, and *P. hysterophorus* powder showed effectiveness against different stored grain pests.

Analysis and Outcome

The investigations were carried out to study the biology of stored grain pests and their control measure using different medicinal plant powders on stored grain under laboratory condition. Studies were also conducted to investigate the seasonal incidence of stored grain pests in different districts of Manipur, to study the major and minor insect pests of storage godown in Manipur, to evaluate the efficacy of certain plant extracts on the biology of these pests, and to suggest suitable methods for improvement in storage condition for the management of stored grain pests.

The study suggests the use of dry leaves of *Z. acanthopodium*, *M. azedarach*, *A. indica*, *P.thysiflorus*, *P. hysterophorus*, and *Vitex trifolia*.

Z. acanthopodium and *A.indica* powder was found to be effective as grain protectants, oviposition deterrent, and suppressor of adult emergence. The test plants, being medicinal, would yield environmentally sound chemicals having no harmful effects on the non-target organisms.

The study did not present any recommendations; however, a project like this is highly essential for pest control and, thus, improvement in the economic conditions of the poor farmers of Manipur who produce the life-sustaining food for the whole state. The study also suggests that there should be better coordination among various government departments in case the findings are implemented.

Study Title

Evaluation Study on Public Distribution System (PDS) in Meghalaya State

Implementing Institution

AMC Research Group Pvt Ltd

Project Location/Completion Year

Meghalaya, 2012

Objective

- Assess the efficiency of the delivery system, including the mechanism built up for monitoring transparency and accountability.
- Assess the impact of the scheme on the objective of attaining food security to the poor and the factors, if any, constraining the desired impact.
- Suggest corrective measures to improve the performance of PDS, viability of fair price shops (FPS), and its implementation.

Study Recommendation

- All the fair price shops have to be opened during working hours till stock exhausted. Supply officials must carry out regular checking of stocks at FPS.
- The role of vigilance committee should be more transparent, accountable, and responsible. A round-the-clock control room must be set up under PDS for grievance redressal.
- FPS should concentrate on non-controlled articles and those articles should be competitive enough in attracting the consumers.
- The supply of food grains at the government-prescribed rates and quality to the identified beneficiaries should be ensured.
- All the FPS should use electronic weight machines instead of manual weighting.
- The awareness of beneficiaries towards PDS is highly necessary to get cent per cent results.

Analysis and Outcome

This study tries to unravel different issues with regard to quality implementation of public distribution system (PDS) in the state of Meghalaya.

The study observed that there are a lot of constraints and loopholes at different levels of the scheme to achieve the desired objectives. The state government has not made any effort to procure food grains at the remunerative MSP besides rice and wheat. It has completely neglected the production of millets or coarse grains like potato, maize, soybean, mustard, pulses, etc., which are used by the tribal people.

The stakeholders involved in the process of execution, monitoring, and distribution are not aware of the objectives of the system. A majority of the stakeholders at different levels are ruled by their own discretions instead of policy guidelines. Continuous violation of the policy guidelines has been observed in some areas.



Study Title

Report on Crop Disease and Pest Survey in Dimapur and Peren Districts of Nagaland

Implementing Institution

Nagaland University

Project Location/Completion Year

Nagaland, 2014

Objective

Study diseases and pests of two major crops, namely, rice and maize in Dimapur and Peren, Nagaland

Study Recommendation

- More comprehensive survey of crop pests and diseases on economically important crops in Nagaland under open as well as protected cultivation.
- Monitoring and surveillance of important diseases and pests.
- Promotion of biocontrol agents for pests and diseases.
- Sensitization and awareness generation among growers on disease and pest problems.
- Conducting on-farm training and demonstration on crop protection measures.
- Promotion of cultural methods of plant protection.
- Promotion of concept of integrated method of pest and disease management.
- Use of safer plant protection chemicals at least for valuable crops.
- Give impetus to the production of resistant varieties through a plant breeding programme.
- Screening of available local germplasm for the source of resistance to important diseases and/or pests.

Analysis and Outcome

The study has revealed low-to-medium occurrence of plant diseases and medium-to-high occurrence of insect pests in both the districts. Based on the survey result, it can be concluded that the crops in the two districts are affected by a number of diseases and insect pests. Though the incidence of diseases ranged from low to medium, the damages by insect pests were significant in many crops.

During the survey, it was felt that there is a need to intensify the training of farmers on crop management practices and have access to scientifically improved inputs. Insect pest management should be seriously considered.

The knowledge on the occurrence of diseases and pests will help in reducing the crop loss and allow increasing crop yield with timely intervention. In this direction, it is pertinent to suggest that surveys should be conducted periodically to gather information on the dynamics of diseases and pests and their spread.

Study Title

Plantation of Elephant Food Plants and Natural Barrier Plants

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2015

Objective

- Reduce human–elephant conflict and continue the plantation activity (mainly elephant food plants).
- Protect the existing elephant habitat by avoiding deforestation (through mass awareness among the community) and spread the message to neighbouring areas where human–elephant problem is a serious issue.

Study Recommendation

Involve a larger section of the society rather than working in isolation. These steps will help conserve the Asian Elephant population and will reduce the loss and damage to crops and properties of villagers.

Analysis and Outcome

This programme was undertaken to preserve and conserve Asiatic Elephants facing existential threat due human activities. The goals were to restore the natural habitat and elephant food plants.

At the initial period of the project, a survey was carried out on the availability of elephant food plants in the elephant habitat of the project site. It was found that few elephant food plants were available and were also in a degraded condition, which required immediate conservation initiatives. Considering the importance of conservation and the involvement of local communities, awareness programmes were organized. As a result, the communities of those areas came forward and started cultivation of those plants.

A total 6100 elephant food plants, including herbs, shrubs, and trees, and 8000 natural barrier plants were planted in the project areas.

The actions taken resulted in decreased elephant raiding in the crop fields and villages of the project area. In the Chakrapani, Goleboka, Nichimpur, and Parogaon villages, elephant raiding was nil.

For a sustained benefit of the programme actions, close working with the village panchayats has been recommended.



Study Title

Development of an Orange Harvester

Implementing Institution

North-Eastern Regional Institute of
Science and Technology

Project Location/Completion Year

Arunachal Pradesh, 2013

Objective

- Improve the design of existing orange harvesters.
- Evaluate improved orange harvesters in actual field condition.
- Compare the performance of improved harvesters with traditional methods and others orange-harvesting equipment.

Study Recommendation

- Large-scale demonstration of the harvesters developed in various orchards of Arunachal Pradesh.
- Collection of feedback and suggestions for further modification.

Analysis and Outcome

The study relates to orange farmers in Arunachal Pradesh. The study was necessitated to develop tools to increase the efficiency of orange harvesting and to ease the physical strain on orange cultivators. Three harvester models were developed to overcome the shortcomings in the Falcon FPFC-228 model. After testing each new model in an actual field, the third model DM3 was finalized.

The DM3 model has its own drawbacks, but its overall performance is better than the other developed models.

A study like this would ease or reduce the burden or physical strain on the farmers and thus improve efficiency and increase productivity.

Study Title

A Comprehensive Study on Cold Storage Facilities vis-à-vis Potatoes in Assam

Implementing Institution

North-Eastern Development Finance Corporation Ltd (NEDFi)

Project Location/Completion Year

Assam, 2019

Objective

- Know the production trend of potatoes, including baby potatoes, in Assam.
- Know the current capacity and status of functioning of existing cold storages in the state with regard to potato.
- Forecast the requirement of cold storage facilities for potatoes in Assam, based on the demand and production of potatoes/seed potatoes in the state and in addition to import from outside the state to ensure availability of potatoes in the markets round the year with steady price realization by farmers.
- Identify prospective location for setting up of new cold storage facilities for potatoes, if warranted.
- Study the existing regulations related to the storage and marketing of potatoes and suggest enabling policy measures required, if any.

Study Recommendation

- Capacity building of the farmers will play the key role in increasing the level of production and productivity of potatoes in the state.
- Notify a nodal agency/department to monitor the establishment and operations of cold storages in the state, and create a geo-spatial database of all cold storages.
- Cold storages need to be established in the higher potato-growing geographies on priority.

Analysis and Outcome

The study attempts to know the issues from the potatoes farmers' point of view as regards production-related problems with more focus on post-harvest, storage, and marketing.

The study found no correlation between the locations identified for setting up cold storages and the level of production of potatoes in the district or catchment area of production belts. Therefore, it may not be feasible for farmers at the individual level to utilize cold storage spaces for better price realization, unless the government takes measures to form clusters of potato growers.

Innovative options—cool chambers of 10 MT capacity, solar-powered cold storage, and zero-energy cool chambers—can be explored as per necessity and feasibility and may be as initial demonstration under government finance.



Study Title

Baseline Data on Area, Production, and Productivity of Horticulture Crops in North-East and Himalayan States: A Study in Assam

Implementing Institution

Project Location/Completion Year

Assam Agricultural University, Agro-Economic Research Centre for North-East India
Assam, 2013

Objective

- Collect data on area, production, and yield of horticultural crops and compare with the baseline data collected by the Department of Horticulture, Revenue Department, and Directorate of Economics and Statistics.
- Identify the horticultural crops on which proper data are not being compiled at present among the selected states.
- Study the problems encountered by the grass-roots officials while collecting horticultural data.
- Identify the problems in the estimation of horticultural crops and to suggest policy measures.

Study Recommendation

- Establishment of a full-fledged horticulture department in Assam.
- A prescribed format for individual farmers covering all aspects of horticulture to facilitate the process of data collection by different agencies.
- A strong mechanism should be in place to have better coordination among the agencies like NSSO and other government departments.
- Involve the local farmer(s) or panchayat representative(s) with concerned agencies for better result.
- Provide funds to the departments to meet the increasing expenses to cover village survey and collection of data.
- Training of officials on scientific data collection/management.
- Conduct awareness programmes to educate the farmers on the importance of book-keeping.

Analysis and Outcome

This study was undertaken to address the serious problem concerning the reliability of data on the horticulture sector, which is one of the most critical requirements to facilitate systematic policy analysis and planning exercise. The discussion and analysis of data clearly indicate that multiple agencies are involved in the horticulture baseline data collection/generation process in Assam. But no systematic and accurate estimates of the area and production of different horticultural crops are available. The estimates made by various agencies also vary considerably. Each agency has its own methodology, often resulting in variations in the data besides the problems of revision and time lag. Further, only a few crops could be compared in this study due to the non-availability of data from the agencies.

From the ongoing analysis, it has emerged that there should be close cooperation among the data-collecting agencies involved in the field of horticultural crops, with the involvement of local bodies like Gaon Panchayats. The agencies must follow standardized/uniform methodologies for data collection so that marked variation and duplication can be avoided to a great extent. All the departments concerned should maintain a fully functional statistical and monitoring cell to keep track of the data collection process with appropriate statistical tools. Also, there is an urgent need for continuous updating of the "Chitha" book to document accurate data from the actual field.

Action taken in this direction can go a long way in formulating workable plans and implementing horticultural development schemes for the improvement of the state economy.

Study Title

Studies on Pesticide Residues in Major Commercial Vegetables of Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2012

Objective

- Monitor the compliance of major commercial vegetables grown in different agro-climatic zones of Assam to the maximum residue limit (MRL) of pesticides as specified in the Food Standards Code.
- Study the effect of different processing methods/decontamination processes of major commercial vegetables for the removal of the pesticide residues.
- Generate and maintain up-to-date information on pesticide residues and to provide guidelines in this regard to research and extension workers in Assam.

Study Recommendation

- Almost all the major vegetables collected from different agro-climatic zones of Assam were below the maximum residue limit (MRL) of pesticides as specified in the Food Standards Code.
- The vegetables clearly showed marked decrease in pesticide residues upon processing.

Analysis and Outcome

Vegetables constitute a major part of our daily diet. To meet the demands of the market, they are produced commercially at an enormous scale. Farmers resort for many different options available for growing; one of them is using fertilizers and chemicals, including pesticides. This study tested the compliance of major commercial vegetables grown in different agro-climatic zones of Assam to the maximum residue limit (MRLs) of pesticides as specified in the Food Standards Code, the effect of different decontamination process, etc.

The study indicates that the vegetables tested were below the maximum residue limit (MRL) as specified in the Food Standards Code. The vegetables clearly showed a marked decrease in pesticide residues upon processing.



Study Title

Impact of Emerging Marketing Channels in Agriculture-Benefit to Producer-Sellers and Marketing Costs and Margins of Orange and Potato in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2011

Objective

- Estimate the share of the farmer in the consumer rupee in emerging marketing channels vis-à-vis the traditional marketing channels.
- Estimate the degree of market efficiency and incidence of post-harvest losses in emerging marketing channels vis-à-vis traditional channels.
- Study the superior market practices and services provided by different agencies in the emerging marketing channels vis-à-vis traditional marketing channels.
- Study the constraints faced by the farmers and different market functionaries in the emerging marketing channels vis-à-vis traditional marketing channels.

Study Recommendation

- There is an urgent need to establish cold storage facilities at the assembling market places (Attention: Directorate of Horticulture, Government of Assam and Assam State Agricultural Marketing Board).
- It is also a necessity to develop the road communication system to facilitate the transportation of marketable goods to the places of assembling and marketing centres. To provide minimum road communication facilities, link roads should be built to connect a cluster of villages growing orange and potato crops having marketable surplus. (Attention: PWD, Government of Assam).
- The growers of orange and potato may be encouraged to adopt some measures for value addition, including grading and standardization of the produces according to size, shape, and degree of ripeness/maturity. (Attention: Directorate of Horticulture, Government of Assam and Assam State Agricultural Marketing Board).
- There is urgent necessity of establishing processing units in the areas producing surplus fruits.
- The market information and market news may be linked with agricultural extension services, adult literacy centres, and Gaon Panchayats to educate the poor illiterate farmers.
- State governments should be empowered to enact pricing policies to fix minimum prices for the principal horticultural crops in the state.

Analysis and Outcome

The study attempted to estimate the costs and margins of producers and buyers and to study the degree of market efficiency, constraints faced by the farmers and other market functionaries in traditional marketing channels (TMCs) and emerging marketing channels (EMCs) of agriculture in Assam. The study was based on a sample of 200 households, of which 100 were under EMCs and the rest were under TMCs. The secondary data were collected from various sources, including the National Informatics Centre and other state/district-level published government sources for the chosen districts—Tinsukia and Nagaon.

The study expected to fill an important gap and throw new light into the problems of orange and potato cultivation in the state, especially in finding marketing and its policy implications. The approach pleads for making an operational plan to promote agricultural development in general and orange and potato cultivation in particular along with efficient marketing. Translating this policy into a programme of action requires resource mobilization, infrastructure development, people's awareness, and supportive/administrative services. The implementation of the provisions of the Agricultural Produce Marketing Committee (APMC) Act is at the infant stage in Assam. Assam is yet to reap the benefits of the emerging market. However, an attempt has been made in this report to highlight the existing EMCs vis-à-vis TMCs in the state.

The current status of the recommendation is not known as of October 2021, and therefore the impact of this study cannot be assessed or measured. For the implementation, the study suggests coordination among various government departments; effective coordination among all stakeholders; public-private partnership; a proactive local government; enthusiasm from the target group (like association); more engagement of social institutions (like NGOs, SHGs).



Study Title

Potato Production, Marketing, and Utilization in Meghalaya, India: Results of a Value Chain Assessment

Implementing Institution

Food Resilience through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific (FoodSTART+)

Project Location/Completion Year

Meghalaya, 2017

Objective

- Collect and collate the data on various aspects of potato production, marketing, and utilization at the regional and national levels.
- Describe existing market chains for potato in the various seasons.
- Identify the benefits of market participation of potato producers, especially food-insecure households.
- Map potato value chains and characterize the actors.
- Examine how the value chain is organized, coordinated, and governed among the key actors.
- Determine profit and marketing margins obtained by actors along the value chain.
- Identify problems, bottlenecks, and opportunities in existing and novel market chains based on the perceptions of different groups of chain actors and stakeholders.
- Identify potential innovations for piloting in Root and tuber crops (RTC) value chains relevant to food security and equity, as well as efficiency and competitiveness.

Study Recommendation

- Options for increasing the supply of and farmers' access to high-quality seeds of modern varieties to improve the seed value chain.
- The potato value chain could also be improved through better post-harvest handling, quality control mechanisms, and the use of proper storage.
- Opportunities for improved potato marketing includes providing market intelligence to farmers to help stabilize prices, building the marketing and entrepreneurial capacity of farmers, identifying processing options, and developing a branding strategy for Meghalaya potatoes to market to other states. All these can be done through better collaboration between farmers, other value chain actors, and government agencies.

Analysis and Outcome

This study was conducted in late 2016 with the overall objective of characterizing the entire potato value chain in Meghalaya, including input supply, varied distribution over seasons, production, and marketing; and identifying major constraints and areas where interventions could significantly increase the returns of potato producers. This study followed a value chain analysis approach and involved cross-sectional data collection among a range of stakeholders and value chain actors through review of secondary data, key informant interviews, FGDs, and surveys.

The per capita availability of potato in the state is almost 80 kg per annum, more than four times the national average, indicating that it is an important food crop in the state. This is partly due to the fact that potatoes can be grown in Meghalaya during most of the year in four distinct seasons, unlike other parts of India where it is a seasonal crop. This enables potatoes to be sold at premium prices outside Meghalaya.

Study Title

Development of Low-Cost Value-Added Processed Products from Squash (*Sechiumedule*) and Dissemination of Technology to the Tribal Women of West Garo Hills District of Meghalaya

Implementing Institution

Central Agricultural University

Project Location/Completion Year

Meghalaya, 2016

Objective

- Analyse the nutritional composition of the raw *Sechiumedule* vegetables.
- Develop and standardize value-added products from raw vegetables (following value-added products are developed and standardized).

Study Recommendation

The project developed products like squash badi, mixed squash and vegetable pickle, squash and mango pickle and studied their storage and quality. Studies show that all these products can be stored without affecting their quality for a period of one year. Besides these products, squash momo, squash and chicken momo, squash paratha, and squash pakora were developed, which were much appreciated.

Analysis and Outcome

The study focuses on increasing the utility of the raw vegetable squash (*Sechiumedule*) and develop value-added products from it with low input technology. Squash is an important vegetable grown by a large number of people in Meghalaya. It is a member of the Cucurbitaceae family, but unlike other members, it has not been exploited for the development of value-added products.

The scope of the study confines not only laboratory investigations but the whole tribal community. The study warrants a multi-disciplinarian approach with the biochemists to identify the nutritional components of the raw vegetables, develop and standardize new value-added products, and study the impact of processing techniques and storage time on the quality of the products, and most importantly the extension specialists to disseminate the developed technologies to the tribal population and provide them proper training and evaluate the developed techniques in field conditions and further popularize the techniques by various instructional devices.

Involvement of the farming community was there from the inception of the project. When the concept of the project was conceived, discussions were held with villagers in general and women groups in particular. Besides, other stakeholders like different government organizations and non-government organizations were also contacted to ascertain the utility and feasibility of the project.

The project has developed products like squash badi, mixed squash and vegetable pickle, squash and mango pickle and studied the storage and quality. Studies show that all these products can be stored without affecting quality for a period of 1 year. Besides these products, squash momo, squash and chicken momo, squash paratha, and squash pakorawere developed, which were much appreciated.

Thus for the implementation is full and saw a very high positive impact.



Study Title

Areca Nut Sub-sector in Meghalaya: A Review

Implementing Institution

Institute of Livelihood Research and Training

Project Location/Completion Year

Meghalaya, 2014

Objective

- Understand the existing players and their practices/contribution for improvement of the sub-sector activities.
- Assess the gaps that are preventing to perform effectively with specific reference to the primary producer.
- Recommend implementable solutions to enhance the stake of primary producers in the sub-sector.

Study Recommendation

- Credit support system to help farmers in distress.
- Bringing farmers together both for collective bargaining and cross learning is essential for their development.
- A project-based approach for improving the production of areca nuts with specific outputs.
- Redefining the role of the horticulture department, especially with entrepreneurs, to train and supply materials to them.
- A greater support during post-harvest is required.
- Investment in training and infrastructure for making arecaleaf to encash the economic value of the sheath attached to the arecanut leaves.

Analysis and Outcome

The study is a livelihood mapping of areca nut potential sub-sector in Meghalaya. The core idea of undertaking this sub-sector study is to assess the opportunities to bring local communities into the fold of the sub-sector, so that the sub-sector gets strengthened and the livelihood choices are enhanced.

The study observes that farmers in Meghalaya do not use any inputs such as manures or fertilizers or pesticides, and other than intercultural operations, no other crop husbandry practices are followed.

The trading scenario in Khasi and Jaintia Hills seems to be supportive to farmers, whereas in Garo Hills, traders dominate the market leading to losses to farmers. Particularly in Garo Hills, both farmers and processors of supari require credit support, which shall provide them a boost so that distress sales of farmers and credit-based system of processors could be avoided. Meghalaya is a fertile ground to take up interventions in improvement of areca plants in the organic way as pesticides and fertilizers are still alien to this land. Bringing farmers together both for collective bargaining and cross learning is essential for their development. A project-based approach for improving the production of areca nuts with specific outputs would support the farmers and processors in a big way. In terms of post-harvest intervention, significant improvement in price realization can be achieved by aggregation, sorting, and grading raw and soaked/fermented nuts and feeding it into the existing value chain players.

As of September 2021, only part of a few recommendations has been implemented. The study further suggests for a better coordination among various government departments, coordination among all stakeholders, public-private partnership, and enthusiasm from target group (like association).

Study Title

Sub-Sector Study of Orange in Meghalaya

Implementing Institution

Institute of Livelihood Research and Training

Project Location/Completion Year

Meghalaya, 2014

Objective

- Understand existing players and their practices/contribution for improvement in the sub-sector activities.
- Assess the gaps preventing effective performance with specific reference to the primary producer.
- Recommend implementable solutions to enhance the stake of primary producers in the sub-sector.

Study Recommendation

- There is need to closely integrate extension and advisory services of the department with the suppliers of planting and plant protection materials.
- A systematic study, including quantitative and qualitative aspects of orange sub-sector, will generate information that can then be fed into an institution design process and shape the broad parameters of an organization that will promote the interests of orange growers.
- The involvement of the organized private sector is almost miniscule in the orange sector in Meghalaya both in volume and product range.
- Undertaking these processing activities is best done by competent private-sector players who not only have the wherewithal to estimate supply and demand conditions but also be more efficient in setting up units that will optimize the supply and demand opportunities.
- Branding and marketing efforts through the Meghalaya Trade Promotion Organization (MTPO) targeted at institutional buyers will also ensure sustainable production and cash flow estimation for orange grower associations in the state.

Analysis and Outcome

The study assessed the opportunities to bring local communities into the fold of sub-sector, so that the sub-sector gets strengthened and the livelihood choices are enhanced. The current value chain situation is quite elementary and poorly evolved. The study pointed out the lack of an integrated approach to input supply. There is need to closely integrate the extension and advisory services of the department with the suppliers of planting and plant protection materials. The study deals with the absence of persistent and consistent hand-holding support to the farmers when a new package of practices is introduced. A systematic study, including quantitative and qualitative aspects of the orange sub-sector, will generate information that can then be fed into an institution design process and shape the broad parameters of an organization that will promote the interests of orange growers. The involvement of the organized private sector is almost miniscule in the orange sector. Branding and marketing efforts through the Meghalaya Trade Promotion Organization (MTPO) targeted at institutional buyers will also ensure sustainable production and cash flow estimation.



Study Title

Evaluation Study of Technology Mission of Horticulture in Meghalaya State

Implementing Institution

Asian Institute for Sustainable Development

Project Location/Completion Year

Meghalaya, 2013

Objective

- See the progress of the project implementation in accordance with the project objectives.
- Verify the fund utilization pattern.
- Assess the incidence of benefits being received by the beneficiaries of the project.
- Identify the programmatic interventions or components that can cause greater impact on the beneficiaries.
- Evaluate the measures to be taken for project sustainability.
- Identify the constraints being faced by the executing agency in programme implementation.

Study Recommendation

- Proper technical support for the implementation of programme components is necessary to ensure area-specific needs that can be addressed. Community participation at the planning stage also needs to be ensured so that its commitment for sustaining the assets created under TMH is obtained.
- Work related with the land and water-based activities in the area may be taken care of by the concerned village institution duly supported by respective technical line departments.
- Conservation of water resources should be given top priority.
- For the management of common property resources, community participation should be ensured.
- Short-term training courses on various attributes may be periodically arranged at different levels.
- Increase the use of HYV by way of seed replacement.
- Arrangement for buffer stocking of fertilizers and bio-fertilizers.
- Farmers' training conducted at regular intervals.
- Availability of irrigation to be ensured.
- IPM measures to be practised vigorously.
- Conservation of biodiversity.

Analysis and Outcome

The Technology Mission of Horticulture (TMH) in the region was launched in 2001-02 to address issues related to production and productivity, post-harvest handling, marketing, and processing of horticultural crops in the north-eastern states. The survey was conducted in all the seven districts of Meghalaya. One block per district was chosen randomly, and further 17 schemes per block were selected randomly. Therefore, a total of 74 programme units were covered in this study. The 74 programme components were spread in 35 villages. A sample of 350 beneficiaries was randomly chosen from 35 villages. Each district had 50 sample respondents (beneficiaries). Out of the 350 respondents, 218 were males and 132 were females.

The evaluation has chalked out some impressive achievements made by the TMH during the period 2001-08. These achievements have been analysed both in terms of financial and physical parameters.

Evaluation of the TMH has been conducted, and the resultant recommendations have been proposed. However, the adoption and level of implementation of the recommendations are not known. Given the current COVID-19 situation, it is a known fact that a considerable number of migrants have returned to their villages and have been engaged in their agricultural activities. In such a scenario, it is imperative that there should be more thrust on the implementation of the proposed recommendations.

Study Title

Resource Mapping and Study on the Potential of Ginger and Turmeric Cultivation in the State of Mizoram with Reference to Its Value Addition and Marketing

Implementing Institution

I-Win Advisory Services Ltd

Project Location/Completion Year

Mizoram, 2016

Objective

- Map production, seasonality, and varieties of ginger and turmeric in Mizoram.
- Assess cost-effective production and effective marketing.
- Assess prospective cultivation of ginger and turmeric in the state.
- Develop a state-of-the-art plan of action.

Study Recommendation

- Introduction of the Nadia variety of ginger. Presently farmers of Mizoram use the Thingpui and Thinglaidum varieties of ginger. However, compared to other suitable varieties, the Thingpui and Thinglaidum varieties are fibrous, and oil content is very less.
- Introduction of pack house in major growing districts. Very few farmers are found doing post-harvest management (PHM) in ginger/turmeric. By practicing PHM, some progressive farmers are also observed charging differential price, which ultimately leads to higher price realization.
- Setting up wholesale markets along the Bangladesh and Myanmar borders.
- Setting up spices parkin and around Guwahati may attract more private investors and chances of success would be higher, resulting in a higher demand for the ginger/turmeric of Mizoram.
- Promote entrepreneurship among local investors; the government can promote small- and medium-scale spice growers.
- The state government took the initiative for organic certification on a pilot basis. However, the process was not continued for subsequent years, as there were no perceptible changes in price realization due to organic certification.

Analysis and Outcome

The project studies the latent potential of a substantial growth in productivity of these delectable herbs like ginger and turmeric. This study indicates how Mizoram can play the most competitive role in efficient production, inter-state trade, product diversification, import substitution, and fuelling export-led growth of the country.

Mizoram along with the North-East Region enjoys product surplus in ginger and turmeric. India dominates export for both spices. On the contrary, in seasonal variation, to meet its huge yearly demand, India has to import these (especially ginger) significantly in terms of combined value. Therefore, this study indicates how Mizoram can play the most competitive role in efficient production, inter-state trade, product diversification, import substitution and fuelling export-led growth of the country.

The scope of work for the I-Win Advisory Services Ltd was limited to the preparation of the study report on "Resource Mapping and Study on the Potential of Ginger and Turmeric Cultivation in the State of Mizoram with Reference to Its Value Addition and Marketing". Hence, details of implementation are not known to I-Win as of October 2021.



Study Title

Study of Organic Cultivation in Sikkim

Implementing Institution

National Bank Staff College

Project Location/Completion Year

Sikkim, 2017

Objective

- Promote Sikkim as an organic state.
- Outline measures to discourage the use of artificial fertilizers and pesticides and gradually substitute plant nutrients by organic manures and fertilizers as well as to control diseases and insect pests by biological means.
- Set up basic infrastructure and statutory development, prerequisites to the initiation of actual organic farming in Sikkim.
- Create or develop markets for organic food produce along with the evolvement of related strategies.
- Formulate a policy of organic farming in Sikkim.

Study Recommendation

- State government policies: Irrigation; introduction of the crops consumed by the local community; promotion; organic dairy; organic manure; bio-pesticides; seed bank; subsidies.
- Farmers: Encouragement to grow mix crops; use organic manure.
- Government agencies: Subsidy on traditional crops; introduction of organic manure; address the problems of diseases and pests through organic modes.
- Storage, processing, and value addition: Construct cold storage facilities at block level so that the farmers or aggregators can store the produce for some time; rural godowns to store food grains; promote local institutions.

Analysis and Outcome

Sikkim is the first state of India to officially announce the adoption of organic farming in 2003 and the only state in India to convert entire state into organic. Organic farming has been a traditional way of farming in Sikkim adopted by farmers since ages.

The study shows that farmers are happy with the decision of the state government. However, there is a need for backward integration (for supply of organic manures and bio-pesticides) and forward integration (especially marketing outside the state for premium price for organic produce). Further, there is need for value addition and processing, leading to better realization of value and local employment. There is also a need for introducing more crops and crop diversification. Multi-cropping may help the farmers in reducing risk. There is need to involve banks, farmers, farmers organizations, and government agencies in decision-making process. Sikkim may provide a lot of insights to other state governments, who are interested to become organic states.

Study Title

Marketing Strategies for Organic Produce of Sikkim

Implementing Institution

CCS National Institute of Agricultural Marketing

Project Location/Completion Year

Sikkim, 2016

Objective

- Develop a comprehensive and feasible market plan to yield a better rate of returns on investment made by the producers and other stakeholders of value chain.
- Prepare an action plan for linking producers with premium consumers to enhance the returns on the crops being raised by them.

Study Recommendation

- Market infrastructure for organic produce in the state.
- Capacity building of farmers.
- Investment in technology.

Analysis and Outcome

This study was designed to do market analysis for five identified crops (ginger, turmeric, large cardamom, buckwheat, and cymbidium) and suggest an action plan to link the producers of Sikkim to consumers of premium market.

The study highlights the necessity of bringing reforms in the agri-marketing system in the state both operational and infrastructure, which can help in creating an enabling condition for state producers to take benefit of marketing of organic produce.

The agriculture sector of Sikkim is facing a number of challenges, which results in low productivity, poor quality, and high wastage due to post-harvest losses. The sector is constrained by low productivity, high cost of production, lack of post-harvest infrastructure resulting in huge post-harvest losses, inefficient and fragmented supply chain, lack of know-how, and poor market access and intelligence.

The recommendations have been fully implemented as of October 2021. Significant positive impact has been observed in terms of income, infrastructure, and access to resources, livelihood, productivity, and skill development. It has further suggested for a better coordination among various government departments, public-private partnership, and more engagement of social institutions (like NGOs, SHGs) for sustainability.



Study Title

Wild Mushroom from NE India: Evaluation of Their Nutritional Status and Medicinal Properties

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

More than one state, 2020

Objective

- Characterize the wild mushrooms based on their morphological and molecular techniques.
- Nutritional evaluation of the wild mushrooms.
- Medicinal properties of the wild mushrooms.

Study Recommendation

Lentinussajor-caju and *L. squarrosulus* containing high nutritive value with potent antioxidant activity, and can be targeted for cultivation in enriched substrates to establish their commercial potential towards complementation of global food security and nutritional demands. Moreover, mushroom extracts could be an emerging source of natural antioxidant compounds, and therefore, consumption of wild mushrooms with radical scavenging activity might be beneficial to combat against oxidative damages in human body.

Analysis and Outcome

The study intends to evaluate the nutritional and medicinal properties of wild mushrooms found in the north-eastern, India.

The study has been fully implemented; however, the impact of the implementation could not be measured due to time constraints. The study seems to have benefitted women folk in great measure and provided skill development among many.

The study recommends that there should be public-private partnership, enthusiasm from target group.

CAUs, ICAR, Department of Horticulture of the states in collaboration with SHGs and other farmers associations are potential agencies of implementing the study.

Study Title

Impact Evaluation Study of Mission Organic Value Chain Development for North-Eastern Region (MOVCDNER)

Implementing Institution

National Institute of Agricultural Extension Management (MANAGE)

Project Location/Completion Year

More than one state, 2017

Objective

- Examine the design of MOVCDNER scheme in terms of planning, stakeholder capacity, implementation challenges, input procurement, and distribution activities (clusters formed, trainings, labs established, inspection of clusters and certification, input supplied) and output (area under organic crops, organic production and market linkages).
- Assess the modalities of delivery of the scheme in terms of FPOs formation, farmers training, inspection of fields, certification, input supply, value chain development, producer companies, market infrastructure, and market support linkage like organic commodity boards.
- Assess the level of utilization of outcomes of MOVCDNER by the farmers across farm size classes, irrigated and rain-fed situations especially in NE and hilly states.
- Assess the impact of MOVCDNER scheme on area expansion under organic agriculture, reduction in cost, use of bio-fertilizers, farm productivity, value chain development, price premium due to labelling, profitability, and sustainability.
- Recommend for improvement in overall design of the programme and state-specific measures for improving the effectiveness of the scheme.

Study Recommendation

- Timely action plan preparation, release of funds and implementation needs to be streamlined.
- There is a need for collaboration of activities being undertaken under various schemes of North-East Region (MOVCD-NER, NERLP, and NERAMAC) addressing production and supply chain gaps across different commodity value chains.
- Major focus should be given to collective procurement and value addition of high-value crops along with promotion of food crops so that biodiversity can be maintained in addition to economic viability.
- Improve the cultivation practices, technological interventions, supply chain and marketing; it is essential to map out the best practices in the region and disseminate the same in identified clusters.
- Clusters should be aggregated to form commodity organizations at the district level under MOVCDNER.
- It has been found that working with farmer federations through FFS (Farmer Field Schools) for capacity building, knowledge enhancement, horizontal sharing and learning works out well.
- Kisan Business School is an approach to build farmers' capacities to understand and deal with markets. Building the capacity at the FIG level is critical.
- Grass-roots democracy could be built through attendance of at least 80–85% members, transparency in accounts, accountable behaviour, regular internal auditing, etc.
- Members and the farmers elected for Board of Director should be trained adequately.
- Each state headquarters should have organic market places established where farmers can directly sell to consumers/retailers.



Analysis and Outcome

The scheme aims at the development of certified organic production in a value chain mode to link growers with consumers and to support the development of entire value chain starting from inputs, seeds, certification, to the creation of facilities for collection, aggregation, processing, marketing, and brand-building initiative. The scheme was approved with an outlay of `400 crores for 3 years.

The project has been fully implemented and very significant and positive results have been seen especially, women. Women employment in organic agriculture, gender disaggregated benefits from organic agriculture. It has generated good employment opportunities.

For better sustained result, better coordination among various government departments, effective coordination among all stakeholders, public-private partnership, a proactive local government, enthusiasm from target groups (like association), more engagement of social institutions (like NGOs, SHGs) should continue.

ICAR, State Agricultural Universities (SAUs), Central Agricultural Universities (CAUs), Krishi Vigyan Kendra (KVKs), National Seeds Corporation Ltd (NSC), Small Farmers Agribusiness Consortium (SFAC) are potential institutions that are capable of implementing and providing support for the project.

Study Title

Seed System Development in Major Spice Crops (Ginger, Turmeric and Naga Chilli) of NER through In-Vitro Techniques

Implementing Institution

School of Agricultural Sciences and Rural Development, Nagaland University

Project Location/Completion Year

More than one state, 2015

Objective

- Validation, refinement, and scaling up of available micro-propagation protocols for large-scale production of disease-free quality planting material of ginger, turmeric, and Naga chilli for commercial use in the NER.
- Demonstration and evaluation of the field performance of in-vitro raised micro-propagated planting material under various growing conditions of NER.

Study Recommendation

- Small-scale demonstration of above-mentioned technologies has completed successfully.
- A large-scale demonstration of the same is required at the Nagaland centres for the successful transfer of the technologies to the north-east areas.
- Budget sanctioned for the third year will be needed for the coming years for the successful functioning of the project and the same may be kindly granted.

Analysis and Outcome

Considering the importance and micro-propagation of important spices from NER India, this study has been undertaken. A significant positive impact was observed from the implementation of the project. Technology was developed under well-established lab and field conditions, but Nagaland farmers grow these crops under rain-fed conditions. However, such technologies may be fully implemented only under irrigated farming conditions.

The study demonstrates a simple and promising protocol for in-vitro plantlet regeneration from shoot explants and callus derived from stem segments of in-vitro raised plants. The use of BA in combination with IAA and NAA favoured plant regeneration and callus induction. This protocol may be applied for the conservation and multiplication of genetically pure and disease-free genotypes of this species.



Study Title

State Irrigation Plan under PMKSY —Arunachal Pradesh

Implementing Institution

NABARD Consultancy Services

Project Location/Completion Year

Arunachal Pradesh, 2020

Objective

- Achieve convergence of investments in irrigation
- Enhance physical access to water on farms
- Expand cultivable area under assured irrigation
- Improve on-farm water use efficiency to reduce wastage
- Enhance precision irrigation (more crop per drop)
- Ensure integrated development of rain-fed areas
- Promote water harvesting and water management
- Attract greater private investments in irrigation

Study Recommendation

- All the stakeholders should convene meetings of Panchayat Samities and then finalize a village plan and prepare a detailed project report (DPR).
- The Agriculture and Horticulture Department should take micro-irrigation projects in the command of minor irrigation projects completed or likely to be completed in the near future.
- All the structures planned should be geo-tagged and marked on map, so that social monitoring of the projects can be conducted. This will also avoid duplicity.
- Priority should be given based on the projects that are directly linked to the development of irrigation infrastructure and enhancing the irrigation potential.

Analysis and Outcome

This study was envisaged under the Pradhan Mantri Krishi Sinchai Yojana (PMKSY), which is an integrated planning and management of water resources, through the estimation of water budget for each of the districts and sub-districts and the preparation of strategic action plans to address the water gap through District Irrigation Plans (DIPs).

The initiatives taken under the PMKSY in the state will help in enhancing the crop production and productivity level, but it needs to be further connected with the agriculture marketing system of the state so that the farmers get the maximum benefits of the produce. It will also help in increasing the marketable surplus of the state.

Research institutes should come with technological breakthroughs for shifting production frontiers and raising efficiency in the use of inputs. The use of scientific agronomical practices such as precision farming to raise the production and income of farmers substantially can easily be observed in many parts of the country. Similarly, modern machinery such as laser land levellers, precision seeders and planters, and practices such as SRI (system of rice intensification), zero tillage, raised-bed plantation, and ridge plantation allow highly efficient technical farming. These technologies require strong extension for the adoption by farmers. The Krishi Vigyan Kendras (KVKs), agriculture institutes, and R&D institutions should also include in their packages, grassroots-level innovation and traditional practices that are resilient, sustainable, and income enhancing.

The main departments across the state that have proposed schemes under the PMKSY are as follows: Agriculture Department, Horticulture Department, Water Resource Department, Soil and Water Conservation, department under Rural Works Department (RWD), Rural Development Department (RD), Agricultural Technology Management Agency (ATMA under Agriculture Department), Tube-well and Ground Water Division (under WRD), Department of Environment and Forests.

Study Title

Detailed Project Report (DPR) on Morigaon I (Bordoloni Integrated Watershed Management Programme (IWMP))

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

Formulate a Detailed Project Report (DPR) on Morigaon I (Bordoloni Integrated Watershed Management Programme (IWMP)) for soil, water, and biomass conservation for implementation of the watershed programme.

Study Recommendation

- The data generated during PRA exercises, field visits, and from secondary sources may be validated during implementation to tap the optimum resource potential for maximum benefit to the target population.
- The proposed user groups for every land-based intervention may be categorically trained for execution, sustainable utilization, and post-project maintenance of the assets created during the project period.
- Participation of women folk in user groups should be invariably encouraged.
- The proposed intervention location and dimension of the physical structures may further be fine-tuned considering the circumstances prevailing during the implementation phase.
- The convergence of line department activities may be explored for fulfilling the needs of the communities, which was reflected during PRA exercises, but could not be considered due to budgetary provision and scope of the project.

Analysis and Outcome

The study will help to understand the acute problem of soil and water conservation in the watershed. The soil erosion and subsequently flood and sedimentation have great impact on the people of the watershed during rainy season and on the other hand acute water shortage during winter season. These problems significantly affect the land utilization pattern, culture and economy of the watershed area and also lead to a degraded environment. Though the present study areas are erosion prone, yet, it has tremendous scope for development considering the natural resources of the areas and the area has high agricultural potential.

Project activities include earthen drainage channel, water-harvesting tank cum fish pond, demonstration of new and sustainable technologies, plantation activities, block plantation, horticultural plantation, natural water body development for pisciculture and irrigation, jute retting pond development, and soil erosion protection. The project is expected to be implemented by different departments of the state along with cooperation from panchayats, village watershed committees, and other SHGs.

Overall, the project focussed on sustainable development and utilization of natural resources for augmenting food production, resource conservation, livelihood generation.



Study Title

Integrated Watershed Management Programme—Darrang II-Ramhari IWMP

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

- Assess the natural resource base of the watershed.
- Understand the problem typology of the watershed.
- Identify the scope of water conservation in the watershed.
- Delineate the watersheds/micro-watersheds for the Integrated Watershed Management Programme.
- Suggest micro-watershed wise plans for use of water and land resources to be treated under the programme.
- Prepare the cost estimate for the project.

Study Recommendation

- The data generated during PRA exercises, field visits, and from secondary sources may be validated during implementation to tap the optimum resource potential for maximum benefit to the target population.
- The proposed user groups for every land-based interventions may be categorically trained for execution, sustainable utilization, and post-project maintenance of the assets created during the project period.
- Participation of women folk in user groups should be invariably encouraged.
- The proposed intervention location and dimension of the physical structures may further be fine-tuned considering the circumstances prevailing during the implementation phase.
- The convergence of line department activities may be explored for fulfilling the needs of the communities, which was reflected during the PRA exercise, but could not be considered due to budgetary provision and scope of the project.

Analysis and Outcome

The study will help to understand the acute problem of soil and water conservation in the watershed. The soil erosion and subsequently flood and sedimentation have great impact on the people of the watershed during rainy season and on the other hand acute water shortage during winter season. These problems significantly affect the land utilization pattern, culture and economy of the watershed area and also lead to a degraded environment. Though the present study areas are erosion prone, yet, it has tremendous scope for development considering the natural resources of the areas and the area has high agricultural potential.

Project activities include earthen drainage channel, water-harvesting tank cum fish pond, demonstration of new and sustainable technologies, plantation activities, block plantation, horticultural plantation, natural water body development for pisciculture and irrigation, jute retting pond development, and soil erosion protection.

The project is expected to be implemented by different departments of the state along with cooperation from panchayats, village watershed committees, and other SHGs.

Study Title

Integrated Watershed Management Programme—Darrang-I-Bhutardol IWMP

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

- Assess the natural resource base of the watershed.
- Understand the problem typology of the watershed.
- Identify the scope of water conservation in the watershed.
- Delineate the watersheds/micro-watersheds for the Integrated Watershed Management Programme.
- Suggest micro-watershed wise plans for use of water and land resources to be treated under the programme.
- Prepare the cost estimate for the project.

Study Recommendation

- The watershed conservation and development programme calls for people's participation through community-based institutions, government departments, panchayats, and the project implementation agency in an inter-connective pattern of approach.
- The proposed user groups for every land-based intervention may be categorically trained for execution, sustainable utilization, and post-project maintenance of the assets created during the project period. Participation of women folk in user groups should be invariably encouraged.

Analysis and Outcome

The study will help to understand the acute problem of soil and water conservation in the watershed. The soil erosion and subsequently flood and sedimentation have great impact on the people of the watershed during rainy season and on the other hand acute water shortage during winter season. These problems significantly affect the land utilization pattern, culture and economy of the watershed area and also lead to a degraded environment. Though the present study areas are erosion prone, yet, it has tremendous scope for development considering the natural resources of the areas and the area has high agricultural potential.

Project activities include earthen drainage channel, water-harvesting tank cum fish pond, demonstration of new and sustainable technologies, plantation activities, block plantation, horticultural plantation, natural water body development for pisciculture and irrigation, jute retting pond development, and soil erosion protection. . The project is to be implemented by different departments of the state along with cooperation from panchayats, village watershed committees, and other SHGs.

Overall, the project will help in sustainable development and utilization of natural resources for the cause of augmenting food production, other livelihood generation and a measure of poverty reduction.



Study Title

Integrated Watershed Management Programme—Sonitpur III-Mornoiguri IWMP

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

- Assess the natural resource base of the watershed.
- Understand the problem typology of the watershed.
- Identify the scope of water conservation in the watershed.
- Delineate the watersheds/micro-watersheds for Integrated Watershed Management Programme.
- Suggest micro-watershed wise plan for use of water and land resources to be treated under the programme.
- Prepare the cost estimate for the project.

Study Recommendation

- Participatory rural appraisal exercise.
- Earthen drainage channel.
- Water-harvesting tank cum fish pond.
- Crop demonstration.
- Roadside plantation.
- Block plantation.
- Drainage line treatment.
- Protective afforestation.
- Horticultural plantation.
- Natural water body development for pisciculture and irrigation.

Analysis and Outcome

The study will help to understand the resource availability and the problems related to soil, water and biomass conservation in the watershed area. The flood, water stagnation in low lying areas, poor drainage due to blockade of natural water ways and sedimentation during rainy season and acute water shortage during winter season have great impact on the people of the watershed. These problems significantly affect the land utilization pattern and economy of the watershed area and also lead to further degradation of the environment. Though the watershed area is having these kinds of problems, yet, it has tremendous scope for development considering the natural resources of the areas.

Proposed interventions were identified in consultation with the communities during Participatory Rural Appraisal exercises followed by field surveys. Activities include earthen drainage channel, water-harvesting tank cum fish pond, crop demonstration for the demonstration of new and sustainable technologies, plantation activities, block plantation, horticultural plantation, natural water body development for pisciculture and irrigation, jute retting pond development, and soil erosion protection.

The project is expected to be implemented by different departments of the state along with cooperation from panchayats, village watershed committees, and other SHGs.

Study Title

Integrated Watershed Management Programme—Sonitpur I-Japorijan IWMP

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

- Improve the livelihoods of the communities.
- In the short term, address the issues for immediate benefits (employment generation).
- In the long term, assess the problems and provide practical and need-based solutions (land and water conservation).

Study Recommendation

- The proposed user groups for every land-based intervention may be categorically trained for execution, sustainable utilization, and post-project maintenance of the assets created during the project period.
- Participation of women folk in user groups should be invariably encouraged.
- The proposed intervention location and dimension of the physical structures may further be fine-tuned considering the circumstances prevailing during the implementation phase.
- The convergence of line department activities may be explored for fulfilling the needs of the communities, which was reflected during PRA exercises, but could not be considered due to budgetary provision and scope of the project.

Analysis and Outcome

The study will help to understand the acute problem of soil and water conservation in the watershed. The soil erosion and subsequently flood and sedimentation have great impact on the people of the watershed during rainy season and on the other hand acute water shortage during winter season. These problems significantly affect the land utilization pattern, culture and economy of the watershed area and also lead to a degraded environment. Though the present study areas are erosion prone, yet, it has tremendous scope for development considering the natural resources of the areas and the area has high agricultural potential.

The project is expected to be implemented by different departments of the state along with cooperation from panchayats, village watershed committees, and other SHGs.

The study will help in sustainable development and utilization of natural resources for the cause of augmenting food production, other livelihood generation and a measure of poverty reduction.



Study Title

Integrated Watershed Management Programme—Sonitpur-IV-Gorjuli-IWMP

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

- Assess the natural resource base of the watershed.
- Understand the problem typology of the watershed.
- Identify the scope of water conservation in the watershed.
- Delineate the watersheds/micro-watersheds for Integrated Watershed Management Programme.
- Suggest micro-watershed wise plan for use of water and land resources to be treated under the programme.
- Prepare the cost estimate for the project.

Study Recommendation

- The watershed conservation and development programme calls for people's participation through community-based institutions, government departments, panchayats, and the project implementation agency in an inter-connective pattern of approach.
- The proposed user groups for every land-based intervention may be categorically trained for execution, sustainable utilization, and post-project maintenance of the assets created during the project period.
- Participation of women folk in user groups should be invariably encouraged.

Analysis and Outcome

The proposed Integrated Watershed Management Programme (IWMP) area is in the Dhekiajuli Development block of the Sonitpur district of Assam. The project proposes to develop an area of approximately 4000 ha encompassing 29 revenue villages from five Gaon Panchayats.

The DPR activities tried to evaluate the natural resources, water-related problems, conservation of water, development of agriculture and other livelihood options of the area, which is ultimately expected to lead to the formulation of a DPR for conservation and management of natural resources (soil, water, vegetation, etc.) for livelihood generation.

Proposed interventions were identified in consultation with the communities during Participatory Rural Appraisal exercises followed by field surveys. Activities include earthen drainage channel, water-harvesting tank cum fish pond, demonstration of new and sustainable technologies, plantation activities, block plantation, horticultural plantation, natural water body development for pisciculture and irrigation, jute retting pond development, and soil erosion protection.

The project is expected to be implemented by different departments of the state along with cooperation from panchayats, village watershed committees, and other SHGs.

Study Title

Integrated Watershed Management Programme—Nagaon II-Nanoi IWMP

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

- Assess the natural resource base of the watershed.
- Understand the problem typology of the watershed.
- Identify the scope of water conservation in the watershed.
- Delineate the watersheds/micro-watersheds for the Integrated Watershed Management Programme.
- Suggest micro-watershed wise plans for use of water and land resources to be treated under the programme.
- Prepare the cost estimate for the project.

Study Recommendation

- The proposed user groups for every land-based intervention may be categorically trained for execution, sustainable utilization, and post-project maintenance of the assets created during the project period.
- Participation of women folk in user groups should be invariably encouraged.
- The proposed intervention location and dimension of the physical structures may further be fine-tuned considering the circumstances prevailing during the implementation phase.
- The convergence of line department activities may be explored for fulfilling the needs of the communities, which was reflected during PRA exercises, but could not be considered due to budgetary provision and scope of the project.

Analysis and Outcome

The project will help to understand the resource availability and the problems related to soil, water and biomass conservation in the watershed area. The flood, water stagnation in low lying areas, poor drainage due to blockade of natural water ways and sedimentation during rainy season and acute water shortage during winter season have great impact on the people of the watershed. These problems significantly affect the land utilization pattern and economy of the watershed area and also lead to further degradation of the environment. Though the watershed area is having these kinds of problems, yet, it has tremendous scope for development considering the natural resources of the areas.

Project activities include earthen drainage channel, water-harvesting tank cum fish pond, crop demonstration for demonstration of new and sustainable technologies, plantation activities, block plantation, horticultural plantation, natural water body development for pisciculture and irrigation, jute retting pond development, and soil erosion protection.

The project is expected to be implemented by different departments of the state along with cooperation from panchayats, village watershed committees, and other SHGs.

The study will help in sustainable development and utilization of natural resources for augmenting food production, resource conservation, and livelihood generation.



Study Title

Integrated Watershed Management Programme—Nagaon-I Phuloguri IWMP

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

Formulate a DPR on Nagaon-I (Phuloguri Integrated Watershed Management Programme (IWMP)) for soil, water, and biomass conservation for implementation of the watershed programme.

Study Recommendation

- The data generated during PRA exercises, field visits, and from secondary sources may be validated during implementation to tap the optimum resource potential for maximum benefit to the target population.
- The proposed user groups for every land-based intervention may be categorically trained for execution, sustainable utilization, and post-project maintenance of the assets created during the project period.
- Participation of women folk in user groups should be invariably encouraged.
- The proposed intervention location and dimension of the physical structures may further be fine-tuned considering the circumstances prevailing during the implementation phase.
- The convergence of line department activities may be explored for fulfilling the needs of the communities, which was reflected during PRA exercises, but could not be considered due to budgetary provision and scope of the project.

Analysis and Outcome

The present DPR activities tried to evaluate the natural resources, water-related problems, conservation of water, development of agriculture and other livelihood options of the area, which is ultimately expected to lead to the formulation of a DPR for conservation and management of natural resources (soil, water, vegetation, etc.) for livelihood generation.

Proposed interventions were identified in consultation with the communities during Participatory Rural Appraisal exercises followed by field surveys. Activities include earthen drainage channel, water-harvesting tank cum fish pond, demonstration of new and sustainable technologies, plantation activities, block plantation, horticultural plantation, natural water body development for pisciculture and irrigation, jute retting pond development, and soil erosion protection.

The project is expected to be implemented by different departments of the state along with cooperation from panchayats, village watershed committees, and other SHGs.

Study Title

Integrated Watershed Management Programme—Sonitpur-II- Gabharu IWMP

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

Formulate a detailed project report (DPR) on Sonitpur-II (Gabharu Integrated Watershed Management Programme (IWMP)) for water and biomass conservation for implementation of the watershed programme

Study Recommendation

- The data generated during PRA exercises, field visits, and from various secondary sources may be validated during the implementation to tap optimum resource potential for maximum benefit to the target population.
- The proposed user groups for every land-based intervention may be categorically trained for execution, sustainable utilization and post-project maintenance of the assets to be created.
- Participation of women folk in user groups should be invariably encouraged.
- The proposed intervention, location, and dimension of the physical structures may further be fine-tuned considering the circumstances prevailing during the implementation phase.
- The convergence of line department activities may be explored for fulfilling the needs of the communities, which was reflected during PRA exercises.

Analysis and Outcome

The proposed Integrated Watershed Management Programme (IWMP) area is in the Bihaguri and Rangapara Development blocks of the Sonitpur district of Assam. The project proposed to develop an area of approximately 3040 ha encompassing 32 revenue villages from six Gaon Panchayats.

The DPR activities tried to evaluate the natural resources, water-related problems, conservation of water, development of agriculture and other livelihood options of the area, which is ultimately expected to lead to the formulation of a DPR for conservation and management of natural resources (soil, water, vegetation, etc.) for livelihood generation.

Proposed interventions were identified in consultation with the communities during Participatory Rural Appraisal exercises followed by field surveys. Activities include earthen drainage channel, water-harvesting tank cum fish pond, demonstration of new and sustainable technologies, plantation activities, block plantation, horticultural plantation, natural water body development for pisciculture and irrigation, jute retting pond development, and soil erosion protection.

The project is expected to be implemented by different departments of the state along with cooperation from panchayats, village watershed committees, and other SHGs.



Study Title

Study on Agriculture Water Management of Small and Marginal Farmers in the District of Morigaon

Implementing Institution

CUTS International

Project Location/Completion Year

Assam, 2011

Objective

Study on agriculture water management in the Morigaon district of Assam.

Study Recommendation

- **Scientific cropping and production technologies:** Development of alternative cropping system and production technologies; combinations of crop cultivation and animal farming.
- **Building a bridge between agriculture department and farmers:** Efforts should be made in bringing the agriculture department close to the grassroots. Community resource persons (CRPs), who are trained by the government departments and institutions and then act as master trainers for the community, can help in bridging this gap.
- **Conservation of rainwater:** Construction of more rainwater-harvesting structures for recharging ground water.
- **Development of natural ecosystems like swamps and beels:** Programmes are required to remove silt from swamps or beels.
- **Addressing gender gap:** Women must be included in different roles and programmes as they play a visible role in water distribution.
- **Governance and need for implementation of state water policy:** Concordant to the Policy for Integrated Management of ground water, a road map of activities in action research and strategies, which are acceptable to people, should be implemented.
- **Holistic intervention required:** The various institutions and departments involved such as the Public Health Engineering Department (PHED), irrigation, agriculture, and the disaster management departments have to work in synergy for agriculture water management.
- **Participatory management policies for ground water management:** A participatory approach may be adopted and community bodies such as SHGs, water user groups, and farmers groups should be given the responsibility for management and maintenance of local water resources.

Analysis and Outcome

Morigaon is one of the youngest districts in Assam carved out of Kamrup and Nagaon districts. The district is poor, ravaged by floods, and mostly depends on agriculture. Therefore, it is imperative to inculcate good water management practices. With this in mind, the RGVN conducted a study on agriculture water management in the Morigaon district of Assam. The overall picture presents that there is high demand for agricultural water. Illiteracy is one of the main problems. The village survey revealed that the sample villages of the district suffer from serious problems of both drinking and agricultural water, lack of electrification, education, public health, and other social sectors. From the productivity status, it is found that there is low agricultural productivity resulting from basic problems like insufficient irrigation facilities, flood and drought, and farmers' ignorance. At the same time, it has been seen that the government-promoted development schemes on supply of seeds and fertilizers are not provided timely and equitably. In contrast, some villagers are found to have benefitted by the government.

Study Title

Evaluation of Irrigation Projects under Soil and Water Conservation Department and Water Resources Department under AIBP

Implementing Institution

AMC Research Group Pvt Ltd

Project Location/Completion Year

Meghalaya, 2012

Objective

Assess detailed performance, implementation process, and the corresponding success of projects being identified and covered under Accelerated Irrigation Benefit Programme (AIBP).

Study Recommendation

- Spending sufficient budget on creating capacity building, which eventually may impact the socio-economic development in the state.
- High priority to converge the irrigation system with the traditional method of cultivation.
- High priority to proper alignment of all the canal system with main, medium, and minor canals along with an appropriate slope.
- Formation of a Water Users Association (WUA) for a participatory approach on irrigation management, improvement of services, better operation and maintenance, etc.
- Proper coordination between concerned departments and the respective officials related to irrigation agriculture, revenue, and land.
- A policy in place to make farmers adopting appropriate cropping pattern that could fetch optimum use of water.
- Provide fund for Field Irrigation Canal (FIC) networks, operation, and maintenance.
- Periodical reassessment system to check the ground water potential on a scientific basis.
- Ground water recharge projects should be developed and implemented for improving both the quality and availability of ground water resource.

Analysis and Outcome

Meghalaya is predominantly an agricultural state with about 80% of its population depending entirely on agriculture and allied activities for their livelihood. Challenges arising due to droughts, floods, and non-availability of water for irrigation throughout the year put a strain on the resources of the state. Therefore, all these issues and problems need to be resolved in the coming years. There is a need for a sustainable and concrete planning for the overall development and management of water resources in the state.

The AIBP scheme has helped in creating irrigation potential, leading to generating rural employment and supported rural Livelihood (agriculture and allied activities). The major constraints that impede the implementation process in the state are lack of fund for monitoring, lack of motivation among staff, lack of supervision facility, lack of proper coordination between concerned departments, delay in releasing funds for monsoon season, etc. There is also no provision existing for repairing and maintenance of work particularly the conveyance system.



Study Title

Integrated Watershed Management Programme, Kolasib – I

Implementing Institution

Bilkhawthlir Rural Development Block

Project Location/Completion Year

Mizoram, 2016

Objective

Tackle the special problems of areas constantly affected by severe drought conditions.

Study Recommendation

- Wherever voluntary organizations are forthcoming, the management of watershed development should be entrusted to them with the ultimate aim of handing over to them one-fourth of the total number of watersheds for development.
- Suitable institutional mechanism for bringing about coordination between different departments at the central and state levels with a view to ensuring uniformity of approach in implementing similar programmes for the conservation of land and water resources.

Analysis and Outcome

The study observed several problems related to watershed management, such as low production of food crops, cultivation/jhuming on steep slopes, low production of horticulture crops, forest degradation, lack of extension services and supply of seed, seedlings of poor quality, lack of assured irrigation facility in the WRC fields, high Soil erosion and run-off, lack of storage and processing facilities, lack of marketing facilities, lack of credit facilities, less involvement of banks and other financial institutions, nature of land ownership, lack of price support, lack of village-level agriculture extension activities, and lack of a strong village administration. The major problem lies with the most primitive and prevalent method of shifting cultivation or jhuming, which results in rapid degradation of the primary forest, heavy soil erosion, and rapid surface run-off flow. To overcome the above-mentioned constraints and for successful implementation of various soil conservation measures proposed in the micro-watershed, effective cooperation of the beneficiaries and participation in the watershed are very important. Since the farmers/users associations are directly involved in the scheme, the socio-economic status of beneficiaries will be increased and will help a lot in implementing the scheme in a major way.

Study Title

Study on Development and Management of Land and Water Resources for Sustainable Agriculture in Mizoram in the Republic of India

Implementing Institution

Japan International Cooperation Agency (JICA)

Project Location/Completion Year

Mizoram, 2015

Objective

- Formulate a master plan for land and water resource development and management for sustainable agriculture.
- Improve the planning process of minor irrigation projects (in terms of corroboration with related government agencies and beneficiaries).

Study Recommendation

- Utilize the master plan prepared by the JICA study as a “road map”, not only for agricultural planning of the state but also for tailoring the activities of the centrally sponsored schemes to fit the actual requirement of the state and/or creating the state’s own CSS.
- Initiate following activities immediately by the state-level stakeholders without additional assistance from the central government or external resources.
- Establish a state-wide system for collecting and managing agriculture-related data and improve information of farm accessibility and transportation development of horticulture agro-industry.
- Empower every village stakeholder, ranging from farmers to local government officers to prepare the regional agriculture plan reflecting the development direction proposed by the master plan and farmers’ needs and capacity for practical implementation of the master plan.
- Post-interventions of reclaimed jhum land through sustainable agricultural practices.
- Take immediate action for applying internal and/or external technical assistance and resources to implement capacity-strengthening projects for irrigation and agriculture allied officers in agriculture development planning and monitoring, production, and marketing.

Analysis and Outcome

The study recommends nine points for implementing the master plan and utilizing the DPR preparation guideline.

Through the assessment of the present socio-economic condition and administration of the state, the study team identified the major challenges faced by the state in improving the viability of the rural economy and environment, tax and revenue status of the state government, and food security. Among many sectors, the agriculture sector is one of the most important sectors in the state and it plays vital roles in the state economy, contributing nearly 20% of the Gross State Domestic Product (GSDP) and absorbing 50% of the main work forces. The study team recommended 27 projects to be implemented stage wise in a 20-year period. The Japan International Cooperation Agency (JICA) study team assessed the impacts of the master plan on environmental and social aspects based on the evaluation of the strategic directions and objectives of the programmes. The master plan has a wide range of important-to-moderate positive impacts, and only very few moderate-to-low negative impacts. These results assume that the mitigation measures have been integrated in planning and implementation. The main positive impacts are the reduction in greenhouse gas emissions, the conservation of soil and control of erosion, the conservation of protected areas and biological diversity, the improvement in livelihoods and alleviation of poverty, and the allocation of benefits to the indigenous people. The negative impacts concern only water quality, water use, and river habitats. They are ranked as small to moderate.



Study Title

Meghalaya Community-Led Landscapes Management Project (MCLLMP)

Implementing Institution

Meghalaya Basin Management Agency
(MBMA)

Project Location/Completion Year

Meghalaya, 2020

Objective

Strengthen community institutions in planning and managing natural resources for sustainability in the state.

Study Recommendation

- It can be emphasized that the inclusion of women in all stages of the project is of utmost importance since it was found that there were more females than males in the Jaintia and Garo Hills regions and the sex ratio for the Khasi region was 969.
- It can be inferred that there is a need to provide technical inputs and capacity building in land and agriculture productivity enhancement so as to enable the community to include such interventions in the community-led plans. Effective use of biomass could reduce deforestation, as felling of trees for fuel has been ranked by the community as the second largest driver of deforestation in a study conducted for identifying the drivers of deforestation in Meghalaya.
- There was ample availability of open forests, culturable wasteland, and grasslands, thereby opening up the opportunity for forestry, agriculture, and horticulture activities.
- Activities for the control of soil erosion and reclamation of eroded stretches are urgently required and communities should be encouraged to take up suitable measures such as vegetative barriers, contour bunds, engineering structures like gabions, loose boulder check dams.

Analysis and Outcome

The Government of Meghalaya has initiated the Community-Led Landscapes Management Project (CLLMP) to strengthen community-led natural resource management (NRM) with a landscape approach in 400 highly degraded and degraded villages of the state through World Bank support. A baseline study was commissioned to understand the current profile of three regions of the state: Garo Hills region, Khasi Hills region, and Jaintia Hills region. A random survey was conducted in 71 villages—24 villages in Garo Hills, 31 villages in Khasi Hills, and 16 villages in Jaintia Hills. The study captures reports on the present status of natural resources and its present utilities. These villages have about 11,690 households with approximately 64,783 populations.

The findings show that 85% of households are engaged in agricultural and related activities with income level of `52,956 per annum from an average land-holding size of 0.34 hectares per family. The remaining 15% of households are engaged in petty business, holding government jobs, and are teachers.

The project emphasizes on gender balance and suggests that all NRM plans have the priorities of women in them. The project has social and environmental safeguard policies in place.

Study Title

Identification of Drivers of Deforestation in Meghalaya

Implementing Institution

Rain Forest Research Institute

Project Location/Completion Year

Meghalaya, 2019

Objective

- Identify potential faulty agricultural practices, social and cultural practices, mining activities, industrial pollution, and other forms of developmental activities.
- Observe the diversity of plant forms with the decrease in the level of biotic interference and disturbance.

Study Recommendation

- Control of illegal wood collection especially in community-managed forests.
- Plantation of indigenous fast-growing species especially in home gardens, farmlands, jhumlands, and fallow lands to meet the increasing demand of wood.
- Promotion and use of energy-efficient cooking devices along with alternative fuels like LPG. Increase availability of seeds of high-yielding varieties of indigenous crops. Control migration from rural areas to urban areas.
- Training programmes on conservation, restoration, and management of forest resources, especially in shifting cultivation areas.
- Sensitization programmes for students against the adverse effect of deforestation on health and environment at the school and college levels. Plantation programmes at the block and village levels, on important social occasions and celebrations weak enforcement.

Analysis and Outcome

The study identified various drivers of deforestation through a scientific empirical study following an appropriate ecological/sociological methodology and arranging them in the right perspective. A perception-based ranking is necessary for a proper understanding of deforestation going on in the state. A five-pronged approach was followed for the study, constituting consultation of existing literature, application of remote sensing and GIS as a tool to understand the spatial distribution and extent of the drivers, ecological studies along the disturbance gradient, consultation with local communities, and seeking expert opinion. Wood collection, shifting cultivation, permanent farming, and mining are some of the direct drivers of deforestation found predominantly operating in the state. The study re-emphasizes the importance of awareness creation among the communities regarding the ill effects of deforestation, strict monitoring of law enforcement, review of some of the existing laws, generation of sustainable and viable alternative income generation activities for communities, besides many recommendations addressing the issues related to deforestation and degradation. The present report is the result of research and review work for a period of about 1 year and hopefully would help in better understanding of the issues pertaining to deforestation and forest degradation in the state of Meghalaya and help in the execution of appropriate strategies for the state in general and for the community in particular.

As of October 2021, recommendations of the study have been partly implemented. There is no full information on implementation available with the Rain Forest Research Institute (RFRI). However, measures are being taken to improve livelihoods through the cultivation of agar wood, bamboo, etc. Efforts have been taken for the reclamation of coal mine areas. The project has high positive impact on employment generation, women empowerment, income opportunity, livelihood improvement, increase in productivity, skill development, etc.



Study Title

Integrated Mission for Creation of Scientific and Comprehensive Soil and Land Resources Information System for Effective Implementation of Comprehensive Agriculture Management Programme (CAMP) Cluster-2, Mawthadraishan and Mawkyrwat Blocks, West Khasi Hills

Implementing Institution

Remote Sensing Instrument

Project Location/Completion Year

Meghalaya, 2019

Objective

- Characterize the soils for their morphological, physical, and chemical properties.
- Understand the land degradation problems in each soil type.
- Classify the soils as per soil taxonomy.
- Classify the lands as per the land capability classification.
- Classify the lands as per the irrigability potential (irrigability classification).
- Evaluate the soils for their suitability for different crops.
- Prepare the action plan for land resource development.

Study Recommendation

- In steeply sloping open forest areas, staggered trenching and gap afforestation have been recommended, where as in lower slopes, gap afforestation has been recommended in the open forest areas.
- The lime requirement to bring the soil pH level up to 6.4 has been estimated and recommended. The lime requirement is found to vary based on the pH of the soil.
- There are advantages and disadvantages in the usage of organic manure and inorganic fertilizers. In view of this, an optimum combination of organic and inorganic fertilizers is recommended for the compensation of deficient nutrients for sustainable agriculture in major crops grown in this cluster.
- They can be recommended for cultivation in those areas. Liming may improve the suitability. Marginally suitable areas are not recommended as they are not economical.

Analysis and Outcome

This project has been initiated by the Directorate of Agriculture, Government of Meghalaya, in order to manage land and water resources, maximize the input use efficiency for getting higher yields, and also protect the scarce and precious land resource base and also for sustainable development in all sectors of agriculture in the state. The Digital Elevation Model (DEM) has been generated using the geo-referenced Cartosat-1 data. Later, contours of 5m interval have been generated from the DEM using photogrammetric techniques. A Base Map has been prepared by using remote sensing and GIS techniques with administrative boundaries, contours, transport network, settlements, drainage system, which is useful for local reference purpose. Different thematic maps for land use/land cover, hydro geomorphology, and soil have been prepared by visual interpretation of the Deimos-2 satellite data and ground truthing. Soil profile points have been dug, and soil samples have been collected at different depths for analysis.

Derivative maps for land degradation, land capability, land irrigability, and crop suitability have been prepared based on the soil map and analysis data. Soil erosion and soil acidity are the major land action plan for land resource development, which includes problems and potentials of soils, slope, existing land use, soil erosion, nutrient deficiencies, and soil acidity problems. The suggested action plan includes various land and water resource development programmes like soil and water conservation measures, liming to increase the pH for improving nutrient availability, and application of deficient nutrients.

Study Title

Integrated Mission for Creation of Scientific and Comprehensive Soil and Land Resources Information System for Effective Implementation of Comprehensive Agriculture Management Programme (CAMP) Cluster-3, Dadenggre Block, West Garo Hills District

Implementing Institution

Remote Sensing Instrument

Project Location/Completion Year

Meghalaya, 2019

Objective

- Characterize the soils for their morphological, physical, and chemical properties.
- Understand the land degradation problems in each soil type.
- Classify the soils as per soil taxonomy.
- Classify the lands as per the land capability classification.
- Classify the lands as per the irrigability potential (irrigability classification).
- Evaluate the soils for their suitability for different crops.
- Prepare the action plan for land resource development.

Study Recommendation

- In steeply sloping open forest areas, staggered trenching and gap afforestation have been recommended, whereas in lower slopes, gap afforestation has been recommended in the open forest areas. The lime requirement to bring the soil pH level up to 6.4 has been estimated and recommended. The lime requirement is found to vary based on the pH of the soil.
- There are advantages and disadvantages in the usage of organic manure and inorganic fertilizers. In view of this, an optimum combination of organic and inorganic fertilizers is recommended for the compensation of deficient nutrients for sustainable agriculture in major crops grown in this cluster. They can be recommended for cultivation in those areas. Liming may improve the suitability. Marginally suitable areas are not recommended as they are not economical.

Analysis and Outcome

This project has been initiated by the Directorate of Agriculture, Government of Meghalaya, in order to manage land and water resources, maximize the input use efficiency for getting higher yields, and protect the scarce and precious land resource base and also for sustainable development in all sectors of agriculture in the state. The Digital Elevation Model (DEM) has been generated using the geo-referenced Cartosat-1 data. Later, contours of 5m interval have been generated from DEM using photogrammetric techniques. A Base Map has been prepared by using remote sensing and GIS techniques with administrative boundaries, contours, transport network, settlements, and drainage system, which is useful for local reference. Different thematic maps on land use/land cover, hydro geomorphology, and soil have been prepared by visual interpretation of Deimos-2 satellite data and ground truthing. Soil profile points have been dug, and soil samples have been collected at different depths for analysis.

Derivative maps for land degradation, land capability, land irrigability, and crop suitability have been prepared based on the soil map and analysed data. Soil erosion and soil acidity are the major land degradation problems in this area. An action plan for land resources development has been suggested by considering problems and potentials of soils, slope, existing land use, soil erosion, nutrient deficiencies, and soil acidity.



Study Title

Integrated Mission for Creation of Scientific and Comprehensive Soil and Land Resources Information System for Effective Implementation of Comprehensive Agriculture Management Programme(CAMP) cluster-1, Thadlaskein Block, West Jaintia Hills District

Implementing Institution

Remote Sensing Instrument

Project Location/Completion Year

Meghalaya, 2019

Objective

- Characterize the soils for their morphological, physical, and chemical properties.
- Understand the land degradation problems in each soil type.
- Classify the soils as per soil taxonomy.
- Classify the lands as per the land capability classification.
- Classify the lands as per the irrigability potential (irrigability classification).
- Evaluate the soils for their suitability for different crops.
- Prepare the action plan for land resource development.

Study Recommendation

- In steeply sloping open forest areas, staggered trenching and gap afforestation have been recommended, whereas in lower slopes, gap afforestation has been recommended in the open forest areas.
- The lime requirement to bring the soil pH level up to 6.4 has been estimated and recommended. The lime requirement is found to vary based on the pH of the soil.
- There are advantages and disadvantages in the usage of organic manure and inorganic fertilizers. In view of this, an optimum combination of organic and inorganic fertilizers is recommended for the compensation of deficient nutrients for sustainable agriculture in major crops grown in this cluster.
- They can be recommended for cultivation in those areas. Liming may improve the suitability. Marginally suitable areas are not recommended as they are not economical.

Analysis and Outcome

This project has been initiated by the Directorate of Agriculture, Government of Meghalaya, in order to manage land and water resources, maximize the input use efficiency for getting higher yields, and also protect the scarce and precious land resource base and also for sustainable development in all sectors of agriculture in the state. The Digital Elevation Model (DEM) has been generated using the geo-referenced Cartosat-1 data. Later, contours of 5m interval have been generated from the DEM using photogrammetric techniques. A Base Map has been prepared by using remote sensing and GIS techniques with administrative boundaries, contours, transport network, settlements, and drainage systems, which is useful for local reference. Different thematic maps for land use/land cover, hydro geomorphology, and soil have been prepared by visual interpretation of the Deimos-2 satellite data and ground truthing. Soil profile points have been dug, and soil samples have been collected at different depths for analysis.

Derivative maps for land degradation, land capability, land irrigability, and crop suitability have been prepared based on the soil map and analysis data. Soil erosion and soil acidity are the major land action plan for land resource development, which includes problems and potentials of soils, slope, existing land use, soil erosion, nutrient deficiencies, and soil acidity problems. The suggested action plan includes various land and water resource development programmes like soil and water conservation measures, liming to increase the pH for improving nutrient availability, and application of deficient nutrients.

Study Title

Scoping Analysis on Livelihood Generation for Recovery, with Special Emphasis on the Agricultural Sector

Implementing Institution

Rashtriya Gramin Vikas Nidhi (RGVN)

Project Location/Completion Year

Assam, 2015

Objective

- Understand the economic vulnerability of the flood-affected agrarian population of the state of Assam.
- Showcase the relationship between people's livelihood resilience and their adaptive capacities.
- Examine and recommend measures for the sustainable, adaptive, and resilient practices for the restoration of livelihood options.
- Advocate for appropriate practice and policies for risk reduction in rural economy.

Study Recommendation

- Development of livelihood activities that are economically and environmentally sustainable.
- Identification of viable activities through exercises like market analysis and value chain studies.
- Cluster development of activities.
- Development of economically oriented institutions.
- Promotion of social entrepreneurs.
- Provision of reasonably priced financial services.
- Promotion of financial literacy.
- Implementation in coordination with local government agencies/NGOs.

Analysis and Outcome

The study is a component of a bigger project titled "Enhancing Institutional and Community Resilience to Disaster and Climate Change" funded by the Government of India (GOI) and the United Nations Development Programme (UNDP).

This report is based on the aforesaid study carried out in Assam by the Rashtriya Gramin Vikas Nidhi (RGVN) of Guwahati. The report has been prepared based on an analysis of secondary data (available literature and documents) and primary data collected from the field in the sampled areas of the state and from stakeholder discussions held in the district headquarters of these areas.

As an outcome of the present assignment, the above measures were recommended for policy formulation, planning, and implementation under the above-mentioned GOI-UNDP project; so that sustainable and resilient practices for restoration of livelihood options can be developed in the flood-affected areas of Assam.

Further follow-up reveals that only part of a few recommendations was implemented as of September 2021. The reason why it is not fully implemented is not known, and therefore, the impact of the project could not be assessed. It has been suggested that there should be more engagement of government agencies with social institutions (like NGOs, SHGs) for effective implementation of the recommendations. Organizations like the Assam State Disaster Management Authority (ASDMA), Assam State Rural Livelihood Mission Society (ASRLMS), etc. are observed as capable institutions to implement further action.



Study Title

Meghalaya Livelihoods and Access to Markets Project Implementation Support Mission Report

Implementing Institution

Meghalaya Basin Management Agency
(MBMA)

Project Location/Completion Year

Meghalaya, 2020

Objective

- Review the progress on agreed short-term targets set by the SM of 2019 and make recommendations about the project performance rating.
- Assess the overall progress made by the project so far and identify strategies that would help in improving the performance.
- Assess activities undertaken under the Integrated Supply Chains and Enterprise Development, which had a slow start, and develop plans to address current challenges/gaps.
- Review the progress under Annual Work Plan & Budget (AWPB) 2019–2020 and assess if the revised AWPB addresses the key priorities to keep the project on track to meet its targets.

Study Recommendation

- Establish targets for the achievement of each component; set district-level targets (physical as well as financial) incorporated into the AWPB; and review progress against these targets (physical and financial) on a quarterly basis.
- Conduct motivational workshops for poor-performing Integrated Village Cooperative Societies (IVCSs) develop one-time incentive schemes for secretaries and IVCSs for the achievement of targets related to IVCS activities.

Analysis and Outcome

The Meghalaya Livelihoods and Access to Markets Project (Megha-LAMP) project is being implemented by the Meghalaya Basin Management Agency (MBMA) with the overall objective of improving rural household incomes and the quality of life in Meghalaya through expanded and sustainable livelihood opportunities adapted to the hill environment and to the effects of climate change.

The project has made substantial progress during this financial year. The achievement against short-term targets has been moderately satisfactory. The project has largely met the short-term targets of the Integrated Natural Resources Management (INRM) component with the exception of releasing the first instalment of Village Development Fund (VDF) to Village Employment Councils (VECs). Under the rural finance component, the project has been successful in registering all 300 IVCSs, but the progress against targets for releasing the first instalment of corpus funds is low. The Integrated Supply Chain and Enterprise Development component has made significant progress related to engagement of market players and support to spice producer groups (PGs), but achievement is under support to piggery PGs and aggregation has been low.

The project has been fully implemented and has high positive impact on women empowerment, access to market/finance, livelihood improvement, increase in productivity, and skill development; and moderate impact on infrastructure development, and access to resources such as water/energy/sanitation, etc. The study further recommended effective coordination among all stakeholders, a proactive local government, and enthusiasm from target groups (like associations) for better implementation.

Study Title

Study on Mining-Affected Areas and Its Impact on Livelihood

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

Meghalaya, 2019

Objective

- Strengthen the community-led natural resource management of different landscapes in Meghalaya.
- Facilitate the community-led planning by providing support, technical inputs, and funding.
- Engage the community at the very early stage of project planning.
- Help the Meghalaya Community-Led Landscape Management Project broadly in the areas of landscape forest and water and help in identifying activities for degraded forest, soil and water conservation, rejuvenation of springs and water bodies, nature-based tourism, agro-forestry, and homestead forestry.
- Conduct assessment of community conservation practices and knowledge.
- Conduct demand supply of wood, fuel wood, and charcoal at the village level.
- Identify suitable sampling sites for the study to cover different minerals like coal, limestone, etc., different types of mining, landscapes, and tribal people.

Study Recommendation

- Undertaking tree plantation, prohibition of coal mining near water bodies used for domestic purposes, prohibition of illicit felling of trees, proper storage of water, construction of drains for diverting polluted water, and Acid Mine Drainage (AMD) in order to protect water sources from contamination.
- Cleaning of rivers and streams at regular intervals, prohibition of plying vehicles near water bodies used as sources of drinking water, construction of enclosure to protect springs, restriction of washing of vehicles near water sources, and cleaning of the villages.
- Prohibition of coal mining in areas used for cultivation of crops, construction of proper drainage system for diverting agricultural run-off away from water bodies, and not allowing dumping of coal near water sources. Burning of domestic waste, proper disposal of domestic waste usually far away from drinking water sources.
- Prohibition of fishing in water bodies with less fish population, and prohibition of the use of any chemical and poison in rivers and streams of the villages for harvesting fishes.



Analysis and Outcome

The study was undertaken with the major objectives of strengthening community-led natural resource management of mining-affected areas of Meghalaya. During the study, information was collected and compiled based on field visits, discussion with the stakeholders, questionnaire survey, laboratory analyses, and consultation with experts. Local bodies, research and voluntary organizations, communities, green volunteers, NGO representatives, etc. were also consulted.

This report has been prepared based on the information generated and gathered from primary and secondary sources. The information gives a generalized view of the state of environment in the mining areas of Meghalaya based on scientific studies and peoples' perception on mining and its impact on natural resources and livelihood based on a questionnaire survey. Measures to mitigate the adverse impacts of mining activity on environmental components and livelihood of the people have also been suggested. Options to restore and rehabilitate the mining-affected areas are also included for the improvement of livelihood options and life of the affected people. It is expected that information included in this report will help in strengthening the community-led natural resource planning and management of different landscapes in Meghalaya.

The implementation of the recommendations is not known as of September 2021, and therefore the impact could not be assessed. However, better coordination among various government departments, effective coordination among all stakeholders, and public-private partnership for better implementation of the research have been suggested.

Study Title

Roots and Tubers for Livelihood Enhancement in Meghalaya, India: Results of a Scoping Study

Implementing Institution

International Potato Centre, CIP

Project Location/Completion Year

Meghalaya, 2016

Objective

- Collect, collate, and analyse existing secondary information on RTC production, processing, marketing, and consumption in target districts covered by IFAD projects and in the province/state in the context of a wider livelihood system.
- Collect, collate, and analyse relevant information on diets, food consumption habits, and nutritional status of rural and urban people (men, women, and children) in the target areas.
- Collect, collate, and analyse additional information about the target area as they relate to the development of climate change scenarios for RTCs.
- Identify key actors and stakeholders across public and private sectors and civil society, with whom FoodSTART+ can engage in both action research and policy formulation to improve the contribution of RTCs to food security.
- Identify key problems and opportunities for attention by FoodSTART+ in the context of partnership with IFAD investment projects and to point out information gaps where further assessments on specific topics are justified.

Study Recommendation

- Improved production and processing of RTCs, including creating opportunities for value addition, low-cost storage, branding of products, and marketing strategies for RTCs.
- The group was keen to have on-farm testing of new varieties of RTCs suitable for processing.
- Since livestock is an integral component of livelihoods of Meghalaya farmers, the group proposed identifying key RTC-based livestock production systems, either based on available information or through undertaking evaluations of new technology options.
- They proposed promoting True Potato Seed (TPS) in potato to solve seed shortage, as has been done in the state of Tripura.

Analysis and Outcome

The study involves gathering information on livelihood, food availability, and vulnerability status of stakeholders in the target site. It also identifies overlaps in food vulnerability with root and tuber crop (RTC) production per site. Diversity in RTCs, especially Colocasia, sweet potato, and yam, which is yet to be fully exploited. Women play a major role in decision-making and perform tasks related to RTC production, utilization, and marketing.

RTC farmers face many challenges, which may be broadly grouped under production, processing, and marketing. Under production, stakeholders mention low output and declining yield of RTCs arising from continuous cultivation of existing varieties and lack of quality seed materials of recommended varieties. RTC production is also affected by biotic and abiotic stresses. The main action areas identified are the RTC value chain; production of quality planting materials for potato; development of new, high-performing varieties of potato, sweet potato, and Colocasia; value addition; plant protection under conditions of organic production; RTC knowledge management and promotion; and formulation of enabling policies.

Some agencies identified as potential stakeholders are ICAR RC, CPRS, CIP-IFAD, and CTCRI.



Study Title

Livelihood Based Agri-Business and Market Study in Mizoram

Implementing Institution

MART Global Management Solutions LLP

Project Location/Completion Year

Mizoram, 2011

Objective

- Understand the existing infrastructure, resources, support services, major occupations, production systems, technology, policy environment, and potential for growth.
- Conduct market assessment and value chain analysis for potential livelihood activities.
- Suggest viable income enhancement strategies for potential farm, off-farm and non-farm sectors.
- Suggest business plans for appropriate livelihood interventions for potential activities.

Study Recommendation

- Turmeric cultivation using improved practices and collective marketing for better returns in both the project districts.
- Cultivation using better practices and collective marketing for better returns in both the districts (Aizawl and Lunglei). Pig rearing for both piglet and port sales in both the districts.
- Poultry (meat) and poultry (egg) in both the districts. Stick (batti) making in both the districts.

Analysis and Outcome

The North-East Rural Livelihood Project (NERLP) of the Ministry of Development of North-Eastern Region (MDoNER), Government of India, aims to address rural poverty in the region through the creation of sustainable livelihood for the rural poor, particularly women. The study covered 10 villages with the support of RDD, Mizoram and conducted FGDs and individual interviews with villagers, state and district officials.

The hallmark of rural community is their engagement in multiple livelihood activities to sustain family needs. Households grow a range of crops, predominantly paddy and horticulture crops. Farmers use traditional and different packages of practices even within one village. The state of Mizoram is a net importer of most agriculture products. There are a number of activities that the project can promote among the poor, including ginger cultivation, passion fruit cultivation, birds eye chilli cultivation, orange cultivation, pig rearing, and poultry rearing. However, five activities namely mandarin orange cultivation, turmeric cultivation, pig rearing, poultry (both broiler and layer) rearing, and stick making (for the purpose of making incensed sticks) have been shortlisted in consultation with PD, NERLP, and the World Bank.

The project need to put in place a cadre of marketing professionals at the headquarters in Guwahati, state level, and at the district level.

The following agencies have been identified as potential support for implementation: horticulture department and MAMCO, animal husbandry and veterinary department, bamboo development agency.

Study Title

Livelihood Based Agri-Business and Market Study in Nagaland

Implementing Institution

MART Global Management Solutions LLP

Project Location/Completion Year

Nagaland, 2011

Objective

Evaluate livelihoods and opportunities on the basis of infrastructure, resources, and support services and value chain analysis in Nagaland.

Study Recommendation

- Organize villagers in SHGs and capacity building of existing SHGs for extending financial support to cultivators.
- Training on improved package of practices with special focus on women. Supply of improved variety of seeds for maize, potato, and soybean with focus on high-yielding local germplasm.
- Supply of improved variety of piglets like Large Black, Hampshire and poultry like Kalinga Brown, Mumbai Desi, Rhode Island Red, CARI Nirbheek, etc.
- Introduce collective action for input sourcing and output marketing. Market exposure and linkages with special focus on women.

Analysis and Outcome

The study objectives were to evaluate livelihoods and opportunities on the basis of infrastructure, resources, and support services and value chain analysis. It covered identification of major livelihood occupations of the rural community and shortlist major high growth subsectors and commodities for value chain analysis where the project can intervene to benefit the poor.

This study presented a picture of subsistence economy in Nagaland that was sporadically linked to the mainstream markets. The study observed that the aged, the widowed, and the orphans faced the severest struggles, and form the poorest of the poor category. These families suffer as there are no able-bodied member to work in the agriculture fields or collect produce from the forests that form the major source of livelihoods. The key findings related to various fields of livelihoods are as follows. Most Naga households are subsistence farmers and grow food for internal consumption only. Livestock rearing is a year-round activity, and as production volume is quite low compared to demand, no seasonal variations are evident. Poultry rearing is an incidental livelihood rather than a planned economic activity in the villages. Cattle rearing is rare in Nagaland. Based on the preceding understanding, five activities were shortlisted for value chain analysis. The five products selected are maize, potato, soybean, pig, and backyard poultry.



Study Title

Livelihood Based Agri-Business and Market Study in Sikkim

Implementing Institution

MART Global Management Solutions LLP

Project Location/Completion Year

Sikkim, 2011

Objective

Assess the economic opportunities in both farm and non-farm activities in the project area, Sikkim.

Study Recommendation

- Improve practices in dairy farming in both project districts.
- Improve package of practices for ginger cultivation in both project districts.
- Rear American Hampstead variety of pig by adopting improved package of practices. Cultivation and marketing of Alstroemeria flowers.
- Promote homestay-based rural tourism.

Analysis and Outcome

The primary objective of the study was to assess the economic opportunities in both farm and non-farm activities in the project area. The NERLP assumes that intensive and innovative use of these local opportunities can result in enhanced livelihood opportunities and incomes for the communities.

Five products, namely, cow milk, ginger, piggery, floriculture, and rural tourism have been identified for intervention. The activities to be performed by the project involves selection of beneficiaries and cluster, social mobilization and institution building, preparation of a business plan with the community, organization of technical and business trainings, market exposure visits, establishment of backward and forward linkages with resource agencies, facilitation of market linkages and monitoring and evaluation, and promotion of higher-order institutions such as federation and producer groups for collective actions.

The following agencies are potential partners for implementations: AHVS department and Sikkim Milk union, wholesalers, HCCD Department, SIMFED, progressive farmers and financial institutions, HCCD Department, SIMFED, Mainam Gardens, retailers, inputs suppliers, Tourism Department, various cooperative societies involved in rural tourism, ECOSS, Help tourism, TASS, etc.

Study Title

Livelihood Based Agri-Business and Market Study in Tripura

Implementing Institution

MART Global Management Solutions LLP

Project Location/Completion Year

Tripura, 2011

Objective

Assess economic opportunities in both farm and non-farm activities in Tripura.

Study Recommendation

- Focus on productivity enhancement.
- Focus on building capacity on markets and marketing and entrepreneurial skills and direct marketing of produce.
- Decentralize production and collective procurement and marketing of produce.
- Regular training on better PoPs/technologies.
- Promote village-level cadres for hand-holding support.

Analysis and Outcome

The primary objective of the study was to assess economic opportunities in both farm and non-farm activities in the project area. The NERLP assumes that intensive and innovative use of these local opportunities can result in enhanced livelihood opportunities and incomes for the communities. The study looked at existing resources, skills, infrastructure and support services, markets for poor, major livelihoods of poor involved in agriculture, livestock and non-farm activities to suggest practical interventions. The study has proposed intervention in the following areas: potato, chilli, fishery, pineapple, and black gram. The activities to be performed by the project involves selection of beneficiaries and cluster, social mobilization and institution building of poor, preparation of business plan with the community, organize technical and business trainings, market exposure visits, establish backward and forward linkages with resource agencies, facilitate market linkages and monitoring and evaluation, and promoting higher-order institutions such as federation and producer groups for collective actions.

The project needs to create a chain of marketing professionals at head office, state level and district level and para professionals at the village level to execute the implementation plan.



Study Title

Study on the Prospects of Economic Forestry with Special Reference to Livelihood, Skill Requirement and Market Linkage of Artisans on Bamboo Craft in Assam, Meghalaya, and Nagaland

Implementing Institution

N R Management Consultants India Pvt Ltd
(NRMCM)

Project Location/Completion Year

More than one state, 2018

Objective

- Assess the existing status of the economic forestry with special reference to bamboo.
- Analyse the current forest laws and policy framework and issues of landownership and rights.
- Identify craft persons and clusters and assess the prevailing/existing crafts and methods, level of investment, and earnings at the cluster level.
- Skill gap analysis.
- Scope for capacity building, skill upgradation of artisans, and promotion of traditional crafts and art with improved technology, design, and value addition.
- Identification of appropriate product, process, efficient tools, and technologies.
- Identification of appropriate marketing concepts and linkages for the producer groups to improve earnings and sustain business turnover.
- Prepare an institutional framework and roadwork for improving the skill set, product line, and marketing opportunity among the artisans and other stakeholders with a special reference to female artisans.

Study Recommendation

- The study highlights that ambiguous legislation and regulatory mechanism for bamboo harvest and trade have inhibited the growth of bamboo-based industries.
- The need of the hour is an efficient regulatory institution, which will enable markets to grow in a sustainable manner.
- Combined with the challenges posed by the regulatory system, there are challenges at each stage of the bamboo value chain—production, transformation, and consumption.
- Further, with the implementation of GST, the cost of the bamboo products is now more than the available alternatives. This will constrain the expansion of the bamboo sector.

Analysis and Outcome

The bamboo sector in the north-east holds great potential to contribute to the development of livelihoods and for the benefit of the rural economy. The easing of various permits, consistency, and uniformity in law, and effective implementation of existing progressive provisions will aid the growth of the sector to contribute to reducing rural poverty. Current demand is heavily concentrated in traditional bamboo markets. But growth for bamboo products is highest in the emerging wood product substitute-based markets.

Study Title

Livelihood Improvement and Empowerment of Rural Poor through Sustainable Farming System

Implementing Institution

ICAR Research Complex, NEH Region, Umiam,
Meghalaya

Project Location/Completion Year

More than one state, 2013

Objective

- Evaluation and validation of indigenous and improved farming system models for enhancing production in agro-ecosystem of disadvantageous areas of the NEH region for sustainability, profitability, and competitiveness.
- Addressing the constraints of deliverables to facilitate the community/ people to harness benefit from the agriculture sector.
- Capacity building, skill upgradation, information access, and promotion of various activities by specific SHGs.
- Employment generation through agro-processing and value addition, including storage, packaging, transportation, and marketing of the produce.

Study Recommendation

Promote SHG formation and facilitate various entrepreneurial activities for their sustenance. Create awareness on various issues such as social ills (drug abuse), sanitation, health, and hygiene for their overall well-being.

Analysis and Outcome

Under this project, the National Agricultural Innovation Project (NAIP) with SASRD, Nagaland University as a consortia partner, and the ICAR Research Complex for NEH Barapani as the lead centre of the region had carried out many agricultural and non-agricultural activities at the Longwa village under the Mon district with the aim to improve livelihoods and pave the way towards sustainability, especially in agriculture.

The following interventions were carried under the project initiative: kitchen gardening; potato cultivation; rice (SARS-V); maize (all rounder); low-cost poly house/net house; off-farm activities such as weaving, knitting, and tailoring; backyard poultry and mini agro-processing. Overall, the project has the following impact: increase in employment/Mandays=Crops- 160 days/yr/HH, Livestock=5.2 days/yr/HH, and Non-Agricultural activities=7.5 days/yr/HH. The most important achievement of the NAIP is gaining the trust and confidence of the villagers who were weary of several other agencies and strangers who had visited the village in the past but had not left any lasting impression as the present project has done.

In addition, the project developed many synergy with different officials and departments such as Deputy Commissioner, Mon; District Agriculture Office; KVK, Aboi and ATMA, Mon; Fishery Department, Government of Nagaland; Veterinary and Animal Husbandry Department, etc. For financial support and guidance, the SBI, Mon and NABARD, Dimapur have been associated.

For a sustained effect, the same institutions and agencies can continue to work together with the villagers.



Study Title

In-situ Conservation of Rich Medicinal Plants Resource Area in Natural Habitat and Establishment of Medicinal Plants Conservation Areas (MPCAs) of High Altitude Medicinal Plants Species

Implementing Institution

NTFP Research Education Extension, Forest,
Environment and Wildlife Management
Department, Government of Sikkim

Project Location/Completion Year

Sikkim, 2014

Objective

- Conservation and sustainable development of Rare, Endangered and Threatened (RET) species having high medicinal value to increase the quality medicinal plants products and local employment generation.

Study Recommendation

Recommendation has not been outlined in this report

Analysis and Outcome

The project activities were implemented in 04 different districts named North, South, East & West. In North and East districts, main medicinal herbs with economic value such as *Picrorhiza kurroa* (Kutki), *Aconitum* sp. (Bhis), *Dactylorhiza hatagirea* (Ungali), *Podophyllum hexandrum*, *Juniper recurva* (Junifer), *Nardostachyis jatamansi* etc. (Jatamasi) *Rheum* Sp. *Ephedra* sp. etc. were found in the field which are to be conserved. In South Sikkim species such as *Abrus precatorius* (lalgeri) *Achyranthes aspera* (Apamarg), *Alstonia scholaris* (Chatiwan), *Asparagus racemosus* (Kurilo), *Boerhavia diffusa* (Punarnava) *Cassia fistula* (Raj briksha), *Centella asiatica* (Ghortapray), *Eclipta prostrate* (Bhringaraj), *Phyllanthus emblica* (Amla), *Terminalia ballerica* (Bahera), *Terminalia chebula* (Harra), *Oroxylum indicum* (Teto) etc were found to be endangered and required to be conserved.

In the West District, main species are being conserved and planted are *Phyllanthus emblica*, *Terminalia ballerica*, *Terminalia chebula*, *Oroxylum indicum*, *Rubia cordifolia*, *Abrus precatorius*, *Achyranthes aspera*, *Alstonia scholaris*, *Asparagus racemosus*, *Boerhavia diffusa*, *Cassia fistula*, *Centella asiatica*

The protection works such as fencing of area, gate fixing etc. is in progress.

Study Title

Exploration, Utilization, Conservation and Documentation of Allium Species in North-East India

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2015

Objective

- Exploration, identification, and habitat characterization of Allium species occurred in different habitats of North-East India.
- Germplasm collection and protection of Allium species under the existing microclimatic conditions at nursery.
- Study on ethno botanical importance of the Allium species.
- Study on phenology, and growth and regeneration potential of a few Allium species having food value and ornamental value.
- Estimation and biochemical characterization of some important Allium species.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

The study was undertaken with a view to conserve and document the Allium species in North-East India. A total of 15 Allium species, namely, *Allium cepa*, *Allium chinense*, *Allium fasciculatum*, *Allium hookerii*, *Allium macranthum*, *Allium porrum*, *Allium prattii*, *Allium rubellum*, *Allium sativum*, *Allium scheonoprasum*, *Allium sikkimense*, *Allium stracheyi*, *Allium tuberosum*, *Allium victorialis*, and *Allium wallichii* were recorded through extensive field survey in different parts of North-East India.

The recorded Allium species are distributed in different habitat types and altitudinal gradients ranging from 400 to 5400 MAMSL. All the recorded species were used for various purposes by several tribes of North-East India. Out of the 15 species, 10 species have medicinal values, which have been widely used for treatments of various health ailments.

The study highlights the rich variety of Allium species in the NER, India, and their uses for different purposes from culinary to décor.

The agricultural research institutes, ICAR, and the agriculture departments of the states can take effective measures to conserve indigenously found Allium spp. in the region.



Study Title

Bay Leaf Cultivation: A Sub-Sector Study in Meghalaya

Implementing Institution

Institute of Livelihood Research and Training

Project Location/Completion Year

Meghalaya, 2014

Objective

- Understand existing players and their practices/contribution for improvement in the sub-sector activities.
- Assess the gaps preventing effective performance with specific reference to the primary producer.
- Recommend implementable solutions to enhance the stake of primary producers in the sub-sector.

Study Recommendation

- Explore opportunities for value-added products like powder, oil; processing into finished products; potential to add value locally by producers/collectors.
- Contractual agreement between suppliers and buyers as means of accessing markets; maintaining quality by following appropriate grades and standards; opportunities to increase production by expanding harvesting areas; planting more trees; collectors' and producers' groups aggregating products to increase volumes; provision of market information related to places of sale, buyers, prices, grades, research information, etc.
- Auction yards where producers/collectors bring their produce and sellers gather to bid prices. The highest bidder purchases the produce.
- Access to finance for setting up small enterprises; provision of working capital, revolving funds; bank credit, etc.
- Opportunities to improve the management of bay leaves and enhance their quality by adopting different certification schemes.
- Opportunities to change and adjust current policy barriers for the benefit of the bay leaf VC actors, particularly producers and collectors.

Analysis and Outcome

Bayleaf is classified as a Non-Timber Forest Produce (NTFP), Minor Forest Produce (MFP) as well as a Medicinal and Aromatic Plant (MAP). Apart from being used as a spice, its oil finds major uses in the perfume, pharmaceutical, and ayurvedic sectors. The study has revealed that an area of 1–3 acres contains 30–40 bay leaf trees with average yield per tree at 35 kg and per acre at 525 kg with net average realization at around ₹4000 per acre. Institutional and policy environment concerning bay leaf is sketchy with only a toll transit tax being collected by the Autonomous District Council. There is no specific initiative either by any department, agency, or corporation of the state in propagation, strengthening, or linking the producers to bulk institutional buyers at remunerative prices. There were no grading standards for bay leaf in place at the upstream level except for sorting twigs before being packed in gunny bags. Storage practices at the primary producer level were not adequate to keep out moisture and increase shelf life. The pricing system was non-transparent with pricing being decided by the larger traders.

Study Title

Management of Ecosystem of the Kaziranga National Park by Creating Climate-Resilient Livelihood for Vulnerable Communities through Organic Farming and Pond-Based Pisciculture

Implementing Institution

Kaziranga National Park (KNP) under the Department of Environment and Forests(DoEF), Government of Assam

Project Location/Completion Year

Assam, 2019

Objective

- Rejuvenate selected beels, which are presently completely dry, including de-siltation to increase their depth and thus augment their water-holding capacity.
- Increase the livelihood options for the vulnerable communities living in the vicinity of the Kaziranga National Park through organic farming and pond-based fisheries.
- Management of watersheds through check dams and ponds.

Study Recommendation

- Rejuvenating selected beels, which are presently completely dry, including de-siltation to increase their depth and thus augment their water-holding capacity. This will help in reducing the intensities of floods as well as provide options for managing and tackling drought conditions under a possible climate change scenario.
- Increase the livelihood options for the vulnerable communities living in the vicinity of the Kaziranga National Park through organic farming and pond-based fisheries.
- Management of watersheds through check dams and ponds to restore and maintain the hydrological balance of the ecosystem, to build its resilience towards climate change affects.

Analysis and Outcome

The study envisages to rejuvenate *beels* with a view to improve the livelihood of the people living in the surrounding areas. Organic farming is envisaged for the vulnerable communities within the southern periphery of the national park. A focused livelihood generation from fisheries is also envisaged. The project sites include North Bank: Tewaripal and Gorpai; South Bank: Rangalu, Difalupathar, Mohpara, Chepenakubua, No.1 and No. 2 Kohora EDC, Kuthori.

With past experience of implementing large-scale resource management projects within the vicinity of the park, the Kaziranga National Park (KNP) is better placed for implementing this project. The Assam Climate Change Management Society, NABARD, Assam Agricultural University, and North-Eastern Regional Institute of Water and Land Management (NERIWALM), and EDCs comprising community members of all project sites along with the civil society organization in the region will extend technical support to the project.



Study Title

Safeguarding the Value-Added Indigenous Breakfast-Rice Cultivars of Assam with Breeding Perspectives, and Exploring the Exploitation Avenues for Promoting Assamese Cuisine “Jalpaan”

Implementing Institution

Society for Socio-Economic Awareness and Environment Protection (SSEAEP)

Project Location/Completion Year

Assam, 2013

Objective

- Survey and surveillance of breakfast-rice cultivars.
- Farmers’ participatory breeding to identify superior cultivars.
- Productive cultivation campaign.
- Liaison with manufacturers for creating marketing avenues.

Study Recommendation

- Each plot under Grow Out Tests, Demonstration and On-Farm Research was closely monitored (Plate 3) with due care to save the Sisu (Baby Trial) from stresses.
- Timely irrigation along with balanced fertilization as per recommended dosages of the Central Brahmaputra Valley (CBV) zone was advocated.

Analysis and Outcome

The study is a component of Project Jalpaan. As part of the study, 93 candidates of the indigenous Joha-Bora-Komal rice cultivars were engaged. The study also accomplished need assessment using PRA for improving the productivity and quality of the value-added rice. From the study, 41 pure lines were developed from the pool of collection of 93 landraces and are maintained in the farmers’ fields. It also initiated mass awareness programme to educate farmers. Participatory farmers of SC, ST, and women benefitted from this project.

As of September 2021, only a few recommendations have been partially implemented due to the lack of finance, regulations, awareness, consultancy, and proper marketing facilities.

The projects generated employment, created a positive impact on women, increased the income of farmers, improved the livelihoods, increased the productivity, and also imparted skills to the farmers.

The outcome of the project has been in the form of report, policy formulation, news items, social media communication, application for the Plant Genome Saviour Community Award, 2013–14.

Study Title

Ericulture for Uplifting the Socio-Economic Conditions of the Rural Women in the Tribal Villages of Assam

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2019

Objective

- Improve the livelihood of tribal women through the introduction of ericulture.
- Set up a central grainage and rearing of Eri silk worm for the production of cocoon, pupae, and yarn in a cluster approach.
- Create awareness and build capacities of the women beneficiaries regarding scientific ericulture.
- Study the economics of ericulture from pupa, cocoon, and yarn.
- Study the quality of cocoon in different food plants of Eri.

Study Recommendation

- Providing looms for weaving of spun yarn.
- Designing and product diversification for better price realization. Natural dyeing of yarn.
- Castor plants need to be cultivated extensively through different government programmes (state and central) for the better growth of the Eri silkworm.

Analysis and Outcome

The project has benefitted several farmers engaging in ericulture by way of providing efficient tools, imparting training programmes related to rearing and management ericulture. However, full benefit of the project could not be achieved because only parts of the recommendations have been implemented because of financial constraints. In effect, only marginal benefits could be seen in employment, income, women empowerment, etc. Therefore, the study further recommends for better coordination among various government departments, effective coordination among all stakeholders, and public-private partnership to reap the benefits of the study.



Study Title

Project Completion Report Package A: Improved Eri silk Spinning and Weaving at Palashbari

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2018

Objective

- To improve the level of knowledge of the women spinners on improved spinning machines for increasing spinning efficiency and reduction of spinning time.
- To increase availability of spun yarn for marketing.
- Awareness about improved Eri spinning machines and marketing of yarn.

Study Recommendation

- Regular supply of cocoons for continuing the spinning and weaving activities.
- Capacity building for the processing of enzymes and chemical means to expedite release of yarn.
- Capacity building of spinners and weavers for the production of quality yarn and fabrics.
- Self-Help Groups (SHGs) for spinning of cocoons, adoption of spinning machine, and capacity building for its operation.
- Weaving, designing, and product diversification.
- Market exposure through participation at various Handloom Mela and trade fair for a wider market niche.

Analysis and Outcome

The study was undertaken to improve the socio-economic condition of women folks of the project villages, namely, Guimara, Simana, Mokhardhoj, Futuri, Bartari, and Boratoli, of the Palashbari area in the Kamrup (Rural) district of Assam. The project activities mainly focused on providing inputs, hand-holding training on eri silk spinning and weaving, establishing forward and backward linkages, and organizing spinners and weavers into groups for collective action.

The implementation of the project has yielded a substantial outcome. As part of the study, 50 group bank accounts for 500 beneficiaries have been opened.

An efficient spinning machine for eri cocoon has been introduced and distributed to target beneficiaries. The introduction of the spinning machine has reduced the spinning time from 6 days in Takli to 3 days. It has also generated more income from `Rs 47/day to Rs 93/day from spinning. The study also has identified more market channel for the beneficiaries.

Study Title

Regional Master Plan and Strategy for Development of Sericulture in Increasing the Eri, Muga, Tasar, and Mulberry Silk Production and Marketing in the NER

Implementing Institution

Spectrum Planning (India) Ltd

Project Location/Completion Year

More than one state, 2018

Objective

- Impact analysis of the initiatives taken up by the Central Silk Board in the NER states, NER Sericulture Development Mission, and central- and state-sponsored schemes providing support services like technology application, modern grain ages, and farmers' training and marketing of products in this sector, etc.
- Study the organizational set-up of the stakeholders involved, assess adequacy, capability, training facility, etc. of functionaries available for sericulture development in the state.
- Identify the constraints affecting the production and marketing of silk products. Identify various intervention measures to be adopted by the government as well as other stakeholders for analysing large-scale production, including design and technological intervention of silk and silk product in the state.
- Identify and suggest marketing interventions required for the promotion of silk both in the domestic as well as international market; branding of the silk produced in NER in line with the Indian silk brand promotion.
- Prepare suitable project profiles for silk production and marketing (separately for Eri, Muga, Tsar, and Mulberry silk) for enterprise development in the sector.

Study Recommendation

- Give more financial support, R&D focus, and extension support. Bring more project components that would encourage youth and women to participate.
- Research on intercropping, and consumption of pupa.
- Development and use of silk information system, vernacular call centre for support and guidance, and mechanization of labour.
- Standardization of silk products, quality control, and certification.
- Catalysing large-scale silk production.
- Interventions for Promotion of Indigenous Silks in the Domestic and International Markets.
- More proactive role to be taken by institutions and stakeholders.

Analysis and Outcome

An exhaustive cross-sectional field survey in all eight states, covering every aspect of sericulture and silk industry, was undertaken and the findings were subjected to qualitative and quantitative appraisal.

The north-eastern sericulture is predominantly ericulture based. According to the official data, Eri silk accounts for more than 90% of the total silk output of NER. Women participation in sericulture is high in NER. Of all the states, Tripura shows the highest feasibility in mulberry sericulture, followed by Assam, Manipur, and Mizoram. There is vast potential of intercropping in mulberry. Medium-scale holdings are economically viable, small, and the large-scale sericultural farms are economically non-viable at the existing operational mode. The Central Silk Board plays a key and vital role in the region's sericulture promotion. There is no proper system of authentication; therefore, markets are flooded with imitation fabrics, which create a severe imbalance in the industry.

The study provides the policy makers important insights into the status, issues, and prospects of sericulture in the NER of India.



Study Title

Impact of Neem-Coated Urea on Production, Productivity, and Soil Health in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2017

Objective

- Analyse the trends in the usage and prices of urea versus neem-coated urea (NCU) in selected states.
- Analyse the adoption behaviour of NCU among selected farmers in irrigated and unirrigated tracts.
- Analyse the impact of adoption of NCU on crop productivity and farmers' income.
- Document the status and implementation of the Soil Health Card scheme.
- Suggest suitable policy measures for the adoption of NCU and the implementation of the SHC scheme

Study Recommendation

- Mass awareness campaign at the village level to educate the farmers on the application of NCU and its advantages.
- Do away with the apprehensions of a section of farmers by conducting some field trials at the village level to instil confidence among the farmers.
- Undertake an impact study of NCU in Assam once a year.
- As evidenced from the research findings, the merits and demerits of normal urea vis-à-vis NCU and their mode of action should be made known to the farmers by the government machineries so that the farmers can take judicious decision on their own.
- Appropriate doses of NCU need to be defined/recommended for each crop grown by the farmers.
- The price of NCU must be monitored weekly at the distributor and retailer levels so that no unscrupulous forces can take undue advantages.
- The supply of NCU at the right time and right place needs focused attention and should be ensured by all possible means

Analysis and Outcome

The study was undertaken at the instance of the Ministry of Agriculture and Farmers Welfare, Government of India. The introduction of NCU is a new initiative primarily intended to replace the normal urea from the crop field in consideration of its comparative advantages. The study was based on both primary and secondary data. The reference period of the study was related to Kharif 2015, covering two crops: paddy (irrigated) and jute (unirrigated). The primary data were collected from two districts: Kamrup and Nagaon. Altogether, the study covered 400 sample farmers comprising 200 samples for each crop.

The results of the study clearly indicated that there was an increase in yield to the tune of 5.34% for paddy and 3.02% for jute following the usage of NCU in the fields.

For a way forward, the study remarks that this initiative must go hand-in-hand with another initiative called the Soil Health Card (SHC) scheme started in February 2015. This would require a dedicated approach by the implementing agencies and a responsive farming community to move forward.

Study Title

Impact of the Soil Health Card Scheme on Production, Productivity, and Soil Health in Assam

Implementing Institution

Assam Agricultural University

Project Location/Completion Year

Assam, 2017

Objective

- Document the status and implementation of the Soil Health Card scheme.
- Analyse the impact of adopting soil-testing technology and the recommended doses of fertilizers on crop production, productivity, and soil health based on SHCs.

Study Recommendation

- Proper monitoring of the work of the agency associated with the collection of soil samples and distribution of cards. As such, the government should develop a kind of supervisory mechanism to see that the scheme is being implemented in letter and spirit.
- A soil map for each district is needed, which would be helpful to capture the soil structure of the district at a glance.
- Adequate infrastructure development of soil labs in the state need focused attention.
- Farmers must be taken into confidence while collecting the soil samples from their crop fields.
- There is an urgent need to develop a functional database of farmers of the state. This will facilitate the implementation of any agricultural development programme.

Analysis and Outcome

The present study was undertaken considering the growing importance of soil testing. This study was based on both primary and secondary data. The reference period of the study was related to Kharif. The primary data were collected from two districts (Jorhat and Golaghat) of Assam. Altogether, the study covered 120 sample farmers comprising 60 Soil Health Card holders and 60 control farmers.

As per the objectives and guidelines, a comparative study was supposed to be undertaken between the two groups of sample respondents to see the impact of the SHC scheme on the production and productivity of crops and to see the awareness of the farmers along with the adoption of the recommended doses of fertilizers on soil test basis, as well. But no visible inference could be drawn from the study conducted in the state, as no farmers having SHCs so far adopted the recommended doses of fertilizers till the date of field survey. Nevertheless, sincere attempts were made to portray the real picture of the field situation in the context of implementation of the SHC scheme. Such an evaluation study will be more meaningful only after the programme reaches the field. The study further recommends better coordination among various government departments, effective coordination among all stakeholders, a proactive local government, and more engagement of social institutions (like NGOs, SHGs).



Study Title

Diversity of Arbuscular Mycorrhizal Fungi in Woody Tree Species from a Tropical Deciduous Forest of Manipur and Evaluation of Their Potential Applications in Nursery

Implementing Institution

Manipur University

Project Location/Completion Year

Manipur, 2015

Objective

- Assessment and identification of species composition of arbuscular mycorrhizal fungi (AMF) in rhizosphere soils during three different seasons and the intensity of mycorrhizal infections in the roots of selected woody trees.
- Analysis of the physio-chemical properties of the collected soil samples.

Study Recommendation

- Continue the maintenance of AMF spores in trap cultures using suitable host plants; extraction of different morphotypes of AMF spores from the trap pot soils and the identification.
- Evaluate efficient mycobionts (AMF species) for their ability to enhance the selected tree seedlings growth under nursery conditions

Analysis and Outcome

Eighty roots and rhizosphere soil samples were collected belonging to sub-tropical plantation forest of different places in Manipur and were examined for arbuscular mycorrhizal (AM) association, dark septate endophyte (DSE) colonization, and AMF spores extraction.

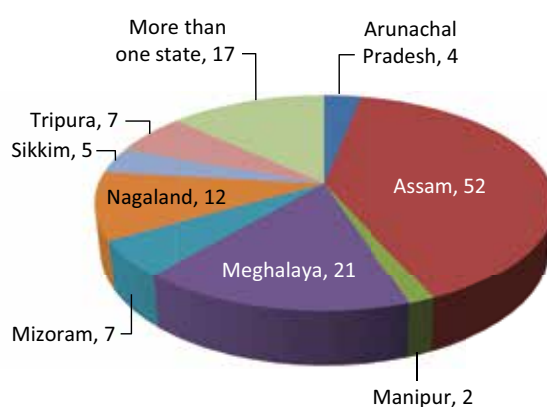
The study concluded that AM fungal inoculation technology can be used in the restoration of fragile habitats. In view of the potential importance of these fungi for vegetation conservation and sustainable forestry, a detailed survey of native AMF diversity in this region would provide a basis for future action for the rehabilitation of degraded ecosystems.

As of September 2021, the recommendations of the study have been fully implemented. It has also been observed that there is significant positive impact in terms of employment generation, women empowerment, income generation, productivity, and skill development.

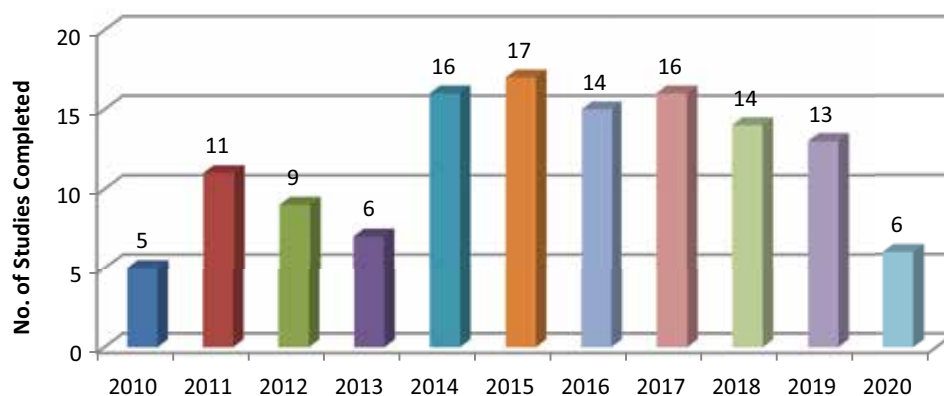
This study would be helpful for forestry research in the North-Eastern India.

State-wise Summary

The North Eastern Region (NER) has untapped potential to enhance the income of the farming community through promotion of location-specific crops, horticultural and plantation crops, fisheries, and livestock production by using appropriate technologies and suitable strategies for diverse agro-climatic conditions of the region. The implementation of various programmes like National Food Security Mission (NFSM), Rashtriya Krishi Vikas Yojana (RKVY), Mission for Integrated Development of Horticulture, Blue revolution, MOVCDNER (Mission Organic Value Chain Development in North Eastern Region) and other such initiatives of the Govt. of India along with the recently declared packages under Aatmanirbhar Bharat would help the region in achieving the much-needed growth in the Agriculture sector. However, the following issues/ areas need immediate attention from the policymakers and other stakeholders.



Studies completed in Agricultural Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Agriculture Sector in NER during 2010 to 2020 (Year-wise)

In the past one decade, over 127 research studies on Agriculture and allied sectors have been carried out in the eight North Eastern states by various academic and research institutions located in all the eight NE states. Academic and research institutions located in Assam received the maximum number of studies (52), followed by Meghalaya (21), Nagaland (12), Tripura (7), Mizoram (7), Sikkim (5), Arunachal Pradesh (4), and Manipur (2). Moreover, 17 research studies have been carried out in more than one state. These studies have focussed on assessment, research and development and livelihood generation activities in the fields of agriculture and allied sectors.

As a result, the sector has witnessed considerable growth over the past 10 years in the areas of cultivation, popularization of technology, post-harvest management, extension, value addition, and marketing.



Arunachal Pradesh

In the present study, 4 study reports related to agriculture and allied sectors have been collected and analysed to understand the constraints and opportunities for development of the sectors for the growth of the State and livelihood generation of the farming communities and entrepreneurs.

Information on four study projects in irrigation, development of agriculture and allied sector, district inventory of agriculture and development of orange harvester were collected.

One of the projects titled “State Irrigation Plan under PMKSY—Arunachal Pradesh” implemented by National Bank for Agriculture and Rural Development (NABARD) has been completed in 2020. This Study was envisaged under the Pradhan Mantri Krishi Sinchai Yojana (PMKSY), which is an integrated planning and management of water resources scheme, through the estimation of water budget for each of the districts and sub-districts and the preparation of strategic action plans to address the water gap through District Irrigation Plans (DIPs).

One of the studies relates to orange farmers in Arunachal Pradesh. The study was necessitated to develop tools to increase the efficiency of orange harvesting and to ease the physical strain on orange cultivators. Development and demonstration of various harvesting methods is important to compare the performance of improved harvesters with traditional methods and others harvesting equipment. Therefore, development of tools is the necessity for the farmers of the state to increase the efficiency of harvesting and to ease the physical exertion of the cultivators in doing so.

Another study has highlighted various constraints affecting the productivity of the major crops in Lower Dibang Valley District. The information provided in this report is useful for the stakeholders. This report may be useful to policy planners, farmers, and all those who are concerned with the development of agriculture and related fields of the district.

Assam

Fifty-two (52) study reports focussing on agriculture and allied sectors in Assam have been collected and analysed to understand the constraints and opportunities for development of the agriculture and allied sectors in the state.

Many reports have highlighted that the scope of increasing farmers’ income through on-farm and off-farm activities are more as the existing production has not been able to fully meet the local demand. The present situation of demand supply promises good potential of interventions for agriculture and allied sectors and off-farm activities in the state.

Integrated Watershed Management Programme has been studied in seven different locations in Assam. This study has been carried out by TERI in 2014. The soil erosion and subsequently flood and sedimentation have significant impact on the people of the watershed during rainy season and on the other hand acute water shortage during winter season. These problems significantly affect the land utilization pattern, culture and economy of the watershed area and also lead to a degraded environment. Though the present study areas are erosion prone, yet, it has tremendous scope for development considering the natural resources of the areas and the area has high agricultural potential.

There are areas which need special attention to boost up the economy of the state by undertaking continuous research and development along with infrastructure development for the modernization of product processes and upgrading the techniques to meet the changing requirements of customers. Capacity building of the farmers and hands-on training is the key in increasing the level of production and productivity along with value addition, designing and product diversification for better price realization.

There is an urgent necessity of development/improvement of road connectivity and infrastructural facilities in the remote areas so that the agripreneurs can build up their ventures for the interest of the farmers.

In the tea sector, the government needs to make sincere efforts and look into the issue concerning the land ownership for the small tea growers of the state. Tea Board of India, Tea Research Authority, and corporate tea producers should take the responsibility to train various aspects of tea cultivation to the small tea growers.

Manipur

In the present study, 2 study reports focussing on agriculture and allied sectors in Manipur have been collected and analysed to understand the constraints and opportunities for development of agriculture and allied sectors in the state.

Agriculture production system is mostly rainfed, monocropped and subsistence in nature. Use of local cultivars, limited use of nutrient and pest protection measures especially in hills, low moisture retention capacity of upland soil and lack of irrigation facilities along with traditional crop management practices have resulted in low crop productivity and low cropping intensity. The State cannot achieve sustained progress in agriculture unless and until more and more cropped area is brought under assured irrigation. Utilization of groundwater for agricultural purposes may create problem in the long run. Therefore, priority should be given for harvesting of rainwater and efficient utilization of surface water. Appropriate watershed programmes adopting ridge to valley approach with people's participation need to be encouraged to harness the untapped benefits that the state has.

The study conducted on the use of arbuscular mycorrhiza (AM) fungal inoculation technology suggested that the technology can be used in the restoration of fragile habitats. In view of the potential importance of these fungi for vegetation conservation and sustainable forestry, a detailed survey of native AM fungal diversity in the state would provide a basis for future action for the rehabilitation of degraded ecosystems.

Meghalaya

In Meghalaya, 21 study reports related to agriculture and allied sectors have been covered under the "Study of Studies" to understand the constraints and opportunities for development of the sectors. Meghalaya has a variation of agro-climatic zones, ranging from temperate to tropical, which offer tremendous scope for cultivation of temperate as well as tropical fruits and vegetables. More than two-thirds of the population in Meghalaya depends on agriculture and allied activities for its livelihood.

Enhancement of foodgrain production in the hill State of Meghalaya is constrained by the topography in which only about 12% of its geographical area is suitable for cultivation of crops for food grains' production. The geo-climatic situation of Meghalaya offers an excellent scope for growing of diverse types of horticultural crops including fruits, vegetables, spices, plantation crops, and medicinal and aromatic plants of high economic values.

Various research studies conducted in the State recommended effective coordination among all stakeholders, a proactive local government, and enthusiasm from target groups for better implementation of the scheme/programme. There is a need to provide technical inputs and capacity building in land and agriculture productivity enhancement so as to enable the community to include such interventions in the community-led plans. Effective use of biomass could reduce deforestation, as felling of trees for fuel has been ranked by the community as the second largest driver of deforestation in a study conducted for identifying the drivers of deforestation in Meghalaya.

So far, in the nutrient management aspect there are advantages and disadvantages in the usage of organic manure and inorganic fertilizers. In view of this, an optimum combination of organic and inorganic fertilizers can be planned for the compensation of deficient nutrients for sustainable agriculture in major crops grown in the State. The study undertaken with the major objectives of strengthening community-led natural resource management of mining-affected areas of Meghalaya need location-specific restoration approach. Derivative maps for land degradation, land capability, land irrigability, and crop suitability need to be prepared based on the soil map and analysis data using GIS tools for better planning and implementation of schemes/programmes. Soil erosion and soil acidity are the major land action plan needed for the State for land resource development. In this regard, various land and water resource development programmes like soil and water conservation measures, liming to increase the pH and decrease the soil acidity for improving nutrient availability, and application of deficient nutrients need to be focused.

In horticulture development sector apart from plantation strengthening of horticulture hubs, post-harvest management, and subsidy to SHGs, construction of low-cost poly house, construction of farmers training centres is required to be undertaken by understanding the location-specific needs. Replacement of old varieties with new high-yielding, climate-resilient ones with good characters and suitable for market need to be taken up by conducting trials and popularizing the best ones. Strengthening the knowledge of farmers and entrepreneurs on value addition through capacity building and creation of brand awareness for



horticulture crop growers and facilitation of marketing are key areas for the growth of the sector to enhance the livelihood of the farming communities of the state.

In livestock sector, traditional poultry farming needs immediate support of vaccination, deworming, and basic management strategy for improvement of the sector. Establishment of decentralized mini-hatcheries and village-level incubators to accommodate poultry farmers' choice of birds and sustain diversity are important to promote vendors for quality chick supply. Development and standardization of package of practice for backyard poultry through amalgamation of traditional practice with modern poultry management will help the farmers and the area needs special focus as livestock provide instant income to the rural population.

Mizoram

In Mizoram, 7 projects related to agriculture and allied sectors have been covered under the study to understand the constraints and opportunities for development of agriculture and allied sectors in the State. Mizoram is an agricultural state in terms of the level of dependence of the population on agriculture and allied sector for livelihood. Agriculture is the backbone of economy of the state, and provides employment opportunities, and also meets the ever-increasing requirement of the population.

Studies conducted in the State indicated that the state does not produce significant surpluses of any crop to be considered a commercial producer capitalizing on its comparative advantage. There have been a number of studies on options for reforming the agricultural sector in the state of Mizoram. The main constraints identified by the studies are the topography, connectivity, and the resultant difficulties in accessing the markets. Therefore, identification of environmentally sound crops for hilly areas, integrated local enterprise policy, which encourages small enterprises development within existing production systems, specific support for small enterprises and new cropping strategies and development of marketing networks, risk mapping using the various climate scenarios to cover all contingencies, intensive monitoring mechanism and mid-term evaluation missions are some of the activities to develop agriculture and allied sectors in the state.

Watershed management approach is another important segment in soil, water, and biomass conservation initiative. In this regard, suitable institutional mechanism for bringing about coordination between different departments at the central and state levels with a view to ensuring uniformity of approach in implementing the programmes for the conservation of land and water resources need to be planned for accordingly. The major problem lies with the most primitive and prevalent method of shifting cultivation or Jhuming, which results in rapid degradation of the primary forest, heavy soil erosion, and rapid surface run-off flow. Therefore, to overcome the above-mentioned constraints and for successful implementation of various soil conservation measures proposed in the micro-watershed, effective cooperation of the beneficiaries and participation in the watershed are very important.

Ginger and turmeric cultivations have lots of potentiality in the State and for proper planning, resource mapping needs to be done properly. Study conducted in this sector indicates how Mizoram can play the most competitive role in efficient production, inter-state trade, product diversification, import substitution, and fuelling export-led growth of the country.

The government should intervene in the marketing of different agricultural commodities in Mizoram. The Minimum Support Price (MSP) scheme in the state should be implemented for any crop in the state. In this regard, there is a need to study the status and modus operandi of the Market Intervention Scheme (MIS) scheme with a view to assess the price behaviour of the targeted commodity and to suggest appropriate policies for better performance of the scheme.

Mizoram is a net importer of most agricultural products. There are a number of activities that can promote among the poor, including ginger cultivation, passion fruit cultivation, birds eye chilli cultivation, orange cultivation, pig rearing, and poultry rearing through various schemes/programmes.

Nagaland

In Nagaland, 13 projects related to agriculture and allied sectors have been covered under the study to understand the constraints and opportunities for development of agriculture and allied sectors in the State.

Nagaland is primarily an agro-based state with around 70% of its people earning their livelihood through growing crops such as millets, yams, potatoes, sugarcane, citrus, banana, etc. Agriculture and allied sectors in Nagaland have high potential for development of a host of industries including floriculture, horticulture, rubber plantation and allied industries, sericulture, tea cultivation and processing, bamboo shoot preservation, mushroom cultivation and processing, piggery, poultry, etc.

There are many study reports collected in this study wherein productivity of livestock has been studied. Livestock sector can play a vital role in upliftment of rural economy in the State. Being a hilly state with a population belonging to the tribal communities, rearing of pig is common in various parts of the State. However, introduction of artificial insemination (AI) to smallholder pig farmers in Nagaland may be adopted to enhance the productivity. Improvement in germplasm quality, improvement in germplasm accessibility, implementation of policies supporting and controlling pig breeding units and breeding operations, policy in using breeding boars, both for artificial insemination and natural mating is required. The roles of breeding farms, both governmental and private sector with financial support should be enhanced to improve the quality and quantity of breeding pigs.

Few study reports have also discussed about land degradation. Land degradation is a problem for the state and has been further aggravated due to population growth for both human and livestock. Fast degradation of land resources reduces agricultural production and invokes ecological problems in the state. To make the degraded land resources resilient, promote sustainable production and to protect the environment; prompt conservation of land resources is urgently required. To tackle these persistent environmental problems, promote sustainable farming, optimize crop production and to protect the environment simultaneously, activities such as bench terracing, water harvesting structure, spur, diversion channel, etc., may be taken up.

In one of the study report, traditional farming system has been studied. Nagaland has its inherent strength like indigenous traditional knowledge of the various ethnic groups that helps to improve productivity significantly, female participation in economic activities is good, rich in land resources, scope for agricultural production at commercial scale especially for growing high value temperate fruits, medicinal plants, etc., scope for quality production in the upland farming system, skillset of local community in handloom and weaving sectors, etc. Agriculture, being the priority sector of development for the state of Nagaland, participatory development in agricultural field is to be adopted to uplift the productivity of agricultural and horticultural crops. To overcome the detrimental effects of Jhum cultivation on the environment, although it is an integral part of the cultural identity of the people of Nagaland, effective measures to improve the technology of Jhum cultivation and to popularize settled cultivation is invariably to be undertaken in a phased manner. Climate change is an important aspect to address and in this front community needs to understand the concept of climate change and how their issues of food security, livelihood, traditional farming practices, and traditional wisdom can be handled simultaneously through a scientific approach. Evaluation of genetic variants through characterization studies is the fundamental part in the assessment of genetic resources available in the State. The true value of each genetic variant can only be determined through their characterization. The study conducted on management of genetic resources proposes enhancement of the understanding and capacity of people dependent on Jhum in the management of genetic and other natural resources under the climate change scenario.

In order to promote livelihood-based agri-business and strengthening of market linkages in Nagaland, organization of villagers in SHGs and capacity building of existing SHGs for extending financial support to cultivators and training on improved package of practices with special focus on women need government initiative. Bamboo forestry has significant impact on the employment, income, livelihood, and access to resources and hence bamboo resource mapping is required for proper planning to improve the bamboo sector in the state.

Sikkim

In Sikkim, 5 study reports related to agriculture and allied sectors have been covered under the study to understand the constraints and opportunities for development of agriculture and allied sectors in the state.

The economy of Sikkim is linked with agriculture that serves as the source of livelihood and economic security of population involved in the sector. The main crop that earns maximum revenue to the state is cardamom. Most of the land under agriculture around Sikkim is used for the growth of cardamom. Tea and coffee are the other two crops that generate revenue to the state economy.



Sikkim has an inherent strength that supports organic farming and Sikkim is the first Indian state to officially announce the adoption of organic farming in 2003 and the only state in India to convert entire state into organic. Organic farming has been a traditional way of farming in Sikkim adopted by farmers since ages. However, there is need for value addition and processing, leading to better realization of value and local employment. There is also a need for introducing more crops and crop diversification. Multi-cropping may help the farmers in reducing risk. Sikkim may provide a lot of insights to other state governments, who are interested to become organic states.

The agriculture sector of Sikkim is facing a number of challenges, which results in low productivity, poor quality, and high wastage due to post-harvest losses. The sector is constrained by low productivity, high cost of production, lack of post-harvest infrastructure resulting in huge post-harvest losses, inefficient and fragmented supply chain, lack of technical knowledge, and poor market access and intelligence. However, the location of Sikkim provides optimum conditions for the cultivation of a wide range of agricultural and horticultural crops. The agro climate varies from subtropical to alpine and no single crop or variety can suit all the elevation ranges, so crop diversification and mixed farming are practiced. Moreover, there is scope for cultivation, value addition, and marketing of medicinal plants in the state.

Subsidy on promotion of traditional crops; introduction of organic manure; addressing the problems of diseases and pests through organic modes are the need of the hour considering the pattern of agriculture scenario of the state. Similarly, improvement in storage facility by constructing cold storage facilities at block level so that the farmers or aggregators can store the produce for some time; rural godowns to store food grains; promote local institutions along with processing, and value addition of the produces are important aspects, which need government intervention and support.

Tripura

In Tripura, 8 projects related to agriculture and allied sectors have been covered under the study to understand the constraints and opportunities for development of agriculture and allied sectors in the state.

Tripura, a land-locked state situated in the North-Eastern part of India is endowed with vast green forests and abundant natural resources. Agriculture continues to be the main occupation in the state and also forms the basis for growth of allied activities like fishing, animal husbandry, poultry as well as industries including trade and transport. The major crops grown in the state are paddy, pulses, oilseeds, fibres, vegetables, spices and condiments, fruits, tea, coffee, and rubber. The state needs infrastructural facilities like storage and processing of fruits and vegetables, which will encourage the farmers to export and increase crop diversification towards high value crops and will raise the farm income in the state.

Tripura is the second rubber capital of India and has conducive environment for rubber crop, farmers have shown their interest to expand area under this crop and so processing and export facilities for rubber should be created in the State. Maximum rural people still depend upon agriculture and there is less scope for increasing the non-farm income in the rural areas. Therefore, steps are to be taken up to effectively integrate dairy, poultry, fishery, goat, and sheep rearing in the farming system.

In order to improve the agriculture and allied sector, transport costs of the agricultural produce may be subsidized by the government. Private parties need to be encouraged for the establishment of more storage facilities including cold storage at strategic locations and fruit-processing units in the tribal areas. Small sheds for selling of agricultural produce in the roadside and market areas may be constructed to encourage the rural population to market their produces and private entrepreneurs may be encouraged to make mobile fruit stalls in selective areas.

Study conducted in the livestock sector indicated that the adoption of settled crop cultivation with crossbred pig rearing played a significant role in empowering the tribal women folk of the State.

Market-led production will help the farmers avoid distress sale and also help in streamlining agricultural as well as market-related activities. Entrepreneurship development will offer scope in agro-based development in the state compared to industrial development. In this regard, a dedicated marketing cell in all the departments of agriculture and allied sectors to properly understand the production and marketing status and plan appropriate interventions based on the needs of the sector is required. Strengthening of collaboration and partnership with Agricultural and Processed Food Products Export Development Authority (APEDA) as well as other agencies for the export of fruits like pineapples, oranges, and jackfruits require development of production and marketing sectors. Similarly, focus should be given in development of

market and post-harvest infrastructure along with development of roads, warehouse, cold storage facilities for storage of fruits, dairy products, and dressed meat.

Bamboo is another sector for socio-economic upliftment of rural population of Tripura. The bamboo sector in the state holds immense potential to contribute to the development of livelihoods and for the benefit of the rural economy. The easing of various permits, consistency, and uniformity in law, and effective implementation of existing progressive provisions will aid the growth of the sector to contribute to reducing rural poverty and hence strategy for that is required to be formulated for effective implementation of the scheme/programmes related to bamboo.

Overall Scenario

Seventeen (17) study reports that have been carried out in more than one state related to agriculture and allied sectors have been covered under the study to understand the constraints and opportunities for development of agriculture and allied sectors in the NE region.

Comprehensive master plan for tapping the export potential of North-Eastern States:

Focus on pineapple, orange, lemon, banana, ginger, and turmeric as they can be easily promoted on the basis of organic production. Investments in awareness creation, training, and capacity building need to be done for the growth of the production and marketing sectors. Promotion of organic certification agency in the NER will be of help to expedite the process of organic certification. Efforts should be given to streamline the supply chain and promote marketing at national and international levels. There is a need to prepare a comprehensive and actionable roadmap for tapping the export potential of the NER and investment is to be made to leverage and capture the potentials of the identified produces of the region, namely, leveraging the organic potential; enhancing efficiency of rural supply chains; optimally utilizing the marketable surplus; improving quality and reaching international markets; and capacity building and skill development.

Development of seed production system in major spice crops (ginger, turmeric, black pepper, large cardamom, Naga chilli, etc.) of the NER:

Considering the importance of quality seed and planting material, appropriate production technology including micro-propagation of important spices from NER India may be adopted to produce quality planting material for further area expansion programme.

Assessment and analysis of the plant oil feedstock available in North-East India for Biodiesel Production:

Proper assessment on availability of oil seeds in North-East India to evaluate the best suitable plant oil feedstock for biodiesel production as an alternative to fossil fuels is required. However, detailed study on fuel characteristic of the plant oils is required to assess their suitability as feedstock for biodiesel production before undertaking any activities on biodiesel production.

As agriculture is the second important economic activity for NER, State Governments should initiate suitable steps to educate farmers about new technologies. This would help farmers to improve their productivity, earn more income and improve their standard of living. These agricultural extension services bring about changes in farmers attitude, knowledge and skills through education and communication.

Lack of awareness about the benefits of high-value agriculture, inadequate hands-on training programmes for farmers etc. also contributes to the challenges for agricultural development in north-eastern part of India. However, despite of these challenges, the North-east region is endowed with a varied topography and agro-climatic conditions which offer scope for development of agriculture, horticulture, and forestry sectors in the region.





6.3 BANKING AND FINANCE

Study Title

Outcome evaluation of state finance of Arunachal Pradesh

Implementing Institution

Rajiv Gandhi University

Project Location/Completion Year

Arunachal Pradesh, 2019

Objective

- To examine the major deficit indicators such as fiscal deficit, revenue deficit, primary deficit
- To examine the main sources of revenue
- To examine the main components of public expenditure
- To examine outstanding debt stock and its composition
- To examine the financial performance of some major centrally sponsored schemes
- To examine the performance of public enterprise and power sector
- To examine the financial performance of urban local bodies and rural local bodies of the State

Study Recommendation

- The State needs to enhance the revenue base.
- To monitor the public expenditure in a more efficient way by appointing third-party monitoring agencies.
- The Government official who prepares data base for Finance Commission needs full training on definition of data. For example, the real data collector is the computer person in the Department. They have lack of knowledge on basic concepts such as revenue expenditure, capital expenditure, etc. So, training of the new person is compulsory.

Analysis and Outcome

The state's expenditure increased in 2020–21 from 2019–20 with increase in both revenue expenditure and capital outlay. Several recommendations of the study are being considered for implementation. The state has been strengthening the revenue administration and taking steps to enhance the efficiency of expenditure. Since the relative importance of own non-tax revenue in aggregate revenue of the state is declining, there is a need to reverse the trend. This can be done by increasing collection of non-tax revenue, revision of existing charges and rates of various services and improving administrative revenue collection through efficiency, accountability, and transparency.

Hydel power is one of the sources which could have been important instruments to generate additional resources. The State Government has urged the Centre for special consideration for the state's power sector under the Atmanirbhar Bharat Abhiyan.[1] The efforts to generate resources from hydel power may start bearing fruit in the years to come. According to NITI Aayog's North Eastern Region District SDG Index Report & Dashboard 2021–22, Arunachal Pradesh bears the distinction of being one of the few states that has aligned their state budgetary allocations with the SDGs.[2]

Agency responsible for implementation:

Department of Economics and Statistics, Government of Arunachal Pradesh

Study Title

Outcome evaluation of State Finances (Assam)

Implementing Institution

Gauhati University

Project Location/Completion Year

Assam, 2018

Objective

- Estimation of the revenue capacity of the State
- Analysis of State's non-tax revenues
- Analysis of expenditure pattern and trends separately for revenue and capital accounts
- Analysis of fiscal and revenue deficits
- Study of the level of debt
- Review of implementation of the Fiscal Responsibility and Budget Management (FRBM) Act
- Analysis of the State Public Enterprises on fiscal health of the State
- Impact of Power Sector reforms on State's fiscal health

Study Recommendation

- The Commission recommends increasing the tax devolution of the divisible pool to states to 42% for years 2015 to 2020. This is 10% more compared to 32% target set by the 13th Financial Commission.
- The Commission recommended that the new tax devolution should be the primary route of transfer of resources to States since it is formula based and thus conducive to sound fiscal federalism.

Analysis and Outcome

The recommendations of the study are being considered for implementation. The focus of the Fourteenth Finance Commission was on enhancing the fiscal autonomy of states, which was sought to be implemented by recommending a 10% hike in the share of the states in the divisible pool of central taxes. Assam benefited by the assignment of 10% weight to the population of 2011 in the devolution formula while capturing the demographic changes since 1971.

The Fifteenth Finance Commission had encouraged the economic situation of states since it suggested to devolve funds for all other tiers along with the earlier left out regions of the 5th and 6th Schedule of the Constitution. However, the funds were not always sufficient to meet the needs of social sectors. At times, due to uncertain health crises (such as the recent pandemic situation) and natural calamities (flood situation of Assam), funds could not be allocated at the proper time. Assam is one of the states recommended for Post Devolution Revenue Deficit Grant by the Fifteenth Finance Commission.[3]

Agency responsible for implementation:

- Department of Finance, Government of Assam



Study Title

Informal microfinance in Assam: Empirical Evidence from Nalbari and Baksa districts

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2010

Objective

- To study informal saving societies in the Nalbari and Baksa districts in Assam
- To study the role of saving societies in meeting the credit gap
- To study the demand for loans and how informal financial institutions respond to it

Study Recommendation

- In the Nalbari and Baksa districts, banking infrastructure is particularly poor compared to the rest of the districts in Assam. There are about 100 microfinance institutions (MFIs) in the North East Region, but very few branches of MFIs operate in Nalbari and Baksa. The development of formal rural financial institutions like co-operative banks, RRBs, etc., is impeded by many constraints, like the difficult terrain, high risk perception and small transaction amounts, resulting in a high cost for formal institutions. Informal saving societies (Private Saving societies) have emerged in these districts as a new avenue of opportunity in the field of financial services.
- These societies allow convenient and easy access to financial services. They allow clients to save small amounts of money on a daily basis and repay in small installments without requiring complicated procedures that clients may be unfamiliar with. These features and the high illiteracy rates in these areas that prevent access to more formal institutions have led to the rise of the informal private saving societies.
- The results of this study suggest that there is strong reason for MFIs to enter the market in lower Assam as well. Another area of concern about the saving societies centres around legal issues. If legal requirements are imposed on these societies, they may have to close, making accessibility to credit for the poor once again a distant dream. It may be necessary to develop a legal framework that suits the pre-existing saving societies, and allows them to continue to provide easy access to credit for the rural masses.

Analysis and Outcome

Microfinance is an acute poverty alleviation mechanism in most of the developing countries, including India. However, the sustainability of its approaches is crucial. The outcomes of the study have been partially achieved. Several challenges need to be overcome to restore microfinance services in the districts. The problems faced include delays in disbursement of loans, trainings of members, insufficient amount of credit, small slabs of loans, problems with maintenance of books of accounts, unsatisfactory income and savings, lack of cooperation among the members, repayments of loans and domestic workloads stand as main problems with sustainability of members in the districts. In the Nalbari and Baksa districts, banking infrastructure is particularly poor when compared to the rest of the districts in Assam.

Although in recent times, a number of microfinance institutions have joined the operation, it is quite insufficient to meet the burgeoning demand. Increasing rural bank branches and opening the avenues of public-private partnership in the sector may temporarily meet some demand. The Assam Micro Finance Institutions (Regulation of Money Lending) Bill, 2020 which aims to “protect and relieve the economically vulnerable groups and individuals from the undue hardship of usurious interest rates and coercive means of recovery” by microfinance companies.[4]

Agency responsible for implementation:

- Department of Finance, Government of Assam

Study Title

Evaluation of state finances of Manipur

Implementing Institution

Manipur University

Project Location/Completion Year

Manipur, 2017

Objective

Cost minimization with minimum roll over risk remains a key objective in the management of states' market borrowings. The state governments issue dated securities, termed state development loans (SDLs), of varying tenures.

Study Recommendation

- Reducing the overall scale of subsidies
- Making subsidies as transparent as possible (and duly reflected in the budget of the government)
- Using subsidies for well-defined economic objectives
- Focussing subsidies to final goods and services with a view to maximizing their impact on the target population at minimum cost
- Instituting systems for periodic review of subsidies
- Setting clear limits on duration of any new subsidy schemes

Analysis and Outcome

Several recommendations of the study are being considered for implementation. Manipur depends on the Central Government mostly for its financial resources. The resource transfer from the Centre in any fiscal year constitutes about 90% of the total revenue receipt of the State. One of the biggest sources of untied receipts from the Centre is the State's share in central taxes. Therefore, any change in this receipt greatly impacts the State's finances. The State Government has focused on bringing in major projects, as these can really accelerate the development of the state. Apart from funding from the Centre, the State has also tapped funding from multilateral banks and agencies like the Asian Development Bank, World Bank, etc.

The COVID-19 pandemic has seriously impacted the resource availability of the State Government. The transfers from the Centre and receipts from the state's resources are likely to see a sizeable reduction vis-à-vis the previous financial years. The State Government has imposed budgetary ceilings to control the state expenditure for fiscal 2021-2022, citing a serious impact on the state resources due to the COVID-19 pandemic.[5]

Agency responsible for implementation:

- Department of Finance, Government of Manipur



Study Title

State finances of Meghalaya

Implementing Institution

IIM Shillong

Project Location/Completion Year

Meghalaya, 2017

Objective

- To assess the fiscal position of the state
- To identify causes and necessary policy initiatives to subdue the fiscal stress of Meghalaya
- To identify the best policies and practices for better fiscal management of the state

Study Recommendation

- Digital literacy and awareness
- Mining receipts are the major head of non-tax revenue generation for the state. Considering the significant drop in the mining receipts, the State Government should focus on building alternative avenues of non-tax revenues such as sale of lotteries, and other general services. Leasing of other minor minerals sources should be considered seriously by the state to ensure alternate sources of non-tax revenue through royalties.
- There is immediate need to address the emerging issues of loss of livelihoods in the region, which has come due to ban on mining, such as displacements and social unrest. The state government should bring impetus to community development initiatives in such regions by collaborating with national as well as international bodies such as The World Bank.
- The State should take serious efforts to ensure the development of tourism and hospitality sector by bringing a comprehensive policy and supporting infrastructure.
- The State should focus on boosting the primary sector-based economic activities since majority of state population depends directly or indirectly on activities such as farming, fisheries, and other allied activities.
- There is a very small share of revenue from the sale of state lotteries in the State. The State Government should strengthen, and expand the sale of lotteries to increase the non-tax revenue.
- The State Government should strengthen the internal control mechanisms to mitigate leakages and misappropriations of funds. The State should ensure proper financial reporting by recipients of any grants through timely submission of utilization certificates

Analysis and Outcome

Sound fiscal management requires advance planning and accurate estimation of revenues and expenditure. The State has set up the Meghalaya Integrated Financial Management System, which is an ICT-based fiscal and financial management information system that provides financial information to the state government agencies to monitor the receipt and expenditure incurred by various departments and to manage and report their financial activities.[6]

The Meghalaya Cabinet, in March 2020, approved the proposed amendment of the Meghalaya Fiscal Responsibility and Budget Management (FRBM) Act, 2006 to increase the state's net borrowing ceiling by over 1%. According to the FRBM Act, 2006, the ceiling of borrowing that the state can take in terms of availing loans is 3% of the GSDP.[7] The Meghalaya Enterprise Architecture Project (MeghEA), launched in September 2021, aims to improve service delivery and governance for the people using the power of Digital technologies. The state government is hopeful to double its gross state domestic product to \$10 billion within the next five years. The state has identified six pillars—Human Capital Development, Primary Sector Rejuvenation, Infrastructure Development, Entrepreneurship, Environment, and Governance.[8]

Agency responsible for implementation:

- Department of Finance, Government of Meghalaya



Study Title

IND: North-Eastern Region capital cities development investment program (Tranche 2) – Shillong, Meghalaya Subproject

Implementing Institution

State Investment Program Management and Implementation Unit (SIPMIU)

Project Location/Completion Year

Meghalaya, 2015

Objective

- Providing a proactive, feasible, and practical working tool to enable the measurement and monitoring of environmental performance on-site.
- Guiding and controlling the implementation of findings and recommendations of the environmental assessment conducted for the project.
- Detailing specific actions deemed necessary to assist in mitigating the environmental impact of the project.
- Ensuring that safety recommendations are complied.

Study Recommendation

- The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed for the Shillong Solid Waste Management Subproject.
- Potential negative impacts were identified in relation to construction and operation of the improved infrastructure.
- No impacts were identified as being due to either the subproject design or location.
- Mitigation measures have been developed to reduce all negative impacts to acceptable levels.

Analysis and Outcome

The North Eastern Region Capital Cities Development Investment Programme envisages improving the environmental condition of urban areas. The programme links capital investments to reforms for sustainable impact. However, the proposed development/improvements of infrastructure facilities may exert certain adverse impacts on the natural environment. While developing urban infrastructure facilities, impacts during the construction stage are expected to be more severe than impacts during the operation phase, though for a short time duration. Exceptions being some facilities such as solid waste landfills and sewage treatment plants that can exert unfavorable impacts during the operation phase, if due care is not taken.

The Initial Environmental Examination was prepared covering the general environmental profile of Shillong and includes an overview of the potential environmental impacts and their magnitude on physical, ecological, economic, and social and cultural resources within the subproject's influence area during design, construction, and operation stages. The report was prepared on the basis of detailed screening and analysis of all environmental parameters, field investigations and stakeholder consultations to meet the requirements for environmental assessment process. An Environmental Management Plan which addresses the potential impacts and risks identified by the environmental assessment is also planned.[9]

Agencies responsible for implementation:

- Department of Finance, Government of Meghalaya
- Community & Rural Development Department, Government of Meghalaya
- Forests & Environment Department, Government of Meghalaya

Study Title

Evaluation of state finance Mizoram

Implementing Institution

Mizoram University

Project Location/Completion Year

Mizoram, 2018

Objective

The doctrine of curtailing government expenditure to bring down deficit financing has become the core objective of the fiscal management of the governments so as to bring deficit financing under control, especially in the post economic reform era.

Study Recommendation

- Enhancement of vertical devolution by FC XIV had significant impact on fund transfer to the state in which the state's share in the central taxes has started to gain more importance.
- This study found the existence of a wide room for its improvement to leverage opportunities arising out of the changes in the living standard and consumption patterns of the population.
- It is thus suggested that necessary efforts be made by the government to assess all the landholdings with immediate effect and institute a more efficient mechanism for its revenue collection.
- The state governments need to clearly define the tax parameters and make the people aware of its significance, while also taking steps to make dealings on transfer of assets more transparent, thus enhancing efficient assessment of taxes/fees.
- Given all these, there is a scope to mobilize more revenue by introducing an additional levy, which may be in the form of cess or sin tax.
- It is necessary to rationalize the structure of vehicles tax, and taxes on goods and passenger in a progressive manner keeping in view the (i) growing number of luxury vehicles, (ii) changes in the travel mode choices among the people, and (iii) emergence and growth of logistic sector and changes in the means of commodity transportation.
- The reforms may either be in the form of Aadhaar linked direct benefit transfer (DBT) or any other technology-aided system.
- This study emphasized the necessity of keeping (i) revenue deficit to zero, (ii) zero fiscal deficit below by 2020–24, and (iii) interest payment below 10% of revenue receipt, for a sustainable fiscal roadmap in the FC-XV period of 2020–2025.



Analysis and Outcome

The framework of fiscal policy of the state has been mostly determined by the recommendations of the Finance Commission. The COVID-19 pandemic outbreak has hit the economy of the Centre as well as the State as realization of tax revenues has been decreased considerably. This has compelled the Centre to extend the borrowings limit of the states. The state envisages higher revenue collection that will contribute to the improvement of the State's economic condition. This is proposed to be achieved through widening of tax base coupled with effective resource mobilization. The impact of transition to GST from VAT has been minimized by the endeavour of the Centre to compensate the states for any revenue loss for a period of five years.

The State Government has been making effort to improve the amount of tax collection under the new tax regime through comprehensive tax assessment, introduction of tax audit for minimization of tax evasion and by ensuring that the dealers get themselves registered under GST to keep them in the tax net. The Mizoram Motor Vehicles Taxation (Amendment) Act, 2011 and the Mizoram Motor Vehicles (Taxation) Rules, 2016 were implemented in the state from February, 2016 under which 6% of the original price of non-transport vehicles is collected as tax, thereby, increasing revenue to a great extent.[10] The Mizoram (Land Revenue) (Amendment) Bill, 2019 would help streamline and improve the procedures and processes of survey, allotment and settlement of land, land record management and assessment and collection of land revenue.

Agency responsible for implementation:

- Department of Finance, Government of Mizoram

Study Title

Evaluation of state finances with reference to the state of Nagaland

Implementing Institution

Nagaland University

Project Location/Completion Year

Nagaland, 2019

Objective

- Build and maintain revenue surplus
- Bring down fiscal deficit to 3% of projected Gross State Domestic Product (GSDP) by the year ending March 31, 2019.
- The total debt stock does not exceed 40% of the estimated GSDP for that year
- Limit the amount of annual incremental risk weighted guarantees to 1% of the Total Revenue Receipt (TRR) or the estimated GSDP in the year preceding the current year, whichever is lower.
- The total salary bill relative to revenue expenditure net of interest payments and pensions does not exceed 61% in any financial year.

Study Recommendation

- The Government needs to take an effective measure for early clearance of backlog account areas and make the accounts up to date.
- The accounts of non-working PSU in the State should be withdrawn and Government needs to expedite closing down these companies to reduce the burden of maintenance.
- The administrative department prerequisites the accountability to direct the activities for strengthening the working PSUs in the State.
- The Government should come forward to set up a monitoring/regulatory cell to the clearance of arrears and set the targets for individual companies.
- The Government need to take an action plan for outsourcing the work relating to preparation, wherever the staff is inadequate or lacks expertise.

Analysis and Outcome

Sound financial management requires advance planning and accurate estimation of revenues and expenditure. The fiscal base and fiscal health of the state are directly related to the development of the State. Public investment in the infrastructure would expand the productive capacity of the economy and thus expand the revenue generating potential of the State. The fiscal base is determined by the size of the economy, which can be expanded in the long run. Thus, in the medium term, the fiscal health of the State has to be improved so that the Government can increase the development expenditure to expand the economic base.

The Nagaland State Government has been making concerted efforts to enhance the revenue base and to optimize revenue collection. The State Government has been trying to contain the revenue expenditure to the extent possible. According to the Nagaland Sustainable Development Goals Vision 2030, the State Government is contemplating to reduce the fiscal deficit to 3% of Gross State Domestic Product and increase state level income generation to empower self-sufficiency by 2030.

Agency responsible for implementation:

- Department of Finance, Government of Nagaland



Study Title

Report on state finances of Sikkim

Implementing Institution

Sikkim University

Project Location/Completion Year

Sikkim, 2019

Objective

- Estimation of the revenue capacity of the State
- Analysis of State's non-tax revenues
- Analysis of expenditure pattern and trends separately for revenue and capital accounts.
- Analysis of Fiscal and Revenue Deficits
- Study of the level of debt
- Review of implementation of the Sikkim Fiscal Responsibility and Budget Management Act of 2010 (FRBM Act)
- Analysis of the State Public Enterprises on fiscal health of the State
- Impact of Power Sector reforms on State's fiscal health
- Analysis of Contingent Liabilities of the State
- Analysis of Subsidies given by the State government, its targeting and evaluation
- Outcome evaluation of State Finances based on 14th FC recommendations
- Determination of a sustainable debt roadmap for the period of 2020–25

Study Recommendation

- **Vertical Devolution:** The commission recommends increasing the tax devolution of the divisible pool to states to 42% for the years 2015 to 2020. This is 10% more compared to 32% target set by the 13th Financial Commission.
- **Horizontal Devolution:** The commission came up with new formula to divide the 42% share of the divisible pool between the states.
- **Grant Devolution:** The Commission recommended that distribution of grants shall be given to the States using 2011 population data with weight of 90% and area with weight of 10%.
- The grant to each State will be divided into two—a grant to duly constituted Gram Panchayats and a grant to duly constituted municipalities, on the basis of urban and rural population of that State using the data of Census 2011.

Analysis and Outcome

Sikkim has been a revenue surplus state. The State has accepted the recommendations by the Fourteenth Finance Commission on vertical and horizontal devolutions. With respect to the grant devolution, the State does not have any grant from the Centre for covering revenue deficit as the state is a revenue surplus state. Since the adoption of the FRBM Act, the state government has shown commitment to the rule-based fiscal management.

The State continues to adopt an inclusive development process in which fiscal policy plays an enabling role. The State has taken several reform measures to strengthen its rural and urban local bodies including the tax sharing pattern. Further, the State Government has reviewed the existing rules to facilitate the levy of property tax and reassess properties by local bodies. The State has achieved the 100% metering for electricity. The State has taken several reform measures in State Public Sector Undertakings (SPSUs) including closure of several SPSUs.

Agency responsible for implementation:

- Department of Finance, Government of Sikkim



Study Title

An evaluation of the state finances of Tripura

Implementing Institution

Tezpur University

Project Location/Completion Year

Tripura, 2019

Objective

- Estimation of revenue capacities of the state and measures to enhance revenue productivity both from tax and non-tax sources.
- Evaluation of the components, pattern and trends of public expenditures, both revenue and capital and measures to enhance technical and allocative efficiencies in this regard.
- Critical analysis of the fiscal and revenue deficits, debt and other liabilities of the Government of Tripura.
- Analysis of the major decentralization initiatives from the part of the State Government to transfer funds to the various rural and urban local bodies.
- Evaluation of the performance of the State Public Sector Undertakings (SPSUs) including the Power Sector Reforms and their impact on the financial health of the state.

Study Recommendation

- Constitution of a permanent Cell of SFC in the State
- Creation of a Data Bank through preservation of relevant and reliable data in the Cell
- More focus on enhancement of own revenue collection of the Local Bodies (LBs)
- Performance-based incentive grants to the LBs on revenue collection and auditing
- Capacity building of the LBs, better qualified and efficient staff, preparation of GPDP
- The GoI should consider for a consistent flow of the rate of share of central taxes from year to year to the State of Tripura, otherwise it will have a negative impact on the finances of LBs

Analysis and Outcome

The economy of Tripura has been maintaining stability and debt sustainability. However, the debt sustainability condition of Tripura may get hampered owing to the introduction of GST implementation. The State Government has to exercise certain constructive measures for making the decentralization process of the State more effective. Enforcement of financial modalities, assessment of the financial management procedures and mid-term reviews of activities of the local bodies and other institutions may be helpful for making the decentralization initiatives of the State Government more effective.

The State has a wide range of fiscal and policy incentives for businesses under the Tripura Industrial Investment Promotion Incentive Scheme, 2017. As part of financial modalities, preparation of annual budgets and finalization of accounts need to be a regular practice for the Panchayati Raj Institutions and Urban Local Bodies in the state. Disbursement of funds needs to be reoriented with more focus to the rural areas.

Agencies responsible for implementation:

- Finance Department, Government of Tripura
- Social Welfare Department, Government of Tripura

Study Title

Study on credit linkage strategy for sustainable livelihood improvement with special reference to NERCORMP

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2020

Objective

- Promote a more people-oriented approach to the design and implementation of development interventions.
- Enhance the capabilities of the local communities to search for and manage appropriate technologies building on indigenous knowledge.
- Increase incomes through the development of more sustainable farming systems and the establishment of non-farm enterprises.
- Make people aware of the need to preserve and regenerate natural resources and biodiversity.
- Establish effective and appropriate delivery systems for inputs (credit, extension, etc.) and for the maintenance of assets and resources.
- Increase participation of women in local institutions and in decision-making processes within the community.
- Enhance savings capacity and promote the habit of thrift.
- Increase access to basic services and infrastructure facilities.

Study Recommendation

- A standard operating procedure for the formation of SHGs, Federations, and other community-based organizations may be followed.
- Develop skill and capacity of selected women from within the community for utilization as Community Resource Persons (CRPs) to facilitate better peer-level learning among the adult women and reduce dependence on PNGOs.
- Implementation of such projects may preferably be done through Government promoted Society, as high attrition rate of employees of NGOs operating in the field level affects quality and uniformity in implementation process.
- Extensive process of exchange of ideas through exposure visits within or outside the region and interactions with community resource persons from outside the region would quickly help to build up the confidence and also help them to explore new ideas and technologies.
- Putting in place the protocols for ensuring access to higher quantum of capital from Banks within a reasonable time, say 6–12 months, is very important to strengthen the capital base for enhancing sustainable livelihood activities of the SHGs.
- APEX model is one of the time-tested indigenous model, which can be upgraded to the next level as NBFC, NBFC-MFI to function as intermediary of banks to provide adequate and timely capital to the rural tribal women through SHG channel.
- Focus needs to be given for improvement in remunerative livelihood activities to have the capacity to generate adequate revenue for repayment of loans and also have surplus for the households.
- Convergence with other Government initiated development schemes in the field of agriculture, livestock, weaving or Bank schemes like MUDRA, KCC, etc., needs to be leveraged to reduce the investment cost of the women in their livelihood activities and increase their rate of return from the activities.
- Digitization of transactions need to be encouraged even in a limited manner and with limitation of available telecom network services to reduce high dependence on availability of cash and problems related to cash transactions.
- Orientation, sensitization and knowledge sharing with the bank managers in addition to exposure trips to other project areas will help in facilitating bank credit to SHGs. Enlisting support of the Government machineries through DCC and SLBC forum will further support the credit linkage process.



Analysis and Outcome

Financial capital is one of the main supporting elements of resources, which are essential for following a sustainable livelihood strategy. A holistic approach has to be taken for sustainable economic empowerment and economic development of rural women of the northeastern states. To achieve this goal, an integrated approach of all community-based organizations; community architecture, rural infrastructure and most importantly the financial and social capital can be adopted. This will ensure improvement of skill, facilitate climate resilient farming practices, improved productivity and market linked production, market linkages, and extensive use of digital technology platform and better price realization with better scale of economy of production to alleviate rural poverty within a desired timeline.

Micro, Small and Medium Enterprises in the North Eastern Region are expected to make huge contributions towards strengthening the rural economy and providing sustainable livelihoods in the region. The Ministry of Development of North Eastern Region merged North East Rural Livelihood Project (NERLP) and NERCORMP into one and renamed the new project as 'North East Agri-Horticulture and Economic Development Project'.^[11]

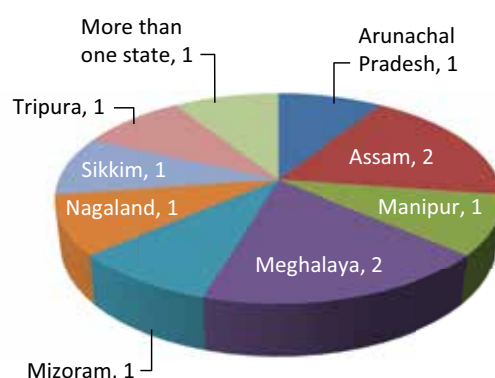
Agencies responsible for implementation:

- Ministry of Development of North Eastern Region, Government of India
- State governments of NER

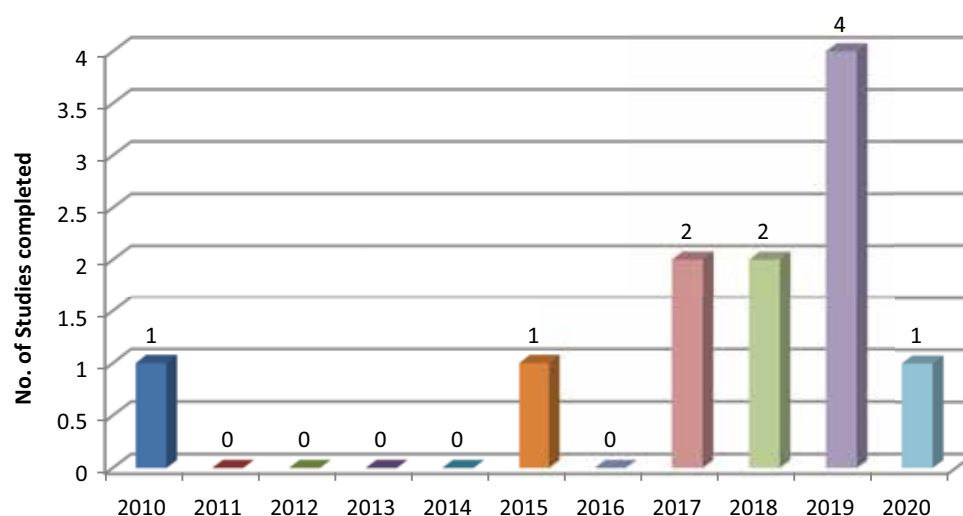
State-wise Summary

The Study of Studies report analyses 11 studies on banking and finance sector, covering the eight states of North Eastern Region (NER) of the country. Two (2) studies each from Assam and Meghalaya have been covered. One study each from rest of the states has been studied; and one study covered multiple states from the region.

The early years of the study period duration from 2010 to 2020 witnessed zero or low turnout of study reports. Maximum studies (4) were completed in 2019. This highlights a critical requirement of further studies in this sector for improving the economic well-being of the region.



Studies completed in Banking & Finance Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Banking & Finance Sector in NER during 2010 to 2020 (Year-wise)

Arunachal Pradesh

Arunachal Pradesh, the largest NER state of India with a low financial inclusion index, intends to make its unreached masses financially reachable through various interventions. The State has been strengthening the revenue administration and taking steps to enhance the efficiency of expenditure. Monitoring of the public expenditure needs to be strengthened in a more efficient way by appointing third party monitoring agencies.



Assam

The outcome evaluation study, covered in this report, provides an insight into Assam's Finances over a thirteen-year period. The focus of the Fourteenth Finance Commission was on enhancing the fiscal autonomy of states, which was sought to be implemented by recommending a 10% hike in the share of the states in the divisible pool of central taxes. Assam benefited by the assignment of 10 per cent weight to the population of 2011 in the devolution formula while capturing the demographic changes since 1971.

Another study covered in this report throws light on how districts are faring with an informal microfinance system in place. Primarily being one of the most difficult terrain in India, it is interesting to note that the informal mechanisms have been doing well.

Manipur

Cost minimization with minimum roll-over risk remains a key objective in the management of states' market borrowings. Subsidies need to be economically well-defined and focus needs to be given on final goods and services with a view to maximizing their impact on the target population at minimum cost. Investment in the monitoring mechanism and governance in the financial sector will have a multiplier effect much larger than any direct investment in economic activities.

Meghalaya

Mining receipts are the major head of non-tax revenue generation for the State. Considering the significant drop in the mining receipts, there is a critical need to address the emerging issues of livelihoods loss in the region. The state should focus on boosting the primary sector-based economic activities since majority of state population depends directly or indirectly in activities such as farming, fisheries, and other allied activities.

The North-Eastern Region Capital Cities Development Investment Programme envisages improving the environmental condition of urban areas. One of the studies covered in this report provides a feasible and practical working tool to enable the measurement and monitoring of environmental performance on-site.

Mizoram

The framework of fiscal policy of the State has been mostly determined by the recommendations of the Finance Commission. The State government has been making efforts to improve the amount of tax collection under the new tax regime through comprehensive tax assessment, introduction of tax audit for minimization of tax evasion and by ensuring that the dealers get themselves registered under GST to keep them in the tax net.

Nagaland

The fiscal base and fiscal health of the state are directly related to the development of the state. The State has been making concerted efforts to enhance the revenue base and to optimize revenue collection. Further, the State has been trying to contain the revenue expenditure to the extent possible.

Sikkim

The State continues to adopt an inclusive development process in which fiscal policy plays an enabling role. The State has taken several reform measures to strengthen its rural and urban local bodies including the tax sharing pattern. The State has taken several reform measures in state public sector undertakings including closure of several State Public Sector Undertakings SPSUs.

Tripura

The economy of Tripura has been maintaining stability and debt sustainability. However, the debt sustainability condition of Tripura may get hampered owing to the introduction of GST implementation. Enforcement of financial modalities, assessment of the financial management procedures and mid-term reviews of activities of the local bodies and other institutions may be helpful for making the decentralization initiatives of the State government more effective.

Overall Scenario

The demographic and geographic characteristics and challenges of NER of India are widely different from other regions and hence seek more attention. Therefore, financial reforms should be accompanied by potentials to nullify the specific challenges persisting in the region. There is a critical need to assess initiatives to promote financial literacy and thereby ensure active participation in using financial services.

Financial capital is one of the main supporting elements of resources, which are essential for following a sustainable livelihood strategy. Expansion of bank branches to semi-urban and rural areas along with infrastructure development can stimulate entrepreneurial and investment activities and ensure financial inclusiveness in the region.

Based on the study and understanding of the scenario in the banking and finance sector in the NER during the past decade, it is recommended that intensive financial literacy and awareness campaign in vernacular languages in all the NER States needs to be further strengthened.





6.4 COMMERCE AND INDUSTRY

Study Title

Assessment and Analysis of 63 Nutritional shops 'Bagan Bazar' in Tea Garden areas of Assam

Implementing Institution

The Moksha Consultancy Pvt. Ltd

Project Location/Completion Year

Assam, 2018

Objective

- Assessment of the 63 Bagan Bazars
- Gap analysis of Bagan Bazars
- Sustainability analysis of the individual Bagan Bazars
- Suggestive strategy and work plan to strengthen the Bagan Bazars
- Framework of a Business Model on Nutrition Shop 'Bagan Bazars' in tea garden areas in order to replicate the same in the state

Study Recommendation

- A Standard Operating Procedure (SOP) for management and operation.
- Defined the role of President and Secretary, and checked excessive use of their position.
- Weekly meetings be monitored by Assam State Rural Livelihood Mission Society (ASRLMS).
- ASRLMS to be pro-active in conflict resolution and provide exit guidelines from the project.
- Relocation of 23 Bazars to suitable areas where Self-help groups (SHGs) are willing to operate.
- Maintain simple and standardized book keeping.
- The tag of 'nutrition shop' be removed and retain only 'Bagan Bazar'.
- The block offices must ensure timely collection and distribution of bank loan statement to the respective SHGs.
- Diversification and addition of activities such as tailoring, tea and snack, etc., to keep the bazar vibrant.

Analysis and Outcome

Bagan Bazar is a special initiative of the Assam State Rural Livelihood Mission Society (ASRLMS), Government of Assam. It is being implemented in 63 tea garden areas across 18 districts of the State. The Bagan Bazars are fully managed and operated by women SHGs of the respective tea gardens.

The recommendations are very generic in nature and are fully implementable. Assam State Rural Livelihood Mission Society (ASRLMS) has developed several strategies for the empowerment of the women in the pursuit of their socio-economic development.

The Government of India has taken many initiatives. 'Poshan Maah' Drive is one of such initiatives, which is helping in fight against malnutrition in Assam^[12]. ASRLMS is already implementing the Deen Dayal Antyodaya Yojana-National Rural Livelihoods Mission (DAY-NRLM) in the State since November, 2011, with the objective of enhancing the social and economic empowerment of the rural poor in Assam^[13]. As on November 25, 2021, the total number of SHGs has reached to 301,227 and total amount of bank linkage provided to SHGs is 45,014 (₹ in lakh)^[14].

Agencies responsible for implementation:

- Local Block Offices
- Assam State Rural Livelihoods Mission

Study Title

Study on small and medium Industries marketing infrastructure for the State of Tripura

Implementing Institution

I-Win Advisory Services Ltd

Project Location/Completion Year

Tripura, 2019

Objective

- The study is aimed at identifying factors encouraging entrepreneurs for investing and selecting location for their units in the State, identifying the competing factors for their production units, supportive reasons of marketing infrastructure and other reasons of relevance attracting investors to invest in Tripura.
- The Study has addressed few more issues like the preference of entrepreneurs in selecting places in the State instead of places outside the State and finding out scope for improving marketing infrastructures in the State.

Study Recommendation

- Way-forward opportunities for agri-horticulture ventures
- Establishment of skill development institutes
- Development of IT-enabled services
- Promotion of Tourism and Health Tourism (establishment of healthcare facilities in collaboration with major hospitals)
- Infrastructure and connectivity
- Marketing of SME products

Analysis and Outcome

The project "Study on small and medium Industries marketing infrastructure for the State of Tripura" was sanctioned to I-WIN Advisory Services Limited by The North Eastern Development Finance Corporation Limited (NEDFi). The current study is aimed to understand the challenges faced by small-scale industries and the strategies they must follow to cope up with the challenges. This study was successful in finding out the loopholes, which were a barrier in the marketing of small- and medium-scale industries.

The challenges such as inadequate banking services, high transportation cost, interrupted power supply, bad roads, shortage of skilled labour, etc., which not only add to the variable cost, also brings down the profit margin of the small and medium enterprises (SME) units in the State to a great extent.

It has been observed from various government sources and local stakeholders that state government has taken many initiatives for the growth of small and medium industries in the North Eastern Region^[15]. All the recommendations are implementable and partially implemented during the course of time.

The government has taken several initiatives to encourage the growth of enterprises in the State. The Department of Tourism has also introduced the 'Tourism Policy 2020-2025' for improving the socio-economic development of the state^[16]. The Ministry of Skill Development & Entrepreneurship (MSDE) has also introduced skill development programme in Agartala, Tripura especially for women. The government has arranged many road shows in different state capitals of India to attract entrepreneurs to the state.

Agencies responsible for implementation:

- Micro, Small and Medium Enterprise Development Institute, Agartala



Study Title

Competitive advantages of the North Eastern States and identification of thrust areas for growth and development in the region

Implementing Institution

Spectrum Planning (India) Ltd

Project Location/Completion Year

More than one state, 2020

Objective

- To identify the sources of competitive advantages of the states in North Eastern Region (NER) of India and suggest possible measures to harness those potentials.

Study Recommendation

- 'Fruit and vegetable bowl' of India –To harness the ideal climatic conditions and adequate groundwater availability, unique quality.
- 'Power house' of India – To explore the enormous possibility of utilizing hydel power of states, NER can help not only north Indian states but also neighbouring nations.
- Tourism – Utilize untapped tourism potential
- Horticulture produce export
- Organic farming extension
- MAP for herbal product manufacturer
- 'Act East' – Preparedness, use of DRC for identification of specific products for export as well as import from neighbouring countries

Analysis and Outcome

The findings of this study are useful in formulating robust developmental plan for each of the states in the North Eastern Region (NER). The recommendations outlined in the study are expected to give an inspiration to various stakeholders. The study has touched upon many sectors such as tourism, horticulture, organic farming, utilization of hydro power, etc., but besides these sectors the study has also focused on some vital issues such as internal security of the state, infrastructure issues, etc. All the recommendations are quite feasible and implementable. This study was completed recently in 2020; there might be chances of partial implementation of the recommendations. However, it has been observed that Central Government and State Government are continuously implementing various developmental activities in the NER. In collaboration with the NITI Ayog, the NITI Forum for North East has been constituted for accelerated inclusive and sustainable development in the NER, which has identified five focus sectors, viz., Tea, Tourism, Bamboo, Dairy, and Pisciculture. Under the Swadesh Darshan Scheme of the Ministry of Tourism, sixteen projects with themes of heritage, wildlife, spiritual, tribal, eco-adventure, etc., with total amount of ₹1337.63 crore have been sanctioned ^[17].

Agencies responsible for implementation:

The study is focused on the growth and development of the NER, hence there could be various stakeholders who would be responsible for the implementation of the recommendations. Primarily, State Government and Central Government Departments can jointly work for the developmental plan.

Study Title

India's Act East Policy: facilitating India–Myanmar border trade

Implementing Institution

Indian Council for Research on International Economic Relations

Project Location/Completion Year

More than one state, 2019

Objective

- To know the major trends in India–Myanmar trade
- To know India–Myanmar border trade increase and what are the impediments
- To know what can be traded
- To identify policy measures, which are needed to enhance India– Myanmar border trade

Study Recommendation

- Awareness and capacity building programmes for small and medium Traders
- Quality infrastructure at the border crossings
- Streamlined trade procedures
- Opening more trading points: The Avangkhu LCS in Nagaland should be notified for formal trade at the earliest. Setting up trade finance instruments and bilateral currency swap arrangement
- B2B interactions between traders in adjoining states across the border
- Border haats for local populations. Mechanism for regular consultations between border officials

Analysis and Outcome

This study was sanctioned to Indian Council for Research on International Economic Relations by the Department of International Development (DFID) to study the effectiveness of the new trade policy measures adopted by India with regard to bilateral trade with Myanmar across the land border and highlights the challenges faced by traders in shifting to normal trade and highlighting the recommendations to improve the trade.

In order to provide a boost to its 'Act East' policy, the Indian Government has multiple connectivity projects, through land, water, and air. Some of them include the India-MyanmarThailand Trilateral Highway; the Kaladan Multi-Modal Transit Transport Project, creating a mode of transport for shipment of cargo from the eastern ports of India to Myanmar as well as to North Eastern Region (NER).^[18]

The Govt. of India announced the Foreign Trade Policy (FTP) 2015–2020 to underline the importance of foreign trade in the growth of the Indian economy to increase India's exports of goods and services.

The Indian government has worked to extend air, land and sea routes to strengthen trade links with Myanmar. While the involvement of India's private sector has been low and growing at a slow pace, both governments are proceeding to enhance cooperation in agriculture, telecommunications, information technology, steel, oil, natural gas, hydrocarbons, and food processing^[19].

Implementable Recommendations:

- B2B Interactions between Traders in Adjoining States across the Border.
- Border Haats for Local Populations. Mechanism for Regular Consultations between Border Officials.

Agencies who could be responsible for the implementation:

- Department of Commerce and Industries, Government of Manipur
- Export-import Bank of India



Study Title

Diversifying Growth Opportunities in North East Region of India

Implementing Institution

Centre for Agriculture and Rural Development / Indian Council for Food and Agriculture

Project Location/Completion Year

More than one state, 2017

Objective

To identify growth opportunities in North East India

Study Recommendation

- Analyse crops for local as well as domestic consumption, for exports to neighbouring countries and rest of the world and for food processing industry.
- Investment in piggery: a tripartite arrangement between an NGO – ICAR – Banker, or a private company supported by the Government can go well in promoting profitable piggeries in the North Eastern Region (NER). Earmark funds for training and exposure visits to successful farming and agro ventures, outside NER so that people of the region could learn most advanced techniques and practices and practice the same.
- Establishment of at least one quality testing lab in Guwahati initially and later one in each state and four incubation centres for the region. A modern tissue culture lab and nursery need to be set up for key crops of the region.
- Supporting industry like packaging material and labelling needs to be promoted. Development of eco-tourism and investment in bamboo sector should be made. Climate smart villages project should be set up. Development of commercial poultry production needs to be promoted. Establishment of information centre should be done. Investment in promotion and marketing of agricultural products of the NER should also be done.

Analysis and Outcome

This study provides insights to the barriers of socio-economic growth opportunities and highlights the steps which can be taken to improve the same.

The study identified certain challenges also such as conventional market-based solutions, poor infrastructure and connectivity, unemployment and low economic development, law and order problems, etc.

All the recommendations mentioned in the study are implementable. It has been observed that in the past recommendations have been partially implemented by the Government of India under various schemes. In August 2019, the Department of Horticulture & Soil Conservation, Government of Manipur and ICAR had set-up a ICAR-NEH Quality Analysis Laboratory at the Indian Council of Agricultural Research (ICAR)-Research Complex for North-Eastern Hill Region, Manipur Centre, Imphal ^[20]. The Department of Biotechnology has introduced Biotech-KISAN—a scientist-farmer collaboration scheme for agricultural innovation in North East that was introduced in 2017. It intends to connect research laboratories with farmers to explore innovative ideas and technology at the farm-level ^[21].

Agencies who could be responsible for the implementation:

- The Ministry of Agriculture and Farmers' Welfare
- Department of Biotechnology
- The Ministry of Rural Development
- Respective State Government Departments

Study Title

Harnessing the potential for cross-border trade between North East India and its neighbouring countries

Implementing Institution

CUTS International

Project Location/Completion Year

More than one state, 2017

Objective

To understand the specific problems of the region and extend precise policy prescription towards the same including greater private sector participation to realize this goal

Study Recommendation

- Holistic development of connectivity initiatives considering all of their dimensions, namely institutional, physical, financial, digital and people-to-people connectivity.
- Setting up of proper storage and integrated cold chain facilities.
- Turn all the existing Land Custom Stations (LCSs) into functional ones.
- Alignment of existing trade routes and the development of alternative ones.
- Training indigenous human resources for doing and facilitating trade.
- Tradable goods through particular LCSs should be regularly revised.
- There should be the establishment of local offices of nodal agencies handling trade matters.
- Opening of more border haats to encourage seasonal trade between North East India and its neighbouring countries.

Analysis and Outcome

This project threw a major light on identifying the potential for cross-border trade between North East India and its neighbouring countries. CUTS International took this opportunity, which was sanctioned by the Federation of Indian Chambers of Commerce & Industry to them.

The recommendations mentioned in the study are vital in the socio-economic development of the North Eastern Region (NER). The Government of India has taken many initiatives in this direction; Central Government's push has played a significant role in the development of the NER. Almost 20 bridges, various key stretches erected along the region has immensely benefitted the frontier state, to stand into the fore for countering the aggressive neighbouring country – China. The state government has also focused on developing the border villages situated along the Indo-China border through better road connectivity, drinking water, health and educational developments, and installation of micro hydel projects and solar lights along these sensitive areas ^[22]. The Government has also developed warehouse and storage of goods for the trade in Rongpo, a border between Darjeeling and Sikkim.

A point has been highlighted during the Focus Group Discussion (FGD), that cold storage facility has been a major issue identified in cross trade and agricultural industry, which is essential for preserving the crops/products for trade.

Agencies who could be responsible for the implementation:

- The Federation of Indian Chambers of Commerce & Industry



Study Title

North East India market exploration study tour report

Implementing Institution

Department of Agricultural Marketing and Cooperatives (DAMC)

Project Location/Completion Year

More than one state, 2017

Objective

To assess market penetration feasibility in North East India

Study Recommendation

- Official intervention/arrangement for Bhutanese traders or farmers to participate in Indian bordering markets during haat days similar to India–Bangladesh border market arrangements.
- During vegetable on-season, the MoAF/DAMC in collaboration with FCB can advertise and invite vegetable dealers from main towns and cities from bordering areas.
- Write a formal letter to the Government of Assam for trading dairy and poultry products. The DAMC can trial market the red eggs and milk in Guwahati through formal channel.

Analysis and Outcome

The aim of the study is to analyse Market Scenario for Bhutanese Agricultural Products that includes Agri-Horti products, Dairy products and Non Wood Forest Products (NWFP). The study links its relevance to understand the current market condition of Bhutanese agricultural products and its scope. This study emphasizes with a motive to improve the prevailing condition of Bhutanese vegetables in the market.

The Government of India has taken many official interventions to enhance the trade between the bordering traders and Bhutanese traders, consequently, it has been observed that total trade between India and Bhutan has increased by nearly 50 times during 2000–01 and 2018–19 ^[23]. Growth in bilateral trade has been driven largely by the rapid economic growth and greater commercial integration between the two countries.

India has extended the fullest cooperation and support to Bhutan in terms of ensuring uninterrupted movement of commodities through the COVID-19 pandemic. The close trade and economic ties are a reflection of the special bonds of trust and understanding between India and Bhutan that have existed over decades. In October 2020, India had granted new market access for five agri-exports (areca nut, mandarin, apple, potato, ginger) of Bhutan and had opened a new plant quarantine office at Jaigaon. At Bhutan's request, the Government of India had lifted the import restriction on potato only for Bhutan up to June 2022, thereby alleviating the difficulties faced by Bhutanese traders in exporting potato to India ^[24].

Agencies who could be responsible for the implementation:

- Department of Agriculture & Farmers Welfare

Study Title

To set up food processing Industries in the states of Assam, Mizoram & Tripura

Implementing Institution

ITV Agro & Food Technologies Pvt. Ltd.

Project Location/Completion Year

More than one state, 2015

Objective

To stimulate and augment the growth of food processing industry in the North Eastern Region

Study Recommendation

- Formulation of a state agriculture and food processing policy and schemes
- Modernization of existing units, setting up new food processing units
- Development of a detailed action plan for market driven, high value and allied sectors
- Revival and modernization of supply chain infrastructure
- Modernization of rice mills and development of rice clusters
- Establishment of modern meat processing infrastructure
- Operationalization of the Food Park
- Facilitating credit linkages including micro-credit
- Establishment of certification and quality control infrastructure
- Implementation of the detailed action plan for market driven high-value agriculture and allied sector such as fisheries, piggery and goaterly in the region
- State-wide dairy development using milk routes
- Linkages with the Mega-food park in Assam/Mizoram



This study aimed to identify the challenges faced by Assam, Mizoram and Tripura in establishing food processing industries and the measures which can be taken to overcome these barriers/challenges.

The recommendations mentioned in the study report are implementable. India's food processing sector is one of the largest in the world and its output is expected to reach \$535 Bn by 2025–26.^[25]

The following initiatives have been taken under the Pradhan Mantri Kisan Sampada Yojana (PMKSY):

1. Scheme for Mega Food Parks

- Mega Food Parks are based on 'cluster' approach and focus on creation of state-of-the-art support infrastructure in a well-defined agri/horticultural zone for setting up of modern food processing units in the industrial plots provided in the park with well-established supply chain.
- Grant-in-aid – at 50% of eligible project cost in general areas and at 75% of eligible project cost in the North Eastern Region (NER) and Difficult Areas

2. Scheme for Cold Chain and Value Addition Infrastructure

- Grant-in-aid for storage infrastructure such as ripening chamber, pack houses, pre-cooling units - at 35% for general areas and at 50% for northeastern states, Himalayan states, Integrated Tribal Development Project (ITDP) areas and islands.
- Grant-in-aid for value addition and processing infra including frozen storage – at 50% for general areas and at 75% North East states, Himalayan states, ITDP areas and islands.
- Grant-in-aid for irradiation facilities – at 50% of eligible project cost in general areas and at 75% of eligible project cost in the NER and difficult areas

There is one food park each in Assam and Tripura, which are operational as on date. Tripura has also introduced many policies for improvement of food processing industries in Tripura under the three-year governance action plan (2020–21 to 2022–23)^[26].

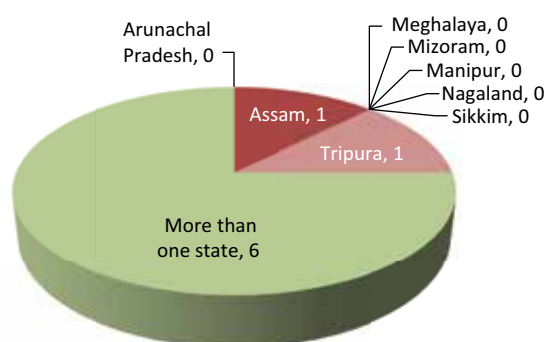
Agencies who could be responsible for the implementation:

- Tripura Industrial Development Corporation Limited
- Ministry of Agriculture & Farmers' Welfare
- Ministry of Food Processing Industries

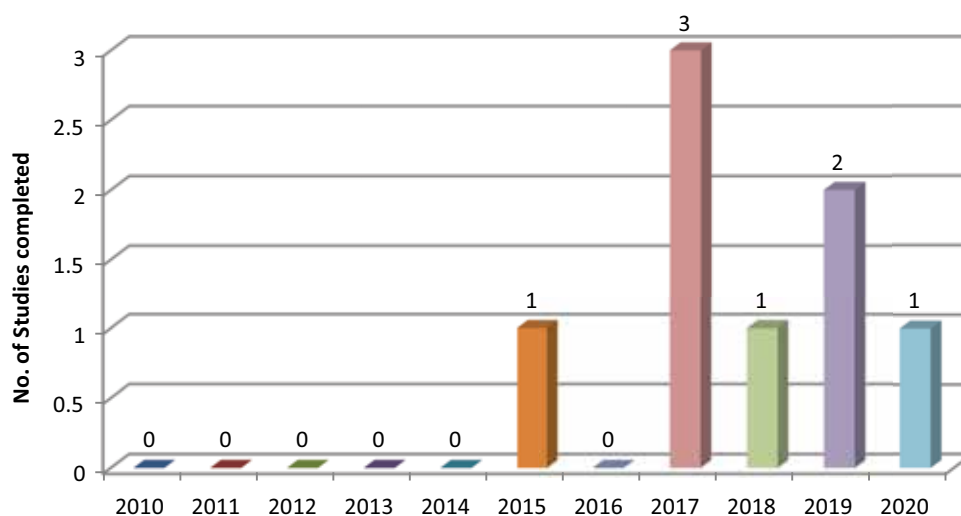
State-wise Summary

The North Eastern Region (NER) in India has abundant natural resources, which can be utilized for all-round economic development and employment generation in the region. The Ministry of Micro, Small and Medium Enterprises (MSME), Government of India, and the concerned State Government is actively promoting the development of MSME and village industries in the NER through the programmes and schemes implemented by the Ministry and its Departments.

In the present study, eight (8) study reports have been collected and analysed. These research studies have been carried out in different states of the NER by various academic and research institutions on commerce & industry sector. In the current study, 6 studies have been carried out in more than one state whereas the other two studies have been carried out in Assam (1) and Tripura (1). These studies were conducted during the years 2015, 2017, 2018, 2019, and 2020.



Studies completed in Commerce & Industry Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Commerce & Industry Sector in NER during 2010 to 2020 (Year-wise)

Assam

Tea is the most important component of the agro-industry of Assam, which contributes immensely to Assam's as well the country's economy. The tea garden community constitutes more than 20% of the state's population. There are more than 1000 tea gardens in Assam, out of which 787 are registered tea gardens. Due to poor socio-economic conditions, undernourishment, and ignorance the tea garden community is vulnerable to various communicable diseases and malnutrition, especially among women and children. Therefore, opening of a special project of Bagan Bazar was proposed in 2015. Bagan Bazar has been



implemented in a phased manner—1st Phase started on October 2, 2015 with the inauguration of twenty four (24) Nos. of Nutrition Shops (Bagan Bazars) and 2nd Phase was implemented in Thirty Nine (39) Nos. during August 2016 in the Tea Estates across the State of Assam. These 63 Bagan Bazars are spread across 29 blocks in 18 Districts of Assam. Five (5) more Bagan Bazars are coming up in 2017–18, preparation of which has been already done.

A study on 63 Bagan Bazars in the tea garden areas of Assam has been conducted by The Moksha Consultancy Pvt. Ltd with a funding support from Assam State Rural Livelihood Mission Society (ASRLMS) in 2017–18. The recommendations of the study are very generic in nature and are fully implementable. ASRLMS has developed several strategies for the empowerment of women in the pursuit of their socio-economic development. The Government of India has undertaken many initiatives such as “Poshan Maah” drive, which is helping to fight against malnutrition in Assam. ASRLMS is already implementing the Deen Dayal Antyodaya Yojana—National Rural Livelihoods Mission (DAY-NRLM) in the State since November 2011.

Tripura

The State of Tripura is predominantly agrarian with vast forest coverage. More than 42% of its population is directly dependent on agriculture and allied activities. The contribution of the primary sector, that is, agriculture & allied activities is around 33% to the Gross Domestic Product of the State— though the availability of land for cultivation is restricted by the topography because of hilly tracts and undulation. Tripura is one of the seven states in the NER of India. Tripura acts as a gateway between North-East India and Bangladesh. The State shares an 856-km international border with Bangladesh. This offers enormous potential for international trade. Tripura is endowed with rich and diverse bamboo resources and is the largest bamboo producing hub in India. The State has an area of 7195 hectares for the production of bamboo.

A study on small and medium industries marketing infrastructure for the state of Tripura was conducted in 2019 by The North Eastern Development Finance Corporation Limited (NEDFi) with the help of I-WIN Advisory Services Limited under Techno Economic Development Fund (TEDF). The current study is aimed to understand the challenges faced by small-scale industries and the strategies they must follow to cope up with the challenges. This study was successful in finding out the loopholes, which were a barrier in the marketing of small- and medium-scale industries.

The study has suggested the following remedial measures to enhance the economic development in the State:

- SME entrepreneurs do lack knowledge about the existing schemes and the guidelines to make their product competitive. Hence, a dedicated handholding facility like “Small Business Development Centre” may be considered for free counselling. This would boost up motivation and proper guidance in terms of market research, product positioning, brand development, and revenue and profit maximization.
- Tripura is known for its famous “Kew” and “Queen” varieties of pineapple for its special aroma and flavour. By facilitating better storage and inventories, more emphasis can be put on converting it into one of the big industries of the State.
- The Study has also suggested state-level vendor development programme on regular basis for the effective implementation of the government schemes.
- Religious tourism has proved to be a significant contributor to state economy and it constitutes a considerable share of the total domestic tourists. The government may think of tourism covering all such traditional religious sites of Tripura for people in pursuit of religious activities. This will help to increase the market size for SME products in general and handicraft products in particular among the tourists who will like to carry memories of Tripura with them.

It has been observed that the government has taken several initiatives to encourage the growth of enterprises in the State. The Department of Tourism has introduced the “Tourism Policy 2020–2025” for improving the socio-economic development of the State. The Ministry of Skill Development & Entrepreneurship (MSDE) has also introduced skill development programme in Agartala, Tripura, especially for women. The government has arranged many roadshows in different state capitals of India to attract entrepreneurs to the state.

Overall Scenario

During this study, 6 reports were collected and analysed wherein more than one state in the NER has been covered in the Study. The focus of these studies includes market feasibility study, micro small and medium enterprises, agro-business, India-Myanmar trade, etc.

A study was carried out by Spectrum Planning (India) Ltd in 2020 on “Competitive advantages of the North Eastern States and identification of thrust areas for growth and development in the region”. The findings of this study are useful in formulating robust developmental plan for each of the states in the NER. The recommendations outlined in the study are expected to give an inspiration to various stakeholders. The study has touched upon many sectors such as tourism, horticulture, organic farming, utilization of hydropower, etc., but besides these sectors the study has also focused on some vital issues such as internal security of the State and infrastructure issues. All the recommendations are quite feasible and implementable. This study has been completed recently in 2020; there might be chances of partial implementation of the recommendations. However, it has been observed that the Central Government and State Government are continuously implementing various developmental activities in the NER. In collaboration with the NITI Aayog, the NITI Forum for North East has been constituted for accelerated inclusive and sustainable development in the NER, which has identified five focus sectors, viz., Tea, Tourism, Bamboo, Dairy, and Pisciculture. Under the Swadesh Darshan Scheme of the Ministry of Tourism, sixteen projects with themes of heritage, wildlife, spiritual, tribal, eco-adventure, etc., with total amount of INR 1337.63 crore have been sanctioned.

Another study was conducted in 2017 on “Diversifying Growth Opportunities in North East Region of India” by the Centre for Agriculture and Rural Development, Indian Council for Food and Agriculture. This study provides insights to the barriers of socio-economic growth opportunities and highlights the steps which can be taken to improve the same. The NER has been a great example of slow industrialization and socio-economic growth, despite being the only region in India with rich natural resources and environment for industrial development. The Study identified certain challenges also, which are conventional market-based solutions, poor infrastructure and connectivity, unemployment and low economic development, law and order problems, etc. All the recommendations mentioned in the study are implementable. It has been observed that in the past recommendations have been partially implemented by the Government of India under various schemes. In August 2019, the Department of Horticulture & Soil Conservation, Government of Manipur and ICAR set-up a ICAR-NEH Quality Analysis Laboratory at the Indian Council of Agricultural Research (ICAR)-Research Complex for North-Eastern Hill Region, Manipur Centre, Imphal. The Department of Biotechnology has introduced Biotech-KISAN—a scientist-farmer collaboration scheme for agricultural innovation in the North-East that was introduced in 2017.

There are two studies on cross border trade between the NER and neighbouring countries. These studies have been conducted in 2017 and 2019 by CUTS International and Indian Council for Research on International Economic Relations, respectively. CUTS International has pointed out in its study that even with immense potential and possibilities, the region is yet to promote itself as a trade hub and bridge to the South East Asia. The reasons for the same are multi-faceted and can be divided into three broad heads. There are diplomatic challenges that often reflect in discontent among India and some of its neighbouring countries. This has created an ambience of distrust and suspicion among relevant stakeholders, which is detrimental to free economic exchange across the border. The recommendations mentioned in the study are vital in the socio-economic development of the NER. However, it has been observed that the Government of India has taken many initiatives in this direction as the Central Government’s push has played a significant role in the NER development. Almost 20 bridges, various key stretches erected along the region have immensely benefitted the frontier state, to stand into the fore for countering the aggressive neighbouring country—China. The State Government has also focused on developing the border villages situated along the Indo-China border through better road connectivity, drinking water, health & educational developments, and installation of micro hydel projects and solar lights along these sensitive areas. The Government has also developed warehouse and storage of goods for the trade in Rongpo, a border area between Darjeeling and Sikkim. However, a point has been highlighted during the Focus Group Discussion (FGD), that cold storage facility has been a major issue identified in cross trade and agricultural industry, which is essential for preserving the crops/products for trade.



Another study conducted by the Department of Agricultural Marketing and Cooperatives in 2017 highlighted market scenario for Bhutanese agricultural products. The study links its relevance to understand the current market condition of Bhutanese agricultural products and its scope. This study emphasizes with a motive to improve the prevailing condition of Bhutanese vegetables in the market. The Government of India has taken many official interventions to enhance the trade between the bordering traders and Bhutanese traders. Consequently, it has been observed that total trade between India and Bhutan has increased by nearly 50 times during 2000–01 and 2018–19. Growth in bilateral trade has been driven largely by the rapid economic growth and greater commercial integration between the two countries. At Bhutan's request, the Government of India had lifted the import restriction on potato only for Bhutan up to June 2022, thereby alleviating the difficulties faced by Bhutanese traders in exporting potato to India.

One of the studies conducted by ITV Agro & Food Technologies Pvt. Ltd in 2015 has highlighted the challenges faced by Assam, Mizoram and Tripura in establishing food processing industries and the measures, which can be taken to overcome these barriers/challenges. The recommendations mentioned in the study report are implementable. India's food processing sector is one of the largest in the world and its output is expected to reach \$535 Bn by 2025–26. The Central Government has taken initiatives towards the food processing and formulation of state agriculture schemes under the Pradhan Mantri Kisan Sampada Yojana (PMKSY). In 2019, during the "North East Food Show 2019" the Union Government had undertaken several initiatives to increase the food production, encourage the farmers, and promote food processing industries. The Union Government has also proposed to provide 75 per cent subsidy to entrepreneurs to set up food-based industries in North-East India. Out of 42 Mega Food Parks to be set up all across the country, 6 of them are in the NER. (<https://www.sentinelassam.com/editorial/developing-ne-as-food-processing-hub-502455>)

Cold storage facility has been a major issue identified in cross trade and agricultural industry, which is essential for preserving the crops/products for trade.

Involvement of the private sector is also highly essential to strengthen the NER trade links in the areas of agriculture, telecommunications, information technology, steel, oil and natural gas and food processing. Foreign investment and collaboration can also help boost economic growth in the region.



6.5 ENERGY

Study Title

Characterization of Producer Gas Generated from Different Locally Available Woody and Non-Woody Biomass through Gasification by Using Gas Chromatograph Analysis and Their Potential Application as Renewable Energy Requirement for Tea-Processing Industries

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2015

Objective

Surveying and collecting samples of different species of woody biomass available in Assam, prominently in nearby tea-processing industries.

Study Recommendation

- It has been observed that *Bambusa tulda* has the highest fixed carbon and *Ficus lepldosa* has the lowest.
- *Psidium guajava* has the highest calorific value and *Ficus lepidosa* has the lowest among the tested biomass samples.

Analysis and Outcome

Biomass gasification is an established renewable energy technology for heat and power applications. It is an option for partial tea-drying energy substitution in tea-manufacturing industries.

Tezpur University, with the support from the University Grants Commission, has successfully conducted a study for the characterization of producer gas generated from woody and non-woody biomass through gasification. It investigated the potential application as renewable energy for tea-processing industries.

Even with such potential benefits, like application of renewable energy for tea drying, green fuel, production cost, etc., it is difficult to convince the tea-industry people for the incorporation of gasifier technology. One or two small industrial-scale demonstrated biomass gasifier systems have been set up in some research organizations in Assam by the government or gasifier manufacturers.[31]

For economy and sustainability, the technology should be encouraged for partial conventional energy substitution in the tea-manufacturing industry of India. There should also be a proper policy and pricing of biomass required for gasification.

Study Title

Study of Performance, Combustion, and Emission Characteristics of a Turbocharged Diesel Engine Fuelled with Some Indigenous Tree Seed Based Biodiesel Available in North-Eastern Region of India

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2015

Objective

Characterization of biodiesel produced from some indigenous tree seeds available in Assam and evaluation of performance of a turbocharged diesel engine with the biodiesel blends.

Study Recommendation

To properly utilize the outcome of this project, it requires further study in engines for evaluating their performance, combustion, and emission in conventional diesel engines.

Analysis and Outcome

The present alarming energy situation enthused researchers to look for new sources of renewable fuel. Tezpur University, with support from the Department of Science and Technology, Government of India, conducted a study for the identification of new varieties of biodiesel and their characterization for determining their similarity with normal diesel fuel.

The study identified nine varieties of seeds as potential sources of biodiesel, of which three are new. Biodiesel production from all these nine tree seeds has been successfully performed.

These biodiesel varieties available in Assam have not been adequately explored, characterized, and tested for engine performance. There is enormous potential for these biodiesel varieties as fuel for diesel engines. Therefore, to properly utilize the outcome of this project, further study is required for evaluating their performance, combustion, and emission in conventional diesel engines.

Funding support could be sought under the scheme "Technology Development Programme" of the Department of Science and Technology, Government of India.



Study Title

Development of an Innovative Model of Combined Heat and Power from Purely Producer Gas Based Engine Alternator System for Partial Conventional Energy Substitution of Tea-Processing Industries in North-East India

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2015

Objective

Application of biomass-based producer gas fired engine generator coupled with exhaust waste-heat recovery system for tea drying

Study Recommendation

No Recommendation

Analysis and Outcome

Tea drying is a highly energy-intensive process. It uses natural gas or coal for its operation. Many tea factories, particularly in the north bank of the river Brahmaputra, are equipped with inefficient coal-fired Furnaces.

The study successfully developed a new model to substitute the partial conventional energy for tea-processing industries in North-East India. The system is environment friendly due to the application of green fuel for both heat and power generation.

Appropriate technical back-up, work force should be locally available for biomass gasifier system to run in thermal and power modes. Once these are taken into consideration, more and more tea-manufacturing industries will be showing interest for installation of gasifier system to substitute fossil fuel partially, to begin with.

The Science and Engineering Research Board, DST, could probably support this activity.

Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D network in Golaghat, Jorhat, Nagaon, Sibsagar, and Karbi Anglong Districts in Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2020

Objective

Identify impacts and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

Public participation and community consultations; inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

Power transmission is an integral part of the power sector and is as vital as power generation. The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various positive and enhancement measures as a part of the project benefit programme to the people.

The affected people have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for transmission lines for systems of 66 KV and above voltage level have been suggested.[30]

As per the report, the CPTD has been disclosed on the websites of World Bank and POWERGRID. Recommendations have been made on organizing public consultation meetings with stakeholders to share the views of the public and informing them about the project at every stage of execution, the compensation scheme, and the status of payment.

Though India has an adequate power generation capacity, it has a substantial proportion of population with limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.



Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Kamrup Rural, Udalguri, and Sonitpur Districts in Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2020

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

The CPTD for the T&D network in Kamrup rural, Udalguri, and Sonitpur districts in Assam envisaged likely assessment of negative impacts and alleviation of these negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested.^[30]

As per the report, the CPTD has been disclosed on the websites of World Bank and POWERGRID. Recommendations have been made for organizing public consultation meetings with stakeholders to share the views of the public and informing about the project at every stage of execution, the compensation scheme, and the status of payment.

Though India has an adequate power generation capacity, it has a substantial proportion of population with limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.

Study Title

Development of Appropriate Product by Studying the Possible Use of Coir Dust in Oil Industries with Reference to North-East India for Absorption of Oil Spill

Implementing Institution

North-East Institute of Science & Technology

Project Location/Completion Year

Assam, 2019

Objective

Study on the characterization of coir pith; different physicochemical treatments of coir pith; design and development of coir dust sorbent; and study on the possibilities of reuse and disposal of coir dust sorbent.

Study Recommendation

Coir dust may be converted to pouches/bags, blocks, and mats/pads by the addition of natural fibre and also by adopting certain mechano-chemical progression.

Analysis and Outcome

The study has successfully explored the possibilities of utilizing coir dust, a waste product generated from the coconut husk and fibres. As per the study, the product has the potential for cleaning up oil spillage, which contributes to environment pollution by the oil industry. The use of such waste materials greatly reduces environmental pollution and helps in making highly efficient oil-absorbing mats for oil spills.

The technology and the associated products are already commercialized with private entrepreneurs. It is already a self-employment generating technology in the coconut-growing belts of North-East India.

As per the study, the coir dust can be converted to many new products such as pouches, bags, mats, etc. Hands on training is imparted by the Indian Council of Agriculture Research.

Agencies such as the CSIR, as per its mandate, support the conduction of awareness and demonstration programmes for further promotion.



Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Dhemaji District in Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2018

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and the status of payment.

Analysis and Outcome

The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various positive and enhancement measures as a part of the project benefit programme to the people.

Though India has an adequate power generation capacity, it has a substantial proportion of population with limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.

Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Tinsukia and Dibrugarh Districts in Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2018

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

The CPTD for the T&D network in Tinsukia and Dibrugarh districts in Assam envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested.^[30]

Though India has an adequate power generation capacity, it has a substantial proportion of population with limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.



Study Title

Environmental and Social Policy and Procedures Framework (ESPPF), Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2015

Objective

Strengthening and augmenting the intra-state and interstate transmission and distribution schemes and undertaking capacity-building initiatives.

Study Recommendation

- The ESMC shall regularly monitor E&S issues with project activities and report to the AGM (transmission).
- Regular monitoring of activities, including environment and social issues.

Analysis and Outcome

The expansion and augmentation of the power transmission and sub-transmission network is a very important developmental activity spread across the six NER states, including various geographical, geotechnical, and eco-sensitive zones. These activities have minimal environmental and social impact owing to the flexibility and management of environmental and social issues in these states.

Post-implementation, efforts should be put on facilitating connection to remote/virgin areas, enhancing capacity and reliability of the system, improving voltage profile, reducing losses, and ultimately enhancing the satisfaction of all categories of consumers across the region. This will, in turn, spur the growth and overall development of the whole state.

This will also lead to fulfilling the Government of India's overall policy of making electricity available 24x7.

Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Dhemaji District Under NERPSIP Tranche-1, Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2015

Objective

Strengthening of the transmission and distribution system in Assam.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

The State of Assam is endowed with rich energy resources but faces significant bottlenecks in electricity access and availability levels. No significant generation capacity has been added for a long period and as a result, inadequate power supply remains a critical constraint to sustainable and inclusive growth, and to scaling up private investment and economic competitiveness in the NER.^[1]

The study deals with Initial Environment Assessment for strengthening of transmission and distribution system in the state of Assam. There is tremendous benefit that comes out of such schemes for the state. They provide insight on possible environment and social issues and also describes measures to mitigate it thereby facilitating transfer of green and clean power with reliability. The scheme not only improves overall power supply situation but also improves reliability, quality, security and enhancement of power supply in the State. Periodic review by higher management of all environmental and social issues needs to be undertaken to ensure that EMP and other measures are fully implemented.



Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Golaghat, Nagaon, Jorhat, Sibsagar, and Karbi Anglong Districts under NERPSIP Tranche-1, Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2015

Objective

Strengthening of the transmission and distribution system in Assam.

Study Recommendation

- Strengthening the present intra-state transmission system of the state
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.

Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Kamrup District under NERPSIP Tranche-1, Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2015

Objective

Strengthening of the transmission and distribution system in Assam.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

The State of Assam is endowed with rich energy resources but faces significant bottlenecks in electricity access and availability levels. No significant generation capacity has been added for a long period and as a result, inadequate power supply remains a critical constraint to sustainable and inclusive growth, and to scaling up private investment and economic competitiveness in the NER.

The study deals with Initial Environment Assessment for strengthening of transmission and distribution system in the state. There is tremendous benefit that comes out of such schemes for the state. They provide insight on possible environment and social issues and also describes measures to mitigate it thereby facilitating transfer of green and clean power with reliability. The scheme not only improves overall power supply situation but also improves reliability, quality, security and enhancement of power supply in the State. Periodic review by higher management of all environmental and social issues needs to be undertaken to ensure that EMP and other measures are fully implemented.



Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Kamrup Rural, Udalguri, and Sonitpur Districts under NERPSIP Tranche-1, Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2015

Objective

Strengthening of the transmission and distribution system in Assam.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

Although the transmission and distribution system covers many areas of the state, it is inadequate in its reach, and the non-availability of redundant T&D system and the breakdown of transmission system elements result in long-term power shortages and make the system highly unreliable.

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.

Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Tinsukia and Dibrugarh Districts in Assam

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Assam, 2015

Objective

Strengthening of the transmission and distribution system in Assam.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

No significant generation capacity has been added for a long period and as a result, inadequate power supply remains a critical constraint to sustainable and inclusive growth, and to scaling up private investment and economic competitiveness in the NER.

The study deals with Initial Environment Assessment for strengthening of transmission and distribution system in the state. There is tremendous benefit that comes out of such schemes for the state. They provide insight on possible environment and social issues and also describes measures to mitigate it thereby facilitating transfer of green and clean power with reliability. The scheme not only improves overall power supply situation but also improves reliability, quality, security and enhancement of power supply in the State. Periodic review by higher management of all environmental and social issues needs to be undertaken to ensure that EMP and other measures are fully implemented.



Study Title

Coal Gasification to Meet Thermal Requirement and Additional Captive Power Generation of 63 kVA, Jorhat Tea Cluster, Assam (India)

Implementing Institution

Petroleum Conservation Research Association (PCRA)

Project Location/Completion Year

Assam, 2010

Objective

Enhance the energy efficiency awareness by funding/subsidizing need-based studies in SME clusters and giving energy conservation recommendations.

Study Recommendation

Capacity building of stakeholders in cluster on energy efficiency and energy conservation programmes.

Analysis and Outcome

The Petroleum Conservation Research Association (PCRA) has executed the BEE-SME programme for the Jorhat Tea Cluster, supported by the Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

The BEE's SME programme has enhanced the energy efficiency awareness by funding/subsidizing need-based studies in SME clusters and giving energy conservation recommendations.

For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, the BEE is focusing on energy efficiency, energy conservation, and technology up-gradation through studies and pilot projects in these SME clusters.

For capacity building of stakeholders on energy efficiency and energy conservation programmes, both the PCRA and the BEE conduct awareness-raising training programmes, under their training module.

Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Imphal West, Imphal East and Tamenglong Districts, Manipur

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Manipur, 2020

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested.^[30]

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network



Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Imphal East, Churachandpur, Thoubal, and Tamenglong Districts, Manipur

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Manipur, 2019

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment

Analysis and Outcome

The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

As per the study, there were no adverse impacts such as permanent loss of assets, livelihood loss or physical resettlement/relocation due to project intervention. However, there were some social impacts due to construction of lines or placing of towers and poles which are temporary in nature in terms of loss of standing crops/trees/structures in the RoW.

Compensation towards temporary damages to all eligible affected persons including non-title holders is paid after assessment by relevant authorities of State Govt, as per the guidelines.

The CPTD greatly benefitted the Indigenous Peoples and ensured that they received social and economic benefits those are culturally appropriate and gender and inter generationally inclusive. The project ascertained broad community support based on social assessment and free prior and informed consultation with the affected Tribal community.

Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Imphal West, Senapati, and Bishnupur Districts, Manipur

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Manipur, 2019

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- All APs are paid compensation for actual damages irrespective of their religion, caste, and economic status.
- There is one-time lump sum assistance to vulnerable households.

Analysis and Outcome

Power transmission is an integral part of the power sector and is as vital as power generation. The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested.[30]

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.



Study Title

Environmental and Social Policy and Procedures Framework (ESPPF), Manipur

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Manipur, 2015

Objective

Strengthening and augmenting the intra-state and interstate transmission and distribution schemes and undertaking capacity-building initiatives.

Study Recommendation

- The ESMC shall regularly monitor E&S issues with project activities and report to the AGM (transmission).
- Regular monitoring of activities, including environment and social issues

Analysis and Outcome

The expansion and augmentation of the power transmission and sub-transmission network is a very important developmental activity spread across the six NER states, including various geographical, geotechnical, and eco-sensitive zones. These activities have minimal environmental and social impact owing to the flexibility and management of environmental and social issues in these states.

Post-implementation, efforts should be put on facilitating connection to remote/virgin areas, enhancing capacity and reliability of the system, improving voltage profile, reducing losses, and ultimately enhancing the satisfaction of all categories of consumers across the region. This will, in turn, spur the growth and overall development of the whole state.

This will also lead to fulfilling the Government of India's overall policy of making electricity available 24x7.

Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Imphal East, Churachandpur, Thoubal, and Tamenglong Districts under NERPSIP Tranche-1, Manipur

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Manipur, 2015

Objective

Strengthen the transmission and distribution system in Manipur.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.



Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Imphal West, Imphal East, and Tamenglong Districts, Manipur

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Manipur, 2015

Objective

Strengthening the transmission and distribution system in Manipur.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

The study deals with Initial Environment Assessment for strengthening of transmission and distribution system in the state of Manipur. There is tremendous benefit that comes out of such schemes for the state. They provide insight on possible environment and social issues and also describes measures to mitigate it thereby facilitating transfer of green and clean power with reliability. The scheme not only improves overall power supply situation but also improves reliability, quality, security and enhancement of power supply in the State. Periodic review by higher management of all environmental and social issues needs to be undertaken to ensure that EMP and other measures are fully implemented.

Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Imphal West, Senapati, and Bishnupur District under NERPSIP Tranche-1, Manipur

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Manipur, 2015

Objective

Strengthening the transmission and distribution system in Manipur.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

As most of the generation projects in the North-Eastern Region are hydro in nature, the state of Manipur faces shortage of power during low-hydro generation condition. Although the transmission and distribution system covers many areas of the state, it is inadequate in its reach, and the non-availability of redundant T&D system and the breakdown of transmission system elements result in long-term power shortages and make the system highly unreliable.

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.



Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in East Khasi Hills and Ri-Bhoi Districts, Meghalaya

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Meghalaya, 2019

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

Power transmission is an integral part of the power sector and is as vital as power generation. The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested.^[30]

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.

Study Title

Final Environmental Assessment Report of Transmission and Distribution Subprojects in Garo Hill Districts of Meghalaya under NERPSIP

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

Meghalaya, 2019

Objective

Assess the environmental impacts of transmission and distribution lines.

Study Recommendation

- Mitigate erosion in tower erection.
- Avoid wildlife corridors and habitat of endangered fauna/flora while erecting towers for transmission lines.
- Avoid orchards for ROW requirements.
- Ensure compensation and rehabilitation wherever necessary.

Analysis and Outcome

The Final Environment Assessment Report aimed at improving the impoverished power T&D system in the Garo Hill District of Meghalaya. The project been undertaken to report any impacts on the biodiversity and protected area and the project-affected people, and to assess the compliance of the Initial Environmental Assessment Report.

It emerged that the project-affected people were appreciative of the project and hoped that the power scenario in the district would improve with the commissioning of the project. The local people are also getting benefited through the project-related employment that was being generated.

The proposed transmission and distribution schemes will improve not only the overall power supply situation but also the reliability, quality, security, and enhancement in the power supply of the state.

According to the project investigator, the project has been fully implemented.



Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in West Garo Hills and South-West Garo Hills Districts, Meghalaya

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Meghalaya, 2018

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

Power transmission is an integral part of the power sector and is as vital as power generation. The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested.[30]

As per the report, the CPTD has been disclosed on the website of World Bank and POWERGRID. Recommendations have been made for organizing public consultation meetings with stakeholders to share the views of the public and informing about the project at every stage of execution, the compensation scheme, and the status of payment.

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.

Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in East Jaintia Hills District, Meghalaya

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Meghalaya, 2018

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested.^[30]

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.



Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in East Jaintia Hills District under NERPSIP Tranche-1, Meghalaya

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Meghalaya, 2015

Objective

Strengthen the transmission and distribution system in Meghalaya.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.

Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in East Khasi Hills and Ri-Bhoi Districts under NERPSIP Tranche-1, Meghalaya

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Meghalaya, 2015

Objective

Strengthen the transmission and distribution system in Meghalaya.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

As most of the generation projects in the North-Eastern Region are hydro in nature, the state of Meghalaya faces shortage of power during low-hydro generation condition. Although the transmission and distribution system covers many areas of the state, it is inadequate in its reach, and the non-availability of redundant T&D system and the breakdown of transmission system elements result in long-term power shortages and make the system highly unreliable.

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.



Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in West Garo Hills and South-West Garo Hills Districts under NERPSIP Tranche-1, Meghalaya

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Meghalaya, 2015

Objective

Strengthen the transmission and distribution system in Meghalaya.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

As most of the generation projects in the North-Eastern Region are hydro in nature, the state of Meghalaya faces shortage of power during low-hydro generation condition. Although the transmission and distribution system covers many areas of the state, it is inadequate in its reach, and the non-availability of redundant T&D system and the breakdown of transmission system elements result in long-term power shortages and make the system highly unreliable.

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.

Study Title

NER Power System Improvement Project (NERSPIP): Tranche I, Meghalaya

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Meghalaya, 2015

Objective

Strengthening and augmentation of the intra-state and interstate transmission and distribution schemes.

Study Recommendation

No Recommendation

Analysis and Outcome

The scheme was being implemented through POWERGRID in association with the beneficiary state Meghalaya, for strengthening the intra-state transmission and distribution infrastructure. The scheme was initially approved in December 2014 as a central sector scheme of the Ministry of Power.

Implementation of this scheme will create a reliable power grid and improve the NER states' connectivity to the upcoming load centres and thus extend the benefits of the grid-connected power to all categories of consumers.[32]



Study Title

Compensation Plan for Temporary Damages for T&D Network in Mamit District under NERPSIP Tranche-1, Mizoram

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Mizoram, 2020

Objective

- Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.
- The CPTD presents (i) introduction and project description; (ii) socio-economic information and profile; (iii) legal and regulatory framework; (iv) project impacts; (v) entitlement, assistance, and benefit; (vi) information disclosure, consultation, and participation; (vii) institutional arrangements; (viii) grievance redress mechanism; (ix) budget; (x) implementation schedule; and (xi) monitoring and reporting.

Study Recommendation

- Pay compensation for actual damages irrespective of religion, caste, and economic status.
- One-time additional lump sum assistance will be paid to vulnerable households not exceeding 25% of the total compensation on recommendation of state authority/ADC/VC.
- As an additional assistance, construction contractors are encouraged to hire local labour that have the necessary skills.

Analysis and Outcome

Power transmission is an integral part of the power sector and is as vital as power generation. The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested.[30]

As per the report, the CPTD has been disclosed on the website of World Bank and POWERGRID. Recommendations have been made for organizing public consultation meetings with stakeholders to share the views of the public and informing about the project at every stage of execution, the compensation scheme, and the status of payment.

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.

Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Lunglei and Lawngtlai Districts under NERPSIP Tranche-1, Mizoram

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Mizoram, 2019

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested. ^[30]

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.



Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Mamit District under NERPSIP Tranche-1, Mizoram

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Mizoram, 2017

Objective

Strengthening the transmission and distribution system in Mizoram.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER

Analysis and Outcome

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.

Study Title

Environmental and Social Policy and Procedures Framework (ESPPF)

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Mizoram, 2015

Objective

Strengthening and augmenting the intra-state and interstate transmission and distribution schemes and undertaking capacity-building initiatives.

Study Recommendation

- The ESMC shall regularly monitor E&S issues with project activities and report to the AGM (transmission).
- Regular monitoring of activities, including environment and social issues.

Analysis and Outcome

The expansion and augmentation of the power transmission and sub-transmission network is a very important developmental activity spread across the six NER states, including various geographical, geotechnical, and eco-sensitive zones. These activities have minimal environmental and social impact owing to the flexibility and management of environmental and social issues in these states.

Post-implementation, efforts should be put on facilitating connection to remote/virgin areas, enhancing capacity and reliability of the system, improving voltage profile, reducing losses, and ultimately enhancing the satisfaction of all categories of consumers across the region. This will, in turn, spur the growth and overall development of the whole state.

This will also lead to fulfilling the Government of India's overall policy of making electricity available 24x7.



Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Lunglei and Lawngtlai Districts under NERPSIP Tranche-1, Mizoram

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Mizoram, 2015

Objective

Strengthening the transmission and distribution system in Mizoram.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

As most of the generation projects in the North-Eastern Region are hydro in nature, the state of Mizoram faces shortage of power during low-hydro generation condition. Although the transmission and distribution system covers many areas of the state, it is inadequate in its reach, and the non-availability of redundant T&D system and the breakdown of transmission system elements result in long-term power shortages and make the system highly unreliable.

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.

Study Title

Final Environment Assessment Report (FEAR) for T&D Network in Longleng and Tuensang Districts under NERPSIP Tranche-1, Nagaland

Implementing Institution

R S Envirolink Technologies Pvt Ltd

Project Location/Completion Year

Nagaland, 2020

Objective

Validate the work undertaken and critically examine any deviation with respect to management measures as outlined in the IEAR, which is based on DPN's ESPPF, World Bank's Operational Policies and Bank's Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution.

Study Recommendation

- The present intra-state transmission system of the state needs to be strengthened to cater to the growing power requirements of the state.
- The present transmission and distribution (T&D) system covers many areas of the state. It is inadequate in its reach, and due to the non-availability of redundant T&D system, breakdown of any transmission system element results in long-term power shortages, making the system highly unreliable.
- Besides, some of the network elements have undergone long-term outage due to breakdown. Therefore, it has become essential to address the above situation through remedial measures in the T&D system.

Analysis and Outcome

The Final Environment Assessment Report aimed at improving the impoverished power T&D system in the Longleng and Tuensang districts of Nagaland. The project has been undertaken to report the impacts on the biodiversity of the protected areas and the project-affected people, and to assess the compliance of the Initial Environmental Assessment Report.

It emerged that the project-affected people were appreciative of the project and hoped that the power scenario in Nagaland would improve with the commissioning of the project. The local people are also getting benefited through the generated project-related employment.

The proposed transmission and distribution schemes will improve not only the overall power supply situation but also the reliability, quality, security, and enhancement in the power supply of the state.



Study Title

Final Environment Assessment Report (FEAR) for T&D Network in Mokokchung, Kohima, Phek, Wokha, Zunheboto, Dimapur, and Mon Districts under NERPSIP Tranche-1, Nagaland

Implementing Institution

R S Envirolink Technologies Pvt Ltd

Project Location/Completion Year

Nagaland, 2020

Objective

Validate the work undertaken and critically examine any deviation with respect to management measures as outlined in the IEAR, which is based on DPN's ESPPF, World Bank's Operational Policies and Bank's Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution.

Study Recommendation

- The present intra-state transmission system of the state needs to be strengthened to cater to the growing power requirements of the state.
- The present transmission and distribution (T&D) system covers many areas of the state. It is inadequate in its reach, and due to the non-availability of redundant T&D system, breakdown of any transmission system element results in long-term power shortages, making the system highly unreliable.
- Besides, some of the network elements have undergone long-term outage due to breakdown. Therefore, it has become essential to address the above situation through remedial measures in the T&D system

Analysis and Outcome

The project has been undertaken to report any impacts on the biodiversity and protected area and the project-affected people, and to assess the compliance of the Initial Environmental Assessment Report.

It emerged that the project-affected people were appreciative of the project and hoped that the power scenario in Nagaland would improve with the commissioning of the project. The local people are also getting benefited through the generated project-related employment.

The proposed transmission and distribution schemes will improve not only the overall power supply situation but also the reliability, quality, security, and enhancement in the power supply of the state.

Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Mokokchung, Kohima, Phek, Wokha, Zunheboto, Dimapur, and Mon Districts under NERPSIP Tranche-1, Nagaland

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Nagaland, 2019

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

Power transmission is an integral part of the power sector and is as vital as power generation. The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested. ^[30]

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.



Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Tuensang and Longleng Districts under NERPSIP Tranche-1, Nagaland

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Nagaland, 2019

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested. ^[30]

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.

Study Title

Environmental and Social Policy and Procedures Framework (ESPPF), Nagaland

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Nagaland, 2015

Objective

Strengthening and augmenting the intra-state and interstate transmission and distribution schemes and undertaking capacity-building initiatives.

Study Recommendation

- The ESMC shall regularly monitor E&S issues with project activities and report to the AGM (transmission).
- Regular monitoring of activities, including environment and social issues.

Analysis and Outcome

The expansion and augmentation of the power transmission and sub-transmission network is a very important developmental activity spread across the six NER states, including various geographical, geotechnical, and eco-sensitive zones. These activities have minimal environmental and social impact owing to the flexibility and management of environmental and social issues in these states.

Post-implementation, efforts should be put on facilitating connection to remote/virgin areas, enhancing capacity and reliability of the system, improving voltage profile, reducing losses, and ultimately enhancing the satisfaction of all categories of consumers across the region. This will, in turn, spur the growth and overall development of the whole state.

This will also lead to fulfilling the Government of India's overall policy of making electricity available 24x7.



Study Title

Environmental and Social Policy and Procedures Framework (ESPPF), Tripura

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Nagaland, 2015

Objective

Strengthening and augmenting the intra-state and interstate transmission and distribution schemes and undertaking capacity-building initiatives.

Study Recommendation

- The ESMC shall regularly monitor E&S issues with project activities and report to the AGM (transmission).
- Regular monitoring of activities, including environment and social issues.

Analysis and Outcome

The expansion and augmentation of the power transmission and sub-transmission network is a very important developmental activity spread across the six NER states, including various geographical, geotechnical, and eco-sensitive zones. These activities have minimal environmental and social impact owing to the flexibility and management of environmental and social issues in these states.

Post-implementation, efforts should be put on facilitating connection to remote/virgin areas, enhancing capacity and reliability of the system, improving voltage profile, reducing losses, and ultimately enhancing the satisfaction of all categories of consumers across the region. This will, in turn, spur the growth and overall development of the whole state.

This will also lead to fulfilling the Government of India's overall policy of making electricity available 24x7.

Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Mokokchung, Kohima, Phek, Wokha, Zunheboto, Dimapur, and Mon Districts under NERPSIP Tranche-1, Nagaland

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Nagaland, 2015

Objective

Strengthening the transmission and distribution system in Nagaland.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

As most of the generation projects in the North-Eastern Region are hydro in nature, the state of Nagaland faces shortage of power during low-hydro generation condition. Although the transmission and distribution system covers many areas of the state, it is inadequate in its reach, and the non-availability of redundant T&D system and the breakdown of transmission system elements result in long-term power shortages and make the system highly unreliable.

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.



Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Tuensang and Longleng Districts under NERPSIP Tranche-1, Nagaland

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Nagaland, 2015

Objective

Strengthening the transmission and distribution system in Nagaland.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER

Analysis and Outcome

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.

Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Gomati and South Tripura Districts in Tripura

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Tripura, 2019

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

As per the study, there were no adverse impacts such as permanent loss of assets, livelihood loss or physical resettlement/relocation due to project intervention. However, there were some social impacts due to construction of lines or placing of towers and poles which are temporary in nature in terms of loss of standing crops/trees/structures in the RoW.

Compensation towards temporary damages to all eligible affected persons including non-title holders is paid after assessment by relevant authorities of State Govt, as per the guidelines.

The CPTD greatly benefitted the Indigenous Peoples and ensured that they received social and economic benefits those are culturally appropriate and gender and inter generationally inclusive. The project ascertained broad community support based on social assessment and free prior and informed consultation with the affected Tribal community

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.



Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in Dhalai, Unakoti, and North Tripura Districts in Tripura

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Tripura, 2018

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

Power transmission is an integral part of the power sector and is as vital as power generation. The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages. The project envisaged likely assessment and alleviation of negative impacts. It suggested implementation of various enhancement measures as a part of the project benefit programme to the people.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested.^[30]

Though India has an adequate power generation capacity, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, India seriously needs to have a robust power transmission network.

Study Title

Compensation Plan for Temporary Damages (CPTD) for T&D Network in West Tripura, South Tripura, Khowai, and Sepahijala Districts in Tripura

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Tripura, 2018

Objective

Identify impacts/damages and plan measures to mitigate losses likely to be caused by the projects.

Study Recommendation

- Public participation and community consultations.
- Inform all affected persons about the compensation scheme and status of payment.

Analysis and Outcome

The Compensation Plan for Temporary Damages (CPTD) is guided by the national policy and legal framework such as the Electricity Act 2003 and the Ministry of Power's guidelines for the payment of compensation towards damages.

The people who are affected have been compensated for land value towards temporary damages to crops/trees/structures. The Ministry of Power (MOP) on 16 July 2020 issued guidelines for the payment of compensation towards the Right of Way (RoW) for transmission lines. As per the guidelines, 85% of the land value for tower footing and up to 15% of the land value for the RoW for the lines for transmission systems of 66 KV and above voltage level have been suggested. ^[30]

As per the report, the CPTD has been disclosed on the website of World Bank and POWERGRID. Recommendations have been made for organizing public consultation meetings with stakeholders to share the views of the public and informing about the project at every stage of execution, the compensation scheme, and the status of payment.



Study Title

Expansion of Existing 726.6 MW (2 × 363.3 MW) Combined Cycle Gas Turbine Power Project at Palatana, Tripura, by Addition of 2 × 363.3 MW Capacity (3rd and 4th Units) with Total Proposed Capacity of Plant to be 1453.2 MW (4 × 363.3 MW)

Implementing Institution

Government of Tripura/ONGC Tripura Power Company Ltd (OTPC)

Project Location/Completion Year

Tripura, 2017

Objective

Preliminary evaluation of the project, taking into consideration the proposed site characteristics, the technology available to set up such large-scale project.

Study Recommendation

No Recommendation

Analysis and Outcome

The Electricity Act 2003 has opened up significant investment opportunities in the generation sector by de-licensing electricity generation. The cost of power generation has become a critical parameter in determining the long-term viability of projects.

The development of infrastructure in the North-East India is also key to the nation's Look East policy — a focus on South-East Asia. The Palatana power project was touted as the single largest investment in the region and a lot of interest was dedicated there.

Implementation of the project will, to a great extent, supply additional power to the power-deficit areas of the north-eastern states of the country.

Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Dhalai, Unakoti, and North Tripura Districts under NERPSIP Tranche-1, Tripura

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Tripura, 2015

Objective

Strengthening the transmission and distribution system in Tripura.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.



Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in Gomati and South Tripura Districts under NERPSIP Tranche-1, Tripura

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Tripura, 2015

Objective

Strengthening the transmission and distribution system in Tripura.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

As most of the generation projects in the North-Eastern Region are hydro in nature, the state of Tripura faces shortage of power during low-hydro generation condition. Although the transmission and distribution system covers many areas of the state, it is inadequate in its reach, and the non-availability of redundant T&D system and the breakdown of transmission system elements result in long-term power shortages and make the system highly unreliable.

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.

Study Title

Initial Environment Assessment Report (IEAR) for T&D Network in West Tripura, South Tripura, Khowai, and Sepahijala Districts in Tripura

Implementing Institution

Power Grid Corporation of India Ltd
(Environment and Social Management
Department)

Project Location/Completion Year

Tripura, 2015

Objective

Strengthening the transmission and distribution system in Tripura.

Study Recommendation

- Strengthening the present intra-state transmission system of the state.
- Building the institutional capacity of the power utilities and departments in the NER.

Analysis and Outcome

The IEAR study provided insight into the possible environmental and social issues and also described the management measures to mitigate them. A periodic review by the higher management of all environmental and social issues needs to be undertaken to ensure that the environment and management plan and other measures are implemented.

The proposed transmission and distribution schemes not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Implementation of the scheme improves the overall power supply situation, reliability, quality, security, and enhancement of power supply in the state.



Study Title

Evaluation of RGGVY Tripura

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Tripura, 2011

Objective

Identify the challenges/bottlenecks in the effective and efficient implementation of RGGVY programme at various levels of implementation and suggest policy interventions that may help in streamlining the programme execution.

Study Recommendation

Develop an institutional framework that provides proper handholding to the franchisee for rapid implementation.

Analysis and Outcome

The Energy and Resources Institute (TERI) has been engaged in conducting impact evaluation studies of the RGGVY programme in Tripura.

The major findings of the evaluation report received from 12 states, out of 20, include: (i) electrification of villages have resulted in socio-economic improvements and villagers are able to utilize electrical appliances for additional comfort convenience and education of their children; (ii) economic activities like agarbatti making, bamboo items, etc. have started specially in the states like West Bengal and Tripura; (iii) there is demand for more number of distribution transformers to cater to higher below poverty line (BPL) and above poverty line (APL) loads.[37]

The state government may take initiative to develop an institutional and operational framework that provides proper handholding to the franchisee for its rapid implementation.

Study Title

Environmental Impact Assessment of Talong Londa Hydro-Electric Project (225 MW) East Kameng District, Arunachal Pradesh

Implementing Institution

R. S. Envirolink Technologies Pvt Ltd

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

Assess the socio-economic status of the project-affected villages/families/ persons and subsequently to prepare a resettlement and rehabilitation plan for the families affected by the Talong Londa Hydro-Electric Project.

Study Recommendation

- For non-forestry use/diversion of forest land, the NPV may be directed to be deposited in the Compensatory Afforestation Fund.
- Total forest land requirement for diversion for non-forest use i.e. for the construction of Talong Londa H.E. Project activities is approximately 413.10 ha of land is required, Out of this about 284 Ha is Forest Land from which 101.00 ha is coming under the riverine zone. As the forest in the project area fall in the Eco Class VI, open forest, therefore NPV @ Rs. 6.99 lacs/ha would be required to be deposited in the Compensatory Afforestation Fund.

Analysis and Outcome

The production of electricity from hydropower results in several environmental impacts, and each hydropower plant has specific influence. The Talong Londa Hydro-Electric Project involved the construction of a 225 MW hydropower plant in Arunachal Pradesh. Considering the positive impact it would have on development activities, harnessing untapped hydro potential, and contributing to India's sustainable development, the effective implementation of this project will be a milestone.

The report highlighted the environmental and social impacts of construction in the planning phase. Rehabilitation and resettlement (R&R) issues were cited as one of the main hindrances. Relevant provisions were considered while developing the R&R package for the project-affected families. Necessary precautions were undertaken to ensure minimal environmental impact. The project developed good rapport with the local people for long-term relationship and mutual benefits.

Successful implementation of this mega project would greatly benefit and result in the sustainable development of the local community through socio-economic and environmental well-being.



Study Title

Report on the construction stage geotechnical investigation of Pare Hydroelectric Project, Papum Pare district, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

The objective of the investigation during FS 2012-13 was to provide geotechnical services (by means of site geological studies at several project components and subsequent recommendations as per site requirements) to Project Authorities, as and when required, for the purpose of smooth execution of construction work at the site

Study Recommendation

Since foundation has number of cracks and undercuts therefore, it should be excavated some more in order to achieve better rock quality. Keeping in mind friable nature of rock, initial layer of concrete should be RCC instead of conventional PCC.

Analysis and Outcome

The major objective of the current project was to investigate the geotechnical services required for the smooth execution of the construction work. Such kind of study is useful in the preliminary investigation of essential and mandatory things required for the construction of stable dam. The report of the study recommended very important points for the stability of the dam. The analysis of the report revealed that it was recommended to excavate deeper for getting better quality of rock and for establishing a stable base for the dam. The report also recommended to have an initial layer of RCC than PCC. The analysis of the report concluded that the recommendations were implemented well [27].

Implementable recommendations:

- Deeper excavation
- Initial layer of concrete should be RCC.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)
- State Electricity Regulatory Commission
- Central Water Commission

Study Title

Report on construction stage geotechnical investigation of Kameng Hydro Electric project, West Kameng district, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2013

Objective

The objective of the item investigated during FS 2012-13 was to provide geotechnical services (by means of site geological studies at several project components and subsequent recommendations as per site requirements) to Project Authorities, as and when required, for the purpose of smooth execution of construction work at the site.

Study Recommendation

- Cleaning and removal of loose rock from foundation surface,
- Dental treatment is suggested as shear treatment for shear zones having thickness less than 50cm.
- Foundation level may have to be lowered by excavation to a suitable depth, for treating the rock zones having weathering grade W2 and above. In case sound (foundation grade) rock is not encountered even after excavation, then depending on dimension of the weak zone

Analysis and Outcome

The current project was aimed at providing geotechnical services by investigating the geological aspects of the region. This study is useful in construction of stable dam by carrying out preliminary investigation. The report of the present study recommended several important points which were essential of the mentioned objective. The analysis of the report identified that the recommended cleaning and removal of loose rock from the foundation site was taken seriously and was removed. The dental treatment was also completed. The recommended lowering of foundation level via excavating was also achieved. The analysis concluded that the recommendations regarding the stability of the dam were implemented well [28].

Implementable recommendations:

- Deeper excavation
- Initial layer of concrete should be RCC.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Draft EIA report of Umngot Hydro-Electric Project (210 MW) East Khasi Hills and Jaintia Hills Districts, Meghalaya

Implementing Institution

EQMS India Pvt Ltd

Project Location/Completion Year

Meghalaya, 2020

Objective

Identify and evaluate the nature, magnitude, and significance of the potential adverse environmental impacts arising during the construction and operation of the project and formulation of site-specific environmental management plan (EMP).

Study Recommendation

No Recommendation

Analysis and Outcome

The EQMS's EIA report presents the environmental impacts of the Umngot Hydro-Electric Project and suggests a suitable environmental management plan with necessary mitigative measures.

The most important source of power development in the North-Eastern Region is hydro-electric power located in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, and Tripura.

The Umngot Hydro-Electric Project would be able to supplement 210 MW of peaking power to the requirements of the state and provide an annual design energy (90% dependability) of 708.98 GWh.

The people around the project area are expected to reap many indirect benefits that would bring about a transformation in the upliftment of their socio-economic conditions from the implementation of this project.

Study Title

Report on construction stage Geotechnical Investigation of New Umtru Hydro Electric Project, Ribhoi Hills District, Meghalaya.

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2014

Objective

The objective of the item investigated during FS 2013-14 was to provide geotechnical services (by means of site specific geological studies at different project components and subsequent recommendations as per site requirements) to Project Authorities, as and when required, for the purpose of smooth execution of construction practice at site.

Study Recommendation

Since the rock is weathered and friable in nature, permeability test should be carried out in both the left and right abutment in order to decipher the seepage condition in the extension blocks

Analysis and Outcome

The aim of the current project was providing geotechnical services by investigating the geological characteristics of rocks. Such studies are useful in constructing the stable dam by carrying out preliminary investigation. The report of the present study recommended few essential suggestions to achieve the objective. The analysis of the report identified that the recommended cleaning and removal of loose rock from the foundation site was taken seriously and was removed. The dental treatment was also completed. The recommended lowering of foundation level via excavating was also achieved. [29] The analysis concluded that the recommendations regarding the stability of the dam were implemented well.

Implementable recommendations:

- Removal of loose rock from the foundation site
- Lowering of foundation level via excavating

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)
- State Electricity Regulatory Commission
- Central Water Commission



Study Title

Report on construction stage geotechnical investigations of Ganol Stage I Small Hydroelectric Project, Tura, West Garo Hills, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2014

Objective

To construct a 35m high concrete Gravity dam across Ganol river with dam foundation at RL 320.0m and a surface PH with turbine setting elevation at RL 187.50m having net head of 148 m to generate 22.5 (7.5 X 3) MW of power. Intake level is at El: 340 m. It has 2.5m dia D-shaped headrace tunnel of 2.06 km length.

Study Recommendation

- Locations of some anchor blocks (AB) are suggested for revision based on revised alignment/profile.
- The finalised surge shaft has lateral cover of 55.53m and vertical cover of 25m at the centre of surge shaft.

Analysis and Outcome

The current study was aimed at construction of 35 m dam for the production of 22.5 MW electricity. This kind of study is useful in the meeting out the requirement of electricity from renewable sources. The report of the study recommended some important recommendations. The report revealed that the recommended revised alignment of the anchor block's location was changed. The shaft of the lateral cover and vertical cover were also revised. The analysis concluded that the recommendations were implemented well [33].

Implementable recommendations:

- Removal of loose rock from the foundation site
- Lowering of foundation level via excavating

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)
- State Electricity Regulatory Commission
- Central Water Commission

Study Title

Report on the feasibility stage geotechnical investigation for Mawblei Hydro Electric Project, West Khasi Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2014

Objective

The main objective is to provide geotechnical inputs (by means of site geological studies at several project components and subsequent recommendations as per site requirements) to the Project Authorities, as and when requested.

Study Recommendation

- Five number bore holes (DH-15 to DH-19) were recommended at present along the water conductor system for sub-surface exploration. In future additional bore holes may be recommended along the water conductor system as per requirement after finalization of Surge Shaft and power house location by the project authority.
- The project authority may finalize the final surge shaft and power house location which may required detailed geological mapping.
- From the sub-surface geotechnical investigation (cores logging) carried out for eleven numbers of bore hole located at the dam site and along the dam axis, taking into account of the bed rock level, core recovery and RQD percentage, weathering grade of fresh rock and also the lugeon values, it seems that further additional drilled hole at present may not required at the dam site.
- Rock mechanics tests such as Unconfined Compressive Strength (UCS), (IS:9143-1979, reaffirmed 2001) depending upon type of structure and load etc. may be carried out as per the requirement of the designers.

Analysis and Outcome

The main objective of the project was providing geotechnical inputs to the authorities of the project by studying the geological aspects of the site. This kind of study is useful in development of a stable dam for the production of electricity. The analysis of the report revealed that the report recommended five bore holes for the exploration of sub-surface. In addition, it was also recommended to have more bore holes as per the requirement after finalizing the location of power house and surge shaft. This recommendation was implemented on priority basis. A detailed geological study recommended in the final location of the power house and surge shaft was implemented. It was identified that the recommended studies like UCS was also carried out. The analysis concluded that all the recommendations were implemented to achieve the target [34].

Implementable recommendations:

- Removal of loose rock from the foundation site
- Lowering of foundation level via excavating

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)
- State Electricity Regulatory Commission
- Central Water Commission



Study Title

East Khasi Hills and Jaintia Hills Districts Umngot Hydro-Electric Project (3 × 80 MW)

Implementing Institution

Agricultural Finance Corporation Ltd

Project Location/Completion Year

Meghalaya, 2010

Objective

- Assess the environmental impact of the proposed hydro-electric power generation project on land, water, air, climate, flora and fauna, public health, etc.
- Formulate a suitable environmental management plan for minimizing or avoiding the negative impacts that are likely to occur due to the construction of the project in the area.

Study Recommendation

- The activity will have a minor and short-term effect on the air and serenity of the area during the development phase and will have a lot of beneficial impacts during operation.
- In the operational phase of the project, there will be good improvement in aesthetics, greenbelt, air quality, water levels, etc.
- The establishment of the project has no detrimental effect on the surroundings but will in fact benefit them as it will develop the aesthetic value and increase the green belt area.

Analysis and Outcome

The direct benefit from the implementation of the Umngot Hydro-Electric Project is the generation of about 856.35 million units in a 90% dependable year. The people around the project are expected to reap many indirect benefits that will bring about a transformation in their socio-economic conditions and the energy demand of the state. Road communication, health facilities, school facilities, and various other social programmes are being undertaken.

As per the "24×7 Power for All (Meghalaya) document", the Ministry of Power, Government of India, had taken up the matter of environmental clearance with the Ministry of Environment, Forest and Climate Change, Government of India, to accept the already prepared EAI&EMP reports and to grant the necessary environmental clearance to enable the state to take up the project for the interest of the state in particular and the country in general. Environmental clearance for the project is yet to be submitted.[36]

Study Title

Report on the reconnaissance stage geotechnical investigation of Tlawng Hydro Electric Project, Aizawl District, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2015

Objective

The objective of the investigation was to provide geotechnical inputs (by means of site geological studies at several project components and subsequent recommendations as per site requirements) to the Project Authorities, as and when requested.

Study Recommendation

- In order to carry out detailed geological mapping of the dam site, the Project Authorities are suggested to provide :
- Topographical contouring map of the dam site on 1:1000 scale with 2m contour interval (IS: 6065, Part -I, 1985), from 200 m upstream to 300 m downstream of the dam axis and upto 390 m on both the abutments
- X- Section along dam axis.
- L- Section perpendicular to Dam axis (i.e., 150 m upstream & 200 m downstream of the dm axis).
- In order to carry out detailed geological map of other project components such as Power House (Surface power house, suggested by the project authority) and HRT, the Project Authority is suggested to provide topographical contour map on 1:500 for power house and 1:1000 (IS: 5497 - 1983) for HRT alignment respectively.

Analysis and Outcome

The current study was aimed at providing geotechnical inputs to the authorities of the projects. This kind of stud is useful in the accomplishment of the aim targeted via carrying out preliminary investigation. The report of the study recommended several essential points to achieve the aim. The recommended topographical contouring map of the dam was prepared on urgent basis. The recommended contour map on 1:500 for power house and 1:1000 for HRT alignment was also implemented. The analysis of the report concluded that the recommendations of the report were implemented well [35].

Implementable recommendations:

- Removal of loose rock from the foundation site
- Lowering of foundation level via excavating

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)
- State Electricity Regulatory Commission
- Central Water Comission



Study Title

Dams and Displacement: Socio-economic Impact of Doyang Hydro Project in Nagaland

Implementing Institution

Tribal Research Centre, Department of
Sociology, Nagaland University

Project Location/Completion Year

Nagaland, 2020

Objective

- Analyse the socio-cultural, economic, and environmental risks that occurred among the displaced population due to the construction of the Doyang dam.
- Understand the process of adaptation or reconstruction taking place among the displaced community.

Study Recommendation

The development planners need to win the people's confidence in advance rather than merely forcing involuntary displacement among the most marginalized sections of the society.

Analysis and Outcome

Hydropower is regarded as an important electricity generation option as it provides electricity efficiently, reliably, and at a relatively low cost. The study focussed on exploring the socio-cultural, economic, and environmental impacts of the Doyang Hydro Project in Nagaland.

While this project offers positive benefits, it also yields negative impacts on the socio-cultural, economic, and environmental aspects of the resettled population. It is, therefore, important that policymakers carefully review and systematically integrate these concerns into resettlement plans. This could enhance the social acceptability of resettlement projects and sustain their benefits while minimizing the negative impact.

Study Title

Pre-feasibility Report of Rongnichu Hydro-Electric Project (115 MW), East Sikkim District, Sikkim

Implementing Institution

EQMS India Pvt Ltd

Project Location/Completion Year

Sikkim, 2020

Objective

Pre-feasibility report of Rongnichu Hydro-Electric Project (115 MW), East Sikkim District, Sikkim

Study Recommendation

No Recommendation

Analysis and Outcome

The Rongnichu Hydro-Electric Project (96 MW) on the Rongnichu stream in the East Sikkim district is a run-of-river hydro-development project. The rapid generation of hydro-electric power as per its potential will improve the economic health of the state. About 12% free power will increase the resources of the state to a significant extent. The need for the Rongnichu Hydro-Electric Project, with installed capacity 115 MW, has been considered in the context of power shortage in the eastern region in general and in the country as whole.

Post-commissioning, rehabilitation and resettlement will have to be taken care to ensure that the project-affected families are offered attractive compensation and are resettled well before the start of the project. This would boost public confidence for future projects. With the help of awareness campaigns, the local people should be made aware about the project benefits and they could be made to feel associated with the entire development process, which would help improve the sense of belongingness among the locals towards the project being developed.



Study Title

Rongnichu Hydro-Electric Project (115 MW) East Sikkim District, Sikkim-Draft Environmental Impact Assessment Report

Implementing Institution

EQMS India Pvt Ltd

Project Location/Completion Year

Sikkim, 2020

Objective

Analyse the existing ambient air quality within the study area and compare it with the NAAQ standards specified by the CPCB to know about the pollution status of air in and around the project area.

Study Recommendation

Capacity enhancement from 96 MW to 115 MW would be able to provide an annual design energy (90% dependability) of 413.78 GWh.

Analysis and Outcome

The project identified and evaluated the nature, magnitude, and significance of the potential adverse environmental impacts arising during construction and operation.

The State of Sikkim has vast hydro-electric power potential in its major rivers. The rivers and their tributaries with steep gradient challenge planners and engineers for the optimal exploitation of hydropower potential.

The rapid generation of hydro-electric power as per its potential will improve the economic health of the state because 12% free power will increase the resources of the state to a significant extent.

The need for the Rongnichu Hydro-Electric Project, with installed capacity 115 MW, has been considered in the context of power shortage in the eastern region in general and in the country as whole.

Study Title

Environmental Impact Assessment of Ting Ting H.E. Project, Sikkim

Implementing Institution

R S Envirolink Technologies Pvt Ltd

Project Location/Completion Year

Sikkim, 2010

Objective

Understand and prioritize the impact of development activity on the natural life support systems and processes with main emphasis on the continuation of ecosystem processes and functions.

Study Recommendation

Catchment area treatment, biodiversity conservation and management, public health delivery system, fisheries development, relocation and rehabilitation of dumping sites, landscaping and restoration of construction area, and creation of green belt.

Analysis and Outcome

The Ting Ting HEP was designed to deliver annually 424 GWh of electrical energy in a 90% dependable year. The project involved acquisition of 29.4068 ha of land, which had an impact on land environment in terms of change in land use and land pollution due to various activities as per changed land use.

Based on the findings of the Environmental Impact Assessment study, various environmental management plans were proposed to be implemented.

In order to monitor the impact and efficacy of these plans, a number of parameters were proposed during and after the completion of the management plans.



Study Title

Environmental Impact Assessment (EIA) Report for Development Drilling of Wells in Onshore ML Areas of Jorhat and Golaghat Districts in Assam

Implementing Institution

Asian Consulting Engineers Pvt Ltd

Project Location/Completion Year

Assam, 2016

Objective

Meet the regulatory environmental clearance criteria as well as to ascertain a sustainable development through the assessment of likely impacts due to project-related activities on the surrounding environment.

Study Recommendation

No Recommendation

Analysis and Outcome

The development of any oil and gas exploration project requires an environmental impact assessment (EIA) study as per the regulatory requirements and best practices. The ONGC proposed the development of oil and gas reserves by development drilling of 12 wells in the Golaghat and Jorhat districts of Assam.

The study identified potential environmental impacts of the project and formulation of an effective environmental management plan (EMP) to prevent, control, and mitigate the adverse environmental impacts and ensure environmental compliance.

The Expert Appraisal Committee of the MoES-CC, in its meeting on 26 February 2019, recommended the project for environmental clearance (notification dated 1 May 2019).

The implementation of various enhancement measures as part of the project will benefit the people through the enhancement of hydrocarbon production, energy security, direct and indirect employment opportunities to the unskilled/skilled local/regional people, and improvement in infrastructure facilities.

The development of these projects will reduce the dependency of India on the import of oil by adding to the availability of energy sources in the country. It will also have a socio-economic benefit at the local level by the development of infrastructure like roads, drainage, etc. and by providing employment opportunities.

Study Title

Instrumented Solar Hot Air Generator (ISHAG) for Optimum Thermal Load in Tea Processing

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2016

Objective

Design development and testing of solar hot air generator (SHAG) for optimum thermal load in tea processing.

Study Recommendation

Low-cost solar air heater is feasible to supplement thermal energy for tea processing.

Analysis and Outcome

Tea processing requires thermal energy for drying operation. Conventionally, hot air or flue gas generated from combustion of fossil fuel is used for drying of tea. Tezpur University has successfully developed a low cost device called 'solar hot air generator' (SHAG) – a potential renewable energy technology for industrial applications in tea processing – that can, as an alternative to fuel, generate hot air for process heat using solar radiation. Generation of hot air in the range of 40-90 °C is demonstrated by SHAG and hot air in this temperature range has been proved to be useful in many applications, such as paddy or rice drying. Local manufacturing capacities have been developed with appropriate training to local youths and it is ready to take up the large scale SHAG manufacturing work.

ISHAG is now market ready product and requires awareness and marketing for its commercial promotion. A series of demonstration cum awareness workshops could be useful for its quicker dissemination. Department of Agriculture, Govt of Assam is a possible source for support for the marketing and promotion of the technology. Coffee Board could also be a potential sponsor for the same.



Study Title

Agro-Climatic Zone Based Mapping of Renewable Energy Resources in Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2011

Objective

Spatial resource mapping of available renewable energy resources in selected districts of Assam.

Study Recommendation

Surplus crop residues can be utilized through Decentralized Generation of Energy (DGE).

Analysis and Outcome

Tezpur University, with the support from the Department of Science and Technology, Government of India, conducted a study on "Agro-Climatic Zone Based Mapping of Renewable Energy Resources in Assam".

The GIS-integrated spatial model has been developed for the assessment of renewable energy resources. The methodology developed is being used for mapping renewable energy resources, particularly biomass resources in other regions. It is also being used as a reference model for development projects.

As per the project investigator's inputs, it has been partially implemented. Better coordination among various government departments, enthusiasm from the target groups (like association), and more engagement of social institutions (like NGOs, SHGs) will further enhance the scope of the project.

The state government should encourage a combined resource mapping and GIS-based rural planning models for determining the scope and best location for implementation.

Study Title

Design and Development of Renewable Energy Hybrid Tea Dryer for Fossil Fuel Substitution in Tea Industry

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2011

Objective

Develop a tea-drying technology taking solar and biomass as sources of thermal energy.

Study Recommendation

Biomass-generated producer gas could be a source of energy for tea drying and as solar power can supplement partially.

Analysis and Outcome

Tezpur University, with the support from the All India Council for Technical Education, Government of India, conducted a study titled "Design and development of renewable energy hybrid tea dryer for fossil fuel substitution in tea industry".

In the tea industry, fossil fuels such as coal and low sulphur diesel are mostly used to encounter the thermal energy needs and these energy sources heavily pollute the environment. These conventional fuels may be replaced by suitable renewable energy resources to meet the energy demand of tea plantations and industries.

The technology could be a suitable renewable energy technology for fossil fuel substitution in the tea industry. Based on the inputs from the project investigator, it has been observed that the suggested recommendation has been partially implemented. Enthusiasm from the target group (like association) will further help in the promotion of the technology.

The future work of this project involves technology refinement, demonstration, and popularization among the prospective tea industries to substitute the conventional energy by solar and renewable biomass energy. Comprehensive work concerning tea quality and economy needs to be continued.

Possible funding support could be sought from

1. Department of Science and Technology
2. Research and Innovation Development Schemes under the AICTE



Study Title

Measurement of Women's, Household's, and Community's Demand and Willingness to Pay for Renewable Energy Products and Services

Implementing Institution

Meghraj Capital Advisors Pvt Ltd

Project Location/Completion Year

Nagaland, 2017

Objective

Estimate the demand of clean energy products by the women in rural India and map their willingness to pay for these renewable energy products.

Study Recommendation

Undertake a pilot to establish a test case for women-centric energy enterprise.

Analysis and Outcome

Energy access is one of the top priorities of the Government of India, and it has the mission of "Power for All" by 2019.

The study evaluated the energy access status of the marginalized women and examine the role these women can play in the energy value chain or the support energy can provide to them in furthering their livelihood options. It addressed their involvement and leadership in gender-sensitive energy policy-making.

It is suggested that the UN Women along with its partners can undertake a pilot to establish a test case for women-centric energy enterprise. The Women Energy Centre model can be the pilot for implementation. A successful test case implementation will have impactful learning for all stakeholders.

The Government of India is currently discussing the outlines of the Women Empowerment Index.

Study Title

Algal Biorefinery for Biodiesel and Bioethanol using Rubber-Processing Factory Wastewater Discharge

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Tripura, 2016

Objective

Produce biofuel by the production of algal biomass using rubber-processing wastewater as feed stock.

Study Recommendation

The nutrient in rubber wastewater discharge could be used as a medium for algae culture.

Analysis and Outcome

The utilization of algal biomass for biodiesel and bioethanol production is a sustainable and eco-friendly way of renewable biofuel production.

As the importance of microalgae in biodiesel production is growing, an equal attention is needed for the efficient use of these easily cultivable microorganisms to generate the green biodiesel and bioethanol.

In-depth investigation and further research in microalgae biorefinery are still necessary prior to commercialization.

The Department of Biotechnology could support for carrying out further research.

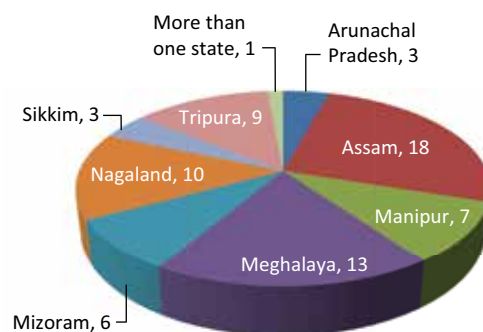


State-wise Summary

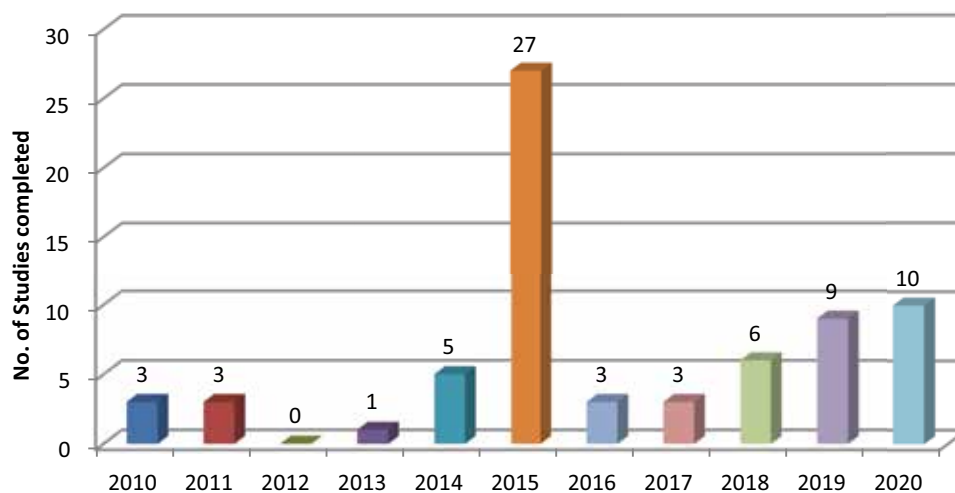
Over the past one decade, 70 research studies pertaining to the eight North Eastern Region (NER) states have been conducted by the academic and research institutions. Institutions located in Assam received the maximum number of studies (18), followed by Meghalaya (13), Nagaland (10), Tripura (9), Manipur (7), Mizoram (6), and Arunachal Pradesh and Sikkim received three projects each. Over 27 studies/projects were successfully completed during 2015. These studies have majorly focussed on development and welfare activities in the fields of hydropower, oil & gas, and coal & renewable energy technology and applications.

A large number of studies pertaining to power sector have been conducted and implemented in the region and as a result, the sub-sector witnessed tremendous growth over the past 10 years in the areas of generation, transmission, and distribution (T&D). The North Eastern Council (NEC) has also taken initiative for supporting studies for funding to renewable energy technology resources of energy schemes, which included micro/mini hydel studies, solar hybrid and wind energy studies, and other energy-efficiency technology studies by various academic and scientific research institutions.

The NEC is endowed with rich hydropower potential, coal, petroleum, natural gas, and other minerals. Rich water resource is another strength and is the storehouse of hydropower potential. There is a much larger number of places that can be used to generate energy. Rising rate of investment in renewable energy, established infrastructure, and increased adoption of energy-efficient technology are some of the strength areas of north-eastern states. Growing demand for energy and rising costs of electric grids are some of the concerns.



Studies completed in Energy Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Energy Sector in NER during 2010 to 2020 (Year-wise)

Arunachal Pradesh

The State of Arunachal Pradesh witnessed a total of three major studies/implementations pertaining to hydropower. The State is rich in minerals and has opportunities and potential to accelerate the development of hydropower. Government interventions are there for the power sector/hydropower development including generation, transmission, distribution, renewable energy, and energy- efficiency measures.

The rehabilitation and resettlement of the affected people is a major issue to deal with. Compensatory schemes need to be strengthened and implemented to compensate the forest land diverted for the construction of projects. Construction of large reservoir power plants is connected with flooding of a large area. This implies social protests, and the need for resettlement. Talong Londa Hydro-Electric Project in East Kameng District, Arunachal Pradesh is an example.

Assam

There were more number of studies/projects during the last decade focussing on energy sector (power, solar, and biomass) in Assam. Successful implementation of these projects during the last decade immensely contributed in bringing down the T&D losses in the State and helped it attain self-sufficiency in electricity production. As a result, there is tremendous change and scope for restructuring the power sector of Assam. This will lead to enhancing the power supply position to meet up the increasing power demand of the State.

Renewable energy efficiency technologies and applications were the focus areas of other sponsored studies. Presence of numerous tea estates are a big strength. Therefore, there is opportunity to involve technology development/refinement among the prospective team industries to substitute the conventional energy by solar and renewable biomass energy. There is tremendous scope to develop technically competent human resources and environmentally benign sustainable technologies in energy sector.

Manipur

Manipur is endowed with rich energy resources but faces significant bottlenecks in electricity access and availability levels. Inadequate power supply remains a critical constraint to sustainable growth.

Recognizing that intrastate T&D systems in the state have remained very weak and that there is a critical need to improve the performance of these networks, the Central Electricity Authority (CEA) developed a comprehensive scheme for the State in consultation with POWERGRID and the State Government.

There were seven (7) studies conducted under the scheme and were intended to augment the existing T&D infrastructure to improve the reliability of service delivery across the State and build institutional capacity of the power utilities and departments in the State. This scheme is expected to develop energy resources in Manipur for electricity supply within the region, to strengthen transmission networks, expand and strengthen sub-transmission systems, and extend last mile electricity connectivity to household. This will lead to overall power supply situation and improve reliability, quality, security and enhancement of power supply in the State.

Meghalaya

Meghalaya is one of the few states in India, which despite having surplus availability of power, has low electricity consumption. Although the State has made significant progress in rural electrification, the power supply in electrified villages is unreliable.

The 13 studies conducted in the last decade focussed more on the power sector/hydropower development including generation, transmission, and distribution systems in the State. These studies aimed at increasing the generation capacity; providing reliable and assured supply of power; and electricity to all the villages of the State in order to achieve 24x7 Power for All—a joint initiative of Government of India and Government of Meghalaya to provide quality, reliable and affordable power to all domestic, commercial, agricultural, and industrial consumers.



With successful implementation, the people around the projects are expected to reap many indirect benefits that will bring about a transformation in their socio-economic conditions and the energy demand of the State.

Mizoram

The intra-state transmission system of the State is quite old and weak and is unable to cater to the growing power requirements of the State. Although the T&D system covers many areas of the State, it is inadequate in its reach and due to non-availability of redundant T&D system, outage of any transmission system element results in long-term power shortages making the system highly unreliable. It has become essential to address this situation through remedial measures in the transmission and distribution system. Accordingly, phase-wise strengthening of transmission & distribution system has been implementation of these schemes, which will improve quantity, reliability, quality, and security of the power supply in the State.

There were five major studies/projects by the Powergrid in order to strengthen the intra-state transmission and distribution system and undertaking capacity building initiatives in Mizoram. The objectives of the studies were also to identify impacts/damages and plan measures to mitigate losses caused by the projects. This will not only improve overall power supply situation but also improve reliability, quality, security and enhancement of power supply in the State.

Nagaland

There were 10 studies conducted in Nagaland during the last decade majorly focussing on development and welfare activities in the fields of hydro energy and intra-state transmission and distribution (T&D) system.

Studies on socio-economic impact of hydropower projects analysed the socio-cultural, economic, and environmental risks due to dam construction. While the projects offered positive benefits, they also yielded negative impacts for the resettled population. It is important that the government carefully review and systematically integrate these concerns into resettlement plans. This could enhance the social acceptability of resettlement projects and sustain their benefits while minimizing the negative impacts.

As for the intra-state T&D system, it needs to be strengthened to cater to the growing power requirements of the State, as the present T&D system is inadequate in its reach. The studies will address this situation through remedial measures in the T&D system, which will improve the overall power supply situation in the State.

Sikkim

Sikkim has vast hydro-electric power potential in its major rivers. The rivers and their tributaries with steep gradient challenge the optimal exploitation of hydropower potential. The rapid generation of hydro-electric power as per its potential will improve the economic health of the State because 12% free power will increase the resources of the State to a significant extent.

The three studies conducted during the period focussed mainly on hydro energy. The need for the Rongnichu Hydro-Electric project, with installed capacity of 115 MW, has been considered in the context of power shortage in the eastern region in general and in the country as a whole. Capacity enhancement from 96 MW to 115 MW will enable an annual design energy (90% dependability) of 413.78 GWh.

The Ting Ting HE study located in West Sikkim envisages the utilization of the flow of Rathong Chhu—a tributary of Rangit River for the generation of electric power. Based on the findings of Environmental Impact Assessment study, various environmental management plans were proposed to be implemented encompassing impacts on the ethnic diversity, socio-cultural and socio-economic aspects including displacement, resettlement and rehabilitation of human societies where developmental activities are undertaken.

Tripura

Tripura has adequate power generation capacity. However, it has a substantial proportion of population having limited access to electricity mostly because of the lack of proper transmission infrastructure. In order to achieve the target of affordable electricity for all, the State has to have a robust scheme for power transmission network and electrification.

There were nine studies/projects focussing on power systems network and rural electrification. The Environment Assessment Studies by the Powergrid aimed at strengthening the transmission and distribution network in West Tripura, South Tripura, Khowai and Sepahijala districts in Tripura, thereby, improving overall power supply situation in the State.

Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), the Centrally Sponsored Scheme of Government of India aimed at electrifying all villages and habitation; and providing access to electricity to all rural households in the State.

Overall Scenerio

Over the past one decade – since 2010 - many research studies in the energy sector were primarily concerned with transmission and distribution (T&D) with grid expansion. These studies have been carried out by various academic, research institutions and government agencies to also generate and distribute power using renewable resources which included micro/ mini hydel projects, solar hybrid and wind energy projects, and other energy efficiency technologies. A large number of un-electrified rural populations were benefitted through these projects by providing minimum need of electricity for their day-to-day requirement through renewable resources of energy.





6.6 ENVIRONMENT

Study Title

Observed Rainfall Variability and Changes Over Arunachal Pradesh State

Implementing Institution

India Meteorological Department, Pune

Project Location/Completion Year

Arunachal Pradesh, 2020

Objective

- To identify the spatial pattern of the mean rainfall
- To understand district-wise observed rainfall trend and variability in annual and SW monsoon season (June, July, August, and September)
- Daily station rainfall data is utilized for identification of the mean spatial patterns and rainfall intensity trends, coefficient of variation is calculated

Study Recommendation

Need to take climate change adaptation for the vulnerable districts of Arunachal Pradesh.

Analysis and Outcome

The present study investigated the rainfall pattern and its variability and also changes based on the recent 30 years (1989-2018) data in 16 districts of Arunachal Pradesh. The analyses considered monsoon months, the monsoon season, and annual scale. The spatial scale has been considered from state to district for study of rainfall total and stations are being considered for seeing intensities of rainfall. The analysis brought many significant features of rainfall pattern and can be used for water agricultural managements and help in understanding the recent changes for climate change adaptation and management by the state authorities. It can assist Central and State Ministries of Water Resources, Agriculture and Civic Bodies, Science and Technology, Disaster Management Agencies for strategic planning and implementation. The status of implementation of the recommendation is not known. It is inferred by the study team that the outcome and finding of the study will have certain impacts on infrastructure development, high impact on access to basic amenities such as water, sanitation, and overall impact on livelihoods of the people in the region.

Agencies responsible for implementation:

- Ministry of Earth Sciences, Government of India
- Department of Environment and Forests, Government of Arunachal Pradesh

Study Title

Impact of Climate Change on Snowmelt Runoff Contribution to Eastern Himalayan Nuranang River

Implementing Institution

North Eastern Regional Institute of Science and Technology

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

- To generate snow-cover data from satellite imageries using depletion curves for a small catchment in Eastern Himalaya
- To calibrate and validate a hydrological snowmelt model using observed climatic inputs and stream flow in the same catchment
- To estimate the effect of warmer climate on the acceleration of depletion of snow-covered area and potential impacts of projected climate warming on snowmelt runoff from this small catchment

Study Recommendation

- The WinSRM model can be recommended to estimate the daily discharge from mountainous basins of Eastern Himalaya. Monitoring and estimation of snowmelt runoff becomes essential for supporting, planning, and management of water resources.
- To tackle such problems, hydrological modelling with snow cover mapping make more sense to provide precise information on snowmelt processes and runoff forecasting that will supplement climate change-impact studies.

Analysis and Outcome

The study was conducted to generate snow-cover data from satellite imageries using depletion curves for a small catchment with an area of 52 km² in Nuranang river basin located at Tawang district of Arunachal Pradesh, India. River Nuranang, a tributary to River Tawang, originates from Sela lake and joins River Tawang as Nuranang fall at Jang, Eastern Himalaya. The temporal variation of snow coverage of Nuranang river basin was evaluated using remote sensing and GIS techniques. Snow accumulation and ablation patterns depend on temperature variation of the basin. WinSRM model was calibrated for three years (2006, 2007, and 2009) and validation was done for year 2004 using the representative value of calibration parameters as obtained for Nuranang river basin. The study team outlined a few key recommendations based on a three-year research. The implementation status of the study is not known.



Study Title

Observed Rainfall Variability and Changes over Assam State

Implementing Institution

India Meteorological Department, Pune

Project Location/Completion Year

Assam, 2020

Objective

- To identify the spatial pattern of the mean rainfall
- To understand district-wise observed rainfall trend and variability in annual and SW monsoon season (June, July, August, and September).

Study Recommendation

Necessary climate change adaptation plan need to be taken for the vulnerable districts

Analysis and Outcome

The present study reports all the analysis of observed rainfall patterns, trends, and variability based on past 30 years (1989-2018) to understand the recent changes for climate change adaptation and management by the state authorities. The present study was carried out in Brahmaputra Valley region in the foothills of the Himalaya in northern part of the state, Barak Valley in the southern part, and Mikir (KarbiAnglong) and Cachar hills that divide the two valleys.

The analysis shows no significant increasing/decreasing trends observed in June, July, August, September monthly rainfall. For the annual rainfall, Dhubri, South Salimara Mankachar, Golaghat, Hailakandi, Karbi Anglong, Hojai, Morigaon, Nagaon, and West Karbi Anglong show significant decreasing trend while no district showed significant increasing trend. During the entire year, there was a significant increase in dry days in Dhubri, Goalpara, Nalbari, Kamrup, Udalguri, Golaghat, Lakhimpur, Dibrugarh, Tinsukia districts while there was a significant decrease in dry days in Cachar, Baksa, Tinsukia districts. The remaining districts did not show any significant change. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Ministry of Earth Sciences, Government of India
- Department of Environment and Forests, Government of Arunachal Pradesh

Study Title

Lowering Emissions and Enhancing Forests (LEEF) in Nagaon, Assam

Implementing Institution

IORA Ecological Solutions

Project Location/Completion Year

Assam, 2017

Objective

- Identify the agents and drivers responsible for deforestation and forest degradation.
- Asses the direct and indirect causes behind deforestation and degradation.
- Map all the relevant stakeholders in the district and record the opinion on willingness to participate in REDD+ project.
- Develop a strategy and action plan for REDD+ implementation through participatory approach The project will achieve its objective through multi-layered planning, the stakeholders of which will also include the forest-dependent communities in the region

Study Recommendation

The study has recommended 12 different interventions against the identified problems/barriers.

Analysis and Outcome

The study is aimed at finding out the reasons behind deforestation and forest degradation in Nagaon district. Forest are important sink of carbon dioxide. The afforestation helps in lowering the emission [47]. The socioeconomic and livelihood conditions of the communities living around the Nagaon forest directly affect the status of the forest. Therefore, the present study was focused on generating baseline data on socioeconomic and livelihood conditions. It was also intended to record an opinion on the willingness to participate in REDD+ project and to develop a strategy for the implementation of REDD+. The study was also intended to develop an strategy for the implementation of REDD+ via participatory approach. It was concentrated on development of multilayered planning so that the objective could be achieved. The report of the current study is missing its recommendations. The possible and potential recommendations of this study might be identification of the various socioeconomic causes responsible for deforestation.

Implementable recommendations:

- Identification of the various socioeconomic causes responsible for deforestation.
- Development of strategic plan for the implementation of REDD+

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)



Study Title

Panchayat Baseline Study of Naruathan (Dhemaji), Tatikata (Morigaon) and Bhatkuchi (Barpeta) Gaon Panchayat, Assam

Implementing Institution

Assam State Disaster Management Authority,
District Disaster Management Authority, All
India Disaster Mitigation institute

Project Location/Completion Year

Assam, 2016

Objective

To conduct a baseline assessment on community resilience to disasters and climate of three panchayats

Study Recommendation

Separate recommendations for each gaon Panchayat have been given.

- Naruathan Gaon Panchayat, Dhemaji. -Scientific study for design of shelter, water treatment mechanism, design of toilets, cropping pattern etc., in areas affected by sand casting. -Utilization of sand-filled land for benefit income and ecology. -Emergency shelter. -Improve road conditions in the villages where bridges have been washed. -Ecological rejuvenation. -Provision of water treatment facility. -Institution building.
- Morigaon -Increasing institutional resilience -Creation of model shelters -Creation of a pool of specialized teams -Iron and Arsenic treatment in water -Cold storage is very much essential to increase the food security as well as economic benefits for farmers -Warning Dissemination hub
- Barpeta -Institutional strengthening. -Creating Raised Platforms and Grains Banks. -Strengthening existing shelters. -Erosion Protection. -Water Treatment and Supply. -Train and equip schools to act as catalyst and facilitators for CBDRR activities. -Strengthening Skylark Club. -Linking religious institutions with CBDRR.

Analysis and Outcome

The analysis of the current situation to identify the starting points for a program or project is known as baseline study. The baseline study focuses on what kind of information must be considered and analyzed to establish a baseline or starting point, the benchmark against which future progress can be assessed or comparisons made. The current study was targeted to analyze a baseline assessment on community resilience to disasters and climate of three panchayats, namely Naruathan, Tatikata, and Bhatkuchi. The report recommended a scientific study for designing shelters in Nathuram panchayat because the shelters were found unsafe and inundated. The water supply was also not in good condition therefore, it was recommended to have water treatment system to provide safe drinking water. To achieve an open defecation free target, the design of toilets were also recommended. The sand casting area was recommended to use for economic and ecological purposes. The transportation system was also needed to be improved. Similarly, in Morigaon, the water was found contaminated with arsenic and iron which needed the water treatment facility. To improve the food security system and achieve SDG 2. The recommendations for Barpeta were strengthening of shelter, protection from erosion, treatment of water and supply system, and education system. All the recommendations for the three panchayats were partially implemented.

Implementable recommendations:

- Strengthening of the shelter system.
- Using sand-filled land economically and ecologically
- Water treatment system
- Transportation system
- Education system
- Food storage facility

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India
- District Disaster Management
- Assam State Disaster Management Authority
- All India Disaster Mitigation institute



Study Title

Disaster Risk Reduction Including Climate Change Adaptation of Guwahati in Context of Dynamic Growth

Implementing Institution

CGSD, Earth Institute, Columbia University,
Sustainable Urbanism International, Indian
Institute of Technology, New Delhi

Project Location/Completion Year

Assam, 2015

Objective

To investigate the range of physical, environmental, socioeconomic, infrastructural, and institutional risk factors that contribute to urban flooding in Guwahati.

Study Recommendation

The study recommends preventive actions in five areas to reduce the risk of disasters rather than the actions during flood emergencies or immediately after towards relief, namely:

- Urban Planning and Development
- Natural Resources (Hills and Water bodies)
- Data, Information and Decisions
- Natural and Artificial Drainage
- Community and Institution.

Analysis and Outcome

Disaster affects particularly in terms of mortality, number of people injured, displaced and homeless, economic losses (as a percentage of GDP) and damage to critical infrastructure. We cannot eradicate poverty and hunger if we don't step up investments in disaster risk reduction. There are several kinds of natural and anthropogenic disasters that affect nature [55]. Few disasters are originating because of climate change. The objectives of the current study were the investigation of the range of physical, environmental, socioeconomic, infrastructural, and institutional risk factors that contribute to urban flooding in Guwahati. The major recommendations of the report to reduce the risk of disaster were preventive in nature which are urban planning and development, natural resources, data information and decisions, natural and artificial drainage, community and institution. The recommendations given in the report were found suitable and partially implemented for achieving the mentioned objectives.

Implementable recommendations:

- Extend the boundary of the sanctuary
- Removal of garbage for the site
- Biomonitoring of algal pollution

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board

Study Title

Impact of Climate Change on Precipitation of Barak Basin

Implementing Institution

Indian Institute of Technology, Guwahati

Project Location/Completion Year

Assam, 2013

Objective

- To study the impact of climate change on precipitation of Barak basin
- To delineate the North-eastern region of India into some homogeneous clusters based on the Fuzzy Clustering concept and to compare the resulting clusters obtained by using conventional methods and non-conventional methods.

Study Recommendation

Recommendation has not been outlined in the report.

Analysis and Outcome

The average of at least 30 years of weather conditions is known as climate and the long term shift in weather pattern is called climate change. The Barak basin and other North-Eastern part of India receive heavy rainfall than other parts of the subcontinent. Therefore, it becomes very important with regard to climate change. This region is characterized by high intensity rainfall for short duration of time followed by and longer dry spell. Such characteristics resulted due to the change in climate. It not only affects flood and drought situations but also the river morphology. Therefore, the prediction of precipitation at different locations of NE region of India using different GCMs and downscaling techniques have been done. The objective of the current study was to analyze the impact of climate change on the precipitation of Barak basin. Such kind of study is very useful in predicting the climate and its impacts [73, 74]. The report of the present study did not reveal any recommendations. The possible recommendations might be the use of modern model for prediction of precipitation patterns.

Implementable recommendations:

- Use of modern model for prediction of precipitation pattern.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- India Meteorological Department



Study Title

Manipur State Action Plan on Climate Change

Implementing Institution

Directorate of Environment, Government of Manipur

Project Location/Completion Year

Manipur, 2013

Objective

To develop a State Action Plan on Climate Change (SAPCC) in Manipur based on the recommendations of the National Action Plan on Climate Change (NAPCC) for sustainable environmental management, including adaptation and mitigation of the climate variable.

Study Recommendation

- Climate change is a relatively new issue. Awareness within the government departments and civil society associated with the different sectors needs to be strengthened.
- Local Level: Creating local level awareness is first step, e.g. barefoot workers, framers, field schools may promote descaled climate change Concerns.
- State Level: Building awareness of legislators, policy, makers on socio-economic and socio-political cost of climate change
- Linkages to national programmes/ missions: Participation in national networks, interface with the national knowledge network and research systems.
- Awareness is the first step. The next is to build the capacity – knowledge, skills and resources – to be able to address climate change concerns. This is again a need across all the individual sectors.
- Local: Monitoring, observation, Awareness/assessment at state/ district/ community levels.
- State: Scientific assessment, measurement, models, with state level technical institutions like state pollution control board, biodiversity board, wetland authority , Regional Centres of National Institution, Universities
- Linkages to national programmes/missions: Special regional modelling and assessments, best practices study and resource leveraging from various missions and mission resource centres and technical secretariats.

Analysis and Outcome

The long term change in weather pattern or an average of at least 30 years of weather pattern is called climate change. The change in climate affects the environment, and economy very badly. Therefore, there must be an action plan to mitigate the climate change. The present study will help in developing strategies to mitigate the climate change and its hazards [95]. The present study was also aimed at preparing state action plan of Manipur on climate change on the basis of recommendations given by NAPCC. The report of the study recommended to fortify the awareness of various government department and civil society of different sectors at local and state level. It recommended that the creation of awareness at local level was first step [96]. The legislators, policy makers must be aware of the socio-economic and socio-political cost of climate change. The state must participate in national programs and research system. The capacity building should be improved by enhancing the skills and resources. The analysis of the report identified that the recommendations given here were genuine and important. All the recommendations were implemented well.

Implementable recommendations:

- Awareness of various government departments and civil society of different sectors at local and state level.
- The legislators, policy makers must be aware about the socio-economic and socio-political cost of climate change
- The capacity building should be improved by enhancing the skills and resources

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India
- State Pollution Control Board



Study Title

Assessment of the Impact of Climate Change on Forests and Biodiversity of Meghalaya

Implementing Institution

Divecha Centre for Climate Change

Project Location/Completion Year

Meghalaya, 2017

Objective

- Assess the state of the forests and floral biodiversity in Meghalaya.
- Assess the change in forests in the last decade in Meghalaya.
- Assess the current/inherent vulnerability of the forests in Meghalaya.
- Assess the impact of projected climate change on the forests and biodiversity of Meghalaya.
- Identify critical and vulnerable forest areas in Meghalaya

Study Recommendation

- Keeping these synergies as well as India's forest sector commitments in mind, the feasibility of an ambitious project like 'interlinking of forests' of the state should be investigated.
- Forest conservation, afforestation/reforestation activities in the state should be designed such that these activities reduce the fragmentation and degradation of the existing forests. Anticipatory planting and assisted natural migration through transplanting plant species could also be considered.
- It is important to carry out the forest conservation activities in a way that these activities increase the overall biodiversity richness of these forests, by planting of mix species, and the native species.
- Since water and nutrients are a critical bottleneck for realizing the benefits of increases in NPP, it is important that water conservation activities are initiated in forests of the state.

Analysis and Outcome

The changing climate is affecting the biodiversity at a great level. The objective of the current project was assessing the present condition and change in forest level and threat to biodiversity since the last decades. Such study is very useful in analyzing the impact of climate change on biodiversity and its mitigation ^[138]. The report recommended essential points for combating the climate change which were very feasible. The analysis of the report revealed that the recommendations were important and implemented completely.

Implementable recommendations:

- Pre S2 intrusions of the charnockite and two pyroxene granulite bodies.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Identification of Climate Vulnerability Hot-Spots in Meghalaya Using High-Resolution Climate Projections

Implementing Institution

Indian Institute of Technology Gandhinagar

Project Location/Completion Year

Meghalaya, 2017

Objective

To identify the regions which are likely to face climatic stresses in the future

Study Recommendation

- In terms of hazards based on precipitation, the central region (West Khasi Hills, East Khasi Hills and South West Khasi Hills) and south-western region (South West Garo Hills and West Garo Hills) are projected to be more susceptible to rise in precipitation. Number of surplus monsoon periods are also expected to rise in these regions.
- The declining forest cover in the center as well as in near Garo Hills may pose a serious problem if deforestation continues unchecked. Whereas an expected rise in precipitation may be a boon to naturally irrigated fields of the region, which is at present more than 50% of the total agricultural fields. Observed and projected variability and changes in precipitation can be considered in the preparation of adaptation policies at the block level.
- A proper management strategy is required for slash and burn (or Jhum) cultivation. If not checked, it will result into more losses in forest cover and reduced land productivity. If necessary, the government should reclaim, restore and preserve regions grievously affected by Jhum.
- Some regions face higher fluctuations than others in pre and post monsoon water table depths. Identifications of these regions will help to provide locations for recharge structures required. Prevent or restrict extraction from shallow aquifers. Provide means of ground water recharge, subsurface storage structures, spring rejuvenation for regions with low water table in non-monsoon seasons.



Analysis and Outcome

The enhanced anthropogenic activity such as land use patterns, industrialization, deforestation, global warming, and greenhouse effect has increased the vulnerability of our climate. The identification of such climate vulnerable hot spots can help a lot to mitigate the effect of climate change. Such kind of study is very useful in identifying the vulnerable hotspots of climate so that the impact of climate can be mitigated [132]. The present study was aimed at stabilizing the concentration of greenhouse gases to the level which might prevent the climate related hazards. The analysis of the report found that the central region and south-western region were highly susceptible to precipitation. The decrease in forest cover in centre and Garo Hill due to deforestation was recommended to check and increase the plantation. The jhum cultivation was recommended to be managed properly for maintaining the productivity of land. It also recommended to identify the region with high fluctuation in the level of water table so that the locations for recharge structures could be provided. Moreover, the restriction of water extraction from shallow aquifers was also recommended. The strategies for recharging ground water, storing subsurface water, etc. were recommended. The analysis of the study concluded that the report recommended essential points to mitigate climate change. It was found that the recommendations were implemented well also.

Implementable recommendations:

- Identification of the region with high fluctuation water table
- Restriction of water extraction from shallow aquifers
- Development of water recharge strategies

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Meghalaya State Climate Change Action Plan

Implementing Institution

Meghalaya State Council on Climate Change and Sustainable Development (MSCC&SD)

Project Location/Completion Year

Meghalaya, 2017

Objective

To strategize adaptation and mitigation initiative towards emission stabilization and enhances the resilience of the ecosystem, climate proofing of the livelihood sector and diversification of the dependency on the natural resources.

Study Recommendation

The study recommends involvement of stakeholders, particularly community, in a more proactive way in the CCA planning (micro level and participatory) implementation. This involvement will relate to

- Promoting much greater climate change awareness within community
- Identifying problematic issues relevant to climate change
- Support in monitoring of climate-induced problems
- Nursing greater accountability to the people on climate change issues. It also calls for capacity development of the community through awareness and training programmes.

Analysis and Outcome

The average of weather conditions for at least 30 years of time period is referred to as climate change. The current study aimed at developing strategies and mitigation measures for climate change. Such kind of study is very useful in combating climate change and its disastrous impacts [134]. The report recommended several important points against the mentioned cause. The recommendations were basic and feasible and could be achieved. The analysis of the report identified that the recommendations were considered seriously. The awareness program, capacity development and identification of issues related to climate change were performed on a priority basis. It was noticed that all the recommendations were implemented completely.

Implementable recommendations:

- Climate change awareness
- Identification of climate related issues
- Monitoring of climate related problems

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)



Study Title

Carbon Footprint Study Meghalaya State

Implementing Institution

Confederation of Indian Industry (CII)

Project Location/Completion Year

Meghalaya, 2016

Objective

- Identify major sources of GHG emissions
- Understand historic emission trends
- Quantify benefits of activities that reduce emissions
- Establish basis for developing a local action plan
- Track progress in reducing emissions
- Set goals and targets for future reduction

Study Recommendation

- Prepare a State-specific Low Carbon Technology Roadmap for the Cement Sector in Meghalaya that will target a 48% reduction in GHG emission intensity (Tons of CO₂/Tons of Cement) by 2050.
- Co-processing of industrial, municipal and other combustible wastes in cement kilns as a solution of both waste management and energy demand.
- Replacement of incandescent lamps with LEDs; decrease dependent on wood as a source of fuel.
- Explore the option of utilizing renewable energy and increase its capacity to 1000 MW by 2022
- Adopt voluntary Renewable Power Obligation (RPO) targets surpassing the mandatory values that government may impose.

Analysis and Outcome

The total amount of greenhouse gases released by both anthropogenic and natural sources is known as carbon foot print. Such study are very useful in minimizing emission of carbon and developing technologies and strategies to curb it [141]. The present study was aimed at studying the various sources of greenhouse gases and emission pattern, developing strategies to curb the emission of greenhouse gases. The study recommended several important points which were feasible and could be achieved to minimize the emission of carbon. The analysis of the report corroborated that the recommendations were implemented well.

Implementable recommendations:

- Roadmap of State-specific Low Carbon Technology
- Waste management
- Use of LEDs
- Promoting renewable energy
- Afforestation
- Creation of Green tax, etc.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

District Level Climate Change Vulnerability Assessment of Mizoram: Agriculture Sector

Implementing Institution

Mizoram Science, Technology and Innovation Council, MISTIC

Project Location/Completion Year

Mizoram, 2020

Objective

Construct the vulnerability index of different districts of Mizoram by focusing on indicators from agriculture and its allied sectors, occupational and demographic characteristics.

Study Recommendation

The study recommends further scale of vulnerability assessment at finer resolution may be done at village or block level to see the actual picture of ground reality where actual problems may be seen and good adaptation plan can be formulated.

Analysis and Outcome

This study attempts to construct the vulnerability index of 8 districts of Mizoram by focusing on indicators from agriculture and its allied sectors, occupational and demographic Characteristics. The analysis is carried out at the district level for comparative representation of the vulnerability in agriculture sector. The steps and methods for this study followed and adopted the IPCC AR4 risk assessment framework. The different districts were given rankings based on the vulnerability index values to identify the districts which are most vulnerable to climate change.

The study also identified the different drivers of vulnerability for the eight districts and highlighted the differences in major drivers of vulnerability from district to district compared to the whole state of Mizoram. A brief analysis on the drivers of vulnerability for the state of Mizoram suggested that higher horticulture output to agriculture output ratio contribute highest to overall vulnerability followed by large area under rainfed crop land, more farmers with limited land holdings and lesser area under fertile soil are the dominant drivers of vulnerability. Similarly, drivers of vulnerability were assessed separately for each districts. The information provided in this study are believed to be informative and useful for policy and decision makers, students, researchers and general public. It will also provide useful baseline information for further research in the science of climate change especially for the state of Mizoram. The recommendation of the study is partially implemented.



Study Title

Observed Rainfall Variability and Changes Over Mizoram State

Implementing Institution

India Meteorological Department, Pune

Project Location/Completion Year

Mizoram, 2020

Objective

- Identify the spatial pattern of the mean rainfall
- Understand district wise observed rainfall trend and variability in annual and SW monsoon season (June, July, August and September).

Study Recommendation

- The study have investigated the rainfall pattern and its variability and also changes based on recent 30 years data.
- Have considered monsoon months, the monsoon season and annual scale. The spatial scale has been considered from state to district for study of rainfall total and stations are being considered for seeing intensities of rainfall.
- The analysis brought many significant features of rainfall pattern and can be used for water agricultural managements.

Analysis and Outcome

The study brings the result of the analysis based on the recent 30 years of data (1989-2018) on the mean spatial rainfall pattern as well as mean spatial pattern of different rainfall events, trends and variability as well as extreme rainfall events during the monsoon months and annual for the state of Mizoram. The analysis considered monsoon months, the monsoon season and annual scale. The spatial scale has been considered from state to district for study of rainfall total and stations are being considered for seeing intensities of rainfall.

The analysis shows Kolasib district received highest rainfall over other districts during all the months and season. Rainfall received over the district are around 410-435mm in June, 414-442mm in July, 472-502mm in August, 365-386mm in September and during the SW monsoon 1719-1818mm and annual 2629-2693mm. Lowest rainfall receives during the SW monsoon season over Champhai district (1314.7mm). Also, Champhai district receives lowest annual rainfall (2037.6). Trends in rainfall shows Lunglei district had significant increasing trend in August rainfall. During the whole southwest monsoon season also no district has shown any significant trend. For the annual rainfall two districts viz. Mamit and Champhai show significant decreasing trend while no district showed significant increasing trend. The study also shows there is a significant decrease in Rainy days in Kolasib, Aizawl, Serchhip, Champhai, Lunglei, Lawngtlai, Saihadistricts. While remaining districts did not show any significant change.

The analysis brought many significant features of rainfall pattern and can be used for water agricultural managements. The recommendation of the study is fully implemented. The study team also infers that given the cross cutting areas covered in the present study, the importance and impact of the study will increase overtime.

Study Title

Preliminary Assessment of Vulnerability and Risk Associated with Climate Change on Water Resources Sector and Human Health in Mizoram

Implementing Institution

Mizoram Science, Technology and Innovation Council, MISTIC

Project Location/Completion Year

Mizoram, 2017

Objective

Assessment of Vulnerability and Risk Associated with Climate Change on Water Resources Sector and Human Health in Mizoram

Study Recommendation

A further in-depth and detailed assessment may be carried out in collaboration with renowned National Institutions coordinated by Department of Science and Technology, Govt. of India, New Delhi.

Analysis and Outcome

The study attempts to serve as a sensitization material and provide baseline information about climate change in Mizoram. It explains the concept of vulnerability in climate change context and describe how vulnerability and risk of a system is assessed. A brief scenario of climate change in Mizoram is also represented. The vulnerability and risk due to climate change which are likely to happen to the water resources and health sector in the coming future projected from the result of the current study are presented in the form of self explanatory maps and figures. The result of the work presented here are product of computer simulations using different software designed to represent the most likely scenario. Even so, the results are determined by certain environmental factors such as land-use, projected climate data from computer simulations, soil types, secondary information, etc. Therefore, it needs to be considered as factor dependent. Thus, the robustness of the simulations are limited to the ability of the computer programme to incorporate necessary environmental factors. Also, the certainty of the projected future scenario are subjected to change depending on the behavior and initiatives taken by human in the coming future.

Further in-depth and detailed assessment is being planned in collaboration with renowned National Institutions coordinated by Department of Science and Technology, Govt. of India, New Delhi. A recent study shows [157]. Mizoram to be one of the states that are least prepared for climate change among Himalayan States.



Study Title

Observed Rainfall Variability and Changes Over Nagaland State

Implementing Institution

India Meteorological Department, Pune

Project Location/Completion Year

Nagaland, 2020

Objective

- Identify the spatial pattern of the mean rainfall
- Understand district wise observed rainfall trend and variability in annual and SW monsoon season (June, July, August and September).

Study Recommendation

- The study investigated the rainfall pattern, variability and change for Nagaland state based on recent 30 years (1989-2018) of data.
- It here we considered, June, July, August and September, SW Monsoon season and annual time scales for the analysis.
- The district spatial patterns are considered to study rainfall total and stations are considered to study rainfall intensities.
- This study brought out many significant features of the rainfall pattern which can be utilized for the water and agricultural management.

Analysis and Outcome

The study investigated the rainfall pattern, variability and change for Nagaland state based on recent 30 years (1989-2018) of data. Here we considered, June, July, August and September, SW Monsoon season and annual time scales for the analysis. The district spatial patterns are considered to study rainfall total and stations are considered to study rainfall intensities. The state receives maximum rainfall in the month of July (30% of SW monsoon rainfall) followed by August (27%), June (24.0%) and September (20%). Contribution of the SW monsoon rainfall to annual total is 68%.

Time series analysis indicates that monthly rainfall, June and July shows non-significantly decreasing trend in rainfall and August and September shows significantly increasing trend in rainfall. Seasonal and annual rainfall show statistically significant decreasing trend. Districts from Northern and southwestern region receive more rainfall as compare to South Eastern region of the Nagaland. There is no statistically significant trend in frequency of heavy rainfall days for the month of June and August. The recommendation of the study is fully implemented. It is also envisaged that the study recommendation will have high impact on access to resources like water, energy and sanitation.

Study Title

Observed Rainfall Variability and Changes Over Sikkim State

Implementing Institution

India Meteorological Department, Pune

Project Location/Completion Year

Sikkim, 2020

Objective

- Identify the spatial pattern of the mean rainfall
- Understand district wise observed rainfall trend and variability in annual and SW monsoon season (June, July, August and September).

Study Recommendation

Need to take climate change adaptation for the vulnerable districts of Sikkim

Analysis and Outcome

India is in the tropical monsoon zone and receives plenty of rainfall as most of the annual rainfall during the monsoon season every year. However, the rainfall is having high temporal and spatial variability and due to the impact of climate changes there are significant changes in the mean rainfall pattern and their variability as well as in the intensity and frequencies of extreme rainfall events. Parliamentary Standing Committee in the year 2019 has instructed Ministry of Earth Sciences to investigate the impact of climate change on rainfall for each state using recent data. The report brings the result of the analysis based on the recent 30 years of data (1989-2018) on the mean spatial rainfall pattern as well as mean spatial pattern of different rainfall events, trends and variability as well as extreme rainfall events during the monsoon months and annual for the state. The report has been submitted by Secretary, MOES to the PSC on 16th Feb, 2020. The analysis brought many significant features of rainfall pattern and can be used for water agricultural managements.

Agencies responsible for implementation:

- Ministry of Earth Sciences, Government of India
- Science and Technology Department, Government of Sikkim



Study Title

Addressing Climate Change Vulnerability of Water Sector at Gram Panchayat Level in Drought Prone Areas of Sikkim

Implementing Institution

Rural Management and Development Department, Government of Sikkim

Project Location/Completion Year

Sikkim, 2018

Objective

- Prepare village water security plans (VWSP), Identification of vulnerable sectors with respect to water security, Implementation of adaptation measures.
- To upgrade Village Water Security Plans for vulnerable GPs through baseline data collection and situation analysis.
- To identify remedial measures to the problem based on the actual ground reality as indicated in Village Water Security Plan

Study Recommendation

- Community mobilization on water conservation and climate resilient activities; Training on preparation of Village Water Security Plan and Training on implementation of Village Water Security Plan
- Preparation of Village Water Security Plan of Gram Panchayat Units and collection of baseline data; Hydrogeological study of the springs to identify the recharge area using scientific study; Feasibility and budget estimation of the suggested measures for climate resilient activities; Updation of village springs atlas

Analysis and Outcome

The study is targeted for people of drought prone rural Sikkim mainly to address the drudgery faced by women folk due to water crisis in the mid hills. The study recommendations were partially implemented [172]. Some of the recommendations that were implemented included: Construction of water tanks at household level for most vulnerable households without storage medium; Construction of community level water tanks for most vulnerable clusters . Horticulture plantation livelihood enhancement.

Fodder plantation for livelihood enhancement. Spring shed management and lake revival for sustainability of local water sources. Resource recovery centers to tackle growing menace of solid waste and keep environment clean. Carried out a pilot study to understand the characteristics of Aquifers at Himalayan mid- hills for better understanding natural processes that provides water in the mid-hills.

Agencies responsible for Implementation:

- Rural Management and Development Department, Government of Sikkim

Study Title

Climate Change Vulnerability Assessment in Snow Leopard Habitat

Implementing Institution

World Wildlife Fund

Project Location/Completion Year

Sikkim, 2017

Objective

- Undertake vulnerability assessment North Sikkim, in the upper catchments of the Teesta Basin around the villages of Lachen and Lachung, which are also considered gateway communities to snow leopard habitat.
- With the purpose of gaining understanding on vulnerability to climate change in limited geographic scope using desktop review, community consultations and an expert workshop.
- The vulnerability assessment

Study Recommendation

- Mainstream climate adaptation into planning processes.
- Revisit the State Action Plan on Climate change (SAPCC).
- Strengthen research, long term monitoring and data collection.
- Enhance awareness of climate change impacts and the urgency of this issue.
- Integrate Ecosystem Based Adaptation Approaches.

Analysis and Outcome

The study provides a broad vulnerability assessment findings with respect to present and future climate change impacts on North Sikkim. An in-depth scientific research is urgently needed on potential impacts of climate change on the ecology of high altitude areas of the district, particularly those that will directly or indirectly affect people, livelihoods, cultures, and ecosystems. The critical ecological importance of the high- altitude areas of the North Sikkim District cannot be overstated. As the water towers of the state, these areas with countless glaciers, fresh water wetlands, streams, and rivers provide ecosystem services to a vast majority of downstream populations in the state. The presence of many important species, chief among these, the snow leopard, also makes this region a biodiversity hotspot within the state.

Development in these areas is also proceeding at an unprecedented pace, the impacts of which are being severely exacerbated by climate change impacts. Thus, there is an urgent need for better development policy coordination across all sectors to collectively address climate change impacts in this fragile high altitude region. In particular, local-level adaptation plans to build the resilience of local ecosystems and communities to climate change and other stressors, such as development impacts, is the need of the hour.

Agencies responsible for Implementation:

- Forest and Environment Department, Government of Sikkim



Study Title

Sub-National Jurisdictional REDD+ Program for Sikkim, India

Implementing Institution

Sikkim Forest, Environment & Wildlife Management Department

Project Location/Completion Year

Sikkim, 2017

Objective

To mitigate the emissions from forests and enhance carbon sequestration in forests of Sikkim. The project aims to establish a first-of-its-kind State level Jurisdictional REDD+ program in India.

Study Recommendation

- **Forest Management:** Interventions under this category will be directly managed by the SFEWMD. These activities majorly include Assisted Natural Regeneration (ANR), Afforestation/Reforestation (AR), fire management, silvi-pastoral and horti-pastoral activities, bio-fencing, and grassland management.
- **Energy Management:** This category of interventions focuses on decreasing the consumption of non-renewable biomass from forests for energy. Major activities under this category are – efficient alternatives for energy generation for cooking and heating purposes, smokeless bio-briquettes as substitute to fuelwood, and sustainable fuelwood management in religious places like monasteries.
- **Agriculture and Land Management:** This category attempts to substitute extraction of resources from forests by growing them in alternative sources such as community land, private land etc. Activities under this category include fuelwood and fodder plantations, and alternate fodder sources through hydroponics and azolla cultivation.
- **Other Supporting Activities:** to provide additional support to the project efforts to enhance the socio-economic situation of the target stakeholders of the project such as construction of community halls, fodder storage rooms; promotion of organic certifications; promotion of solar thermal energy for cooking and heating water by using solar or biomass-solar hybrid models of cookers.

Analysis and Outcome

The study recommendations are fully implemented. The landscape for the Project in Sikkim was finalized in 14 June 2013, as part of the USAID funded Forest-PLUS program. It was approved by the Ministry of Environment, Forest and Climate Change (MoEFCC), after a joint decision taken by the MoEFCC, FSI, ICFRE, IGNFA and USAID based on the selection criteria. It was further decided that a jurisdictional REDD+ project will be promoted as the 1st jurisdictional REDD+ project in India (at a sub-national level), covering the whole state of Sikkim as the jurisdiction. The evidence and capabilities in favour of this decision was:

- India's Draft National REDD+ Policy endorses the development of jurisdictional REDD+ at sub-national scales.
- International REDD+ negotiations are increasingly focussing towards the development of jurisdictional REDD+ Programs.
- It will be the first jurisdictional-level REDD+ Program in India, and one of the first in the world.
- It would help develop national jurisdictional REDD+ methodologies.
- It would be able to capture Sikkim's accomplishments in forest regrowth and associated carbon credits.

Study Title

Final Report on Secular Movement Studies of Glaciers in East Rathong Basin, West District, Sikkim Himalaya on Expedition Basis

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2016

Objective

Generate baseline data on the retreat of the glaciers in representative selected glaciers in part of Himalaya chosen for secular movement studies East Rathong Basin and Tista Basin during the Field Season 2015-2016 on expedition basis.

Study Recommendation

- The impact of the changes in the terminal positions of glaciers in Sikkim is localized. Therefore it is not prudent to correlate such small changes in climatic scale. These variations at short time scale may be helpful to see the weather changes rather than the climatic changes.
- Due to the retreat of East Rathong Glacier, catchment areas of Rathong River can be under direct impact. Hydrological parameters of the East Rathong basin need to be analysed in detailed ensuing the ongoing hydro power projects in the downstream areas of the river.
- Acquiring meteorological data and its inputs with detail terrain analyses of the East Rathong basin and other glacierised basins of Sikkim will bring fruitful scientific results not only to the scientific community but also to the common masses of Sikkim.
- Sikkim being a highly rated state in seismic calamity, these glacier studies can also be correlated with the seismic data to combat seismic induced avalanches and other related hazards or at least to minimise the effect of wrath of nature in this small Himalayan Kingdom.

Analysis and Outcome

The present study was carried out to generate baseline data on the retreat of the glaciers in Sikkim part of Himalaya during the Field Season 2015-2016. Sikkim Himalaya contains 193 glaciers covering an area of 667.38 sq km with 53.81cu.km. of locked up ice. East Rathong, Talung, Changme Khangpu and Zemu basins contain 19, 31, 43 and 100 nos. of glaciers respectively. Snout monitoring and secular movement studies in Sikkim were carried out during 1979-1986 and 2012-14 by GSI. However, East Rathong Glacier has been studied for the first time by GSI. During the present study, snout and glacial geomorphology of the East Rathong Glacier have been studied using Total Station and several temporal satellite data and SOI, Toposheet as base map. The pattern of retreat rate of East Rathong glacier also corroborates with the pattern in Changme Khangpu and Zemu glaciers. East Rathong glacier has retreated at 4.17m/yr during 1976-1978, 19.92 m/yr for 1988-2000, 46.83 m/yr during 2000-2005 and 12.38 m/yr during 2006- 2014. In the overall scenario, the glaciers in Sikkim showed retreat in their glacial terminus positions though at variable rate. It has been observed that the relative displacement rate of East Rathong Glacier from 2014 to 2016 is about 12.5m/year. During the last five decades, approximately an area of 2.25 sq km has been vacated and the rate of retreat is calculated at 20.02 meters/year. The recommendations of the study are partially implemented.

Agencies responsible for implementation:

- Science and Technology Department, Government of Sikkim
- Forest and Environment Department, Government of Sikkim



Study Title

The Sikkim State Action Plan on Climate Change

Implementing Institution

Department of Science & Technology and Climate Change, Government of Sikkim

Project Location/Completion Year

Sikkim, 2014

Objective

Formulation of the State Action Plan on Climate Change (SAPCC).

Study Recommendation

Recommendations have been given in 5 sectors namely, water; agriculture; biodiversity, forests, wildlife, and ecotourism; urban and rural habitats; and urban transport.

- Water: Recharging of dried springs; Recharging of natural lakes on hill tops; Maintenance of enough forest cover at the upper catchment areas for them to act as recharge zones. Enabling adequate artificial water harvesting to recharge ground water etc.
- Agriculture: introduction of new seed varieties, popularization indigenous variety, crop diversification, integrated pest management, seed production and certification etc.
- Urban transport: Vehicle registration policy/ taxation Public Transport Policy Reschedule/adjust work/activity timing Promoting non-motorized transport system Dynamic Fuel policy Transport regulatory authority

Analysis and Outcome

The State Action Plan on Climate Change for the State of Sikkim have been released by the Department of Science and Technology and Climate change, and GIZ India supported technically for the formulation of the action plan. The strategies developed in Action Plan to tackle the climate change has undergone series of discussions, field researches and deliberations among the line departments of Sikkim to make it success, where Department of Science and Technology and Climate Change acted as a nodal department while preparing Climate Change Action Plan for Sikkim.

The Government of Sikkim has undertaken number of initiatives to address issues of climate change based on the present study. Among which are the ban on cattle grazing in forests and on illicit hunting, reforestation programmes, ban on plastic, ban on use of chemical pesticides and fertilizers, etc. This resulted in tremendous increase of forest and wildlife areas. [175] The recommendation laid out by the plan is being implemented by all the concerned departments spearheaded by SSCCC. Some of the major work undertaken by the Cell are: Generation of database for the vulnerability and risk assessment of state in terms of climate change; Institutional Capacity building and R&D for data base generation; Training programme of Stakeholders including Government officials, researchers, community based organisations, media etc; Public Awareness. The study has resulted in visible positive impact with regard to climate change mitigation and adaptation strategies in the state.

Agencies responsible for implementation:

- Government of Sikkim
- Ministry of Environment Forest and Climate Change, Government of India

Study Title

A Report on the Updation of Glacier Inventory of Sikkim Himalaya

Implementing Institution

Geological Survey of India, State Unit: Sikkim

Project Location/Completion Year

Sikkim, 2013

Objective

The updation of glacier inventory of Sikkim Himalaya

Study Recommendation

Recommendation has not been outlined in this report

Analysis and Outcome

The updation of glacier inventory of Sikkim Himalaya was initiated during 2008-09. The earlier glacier inventory of Sikkim Himalaya was compiled by GSI during eighties. In view of the certain limitations while preparing previous inventory, viz coarse resolution of imageries, no cut off size of the glaciers, and resultant confusion vis-à-vis the new attempts by various organisations, the present study was undertaken. The geographical area of Sikkim is 7076 sq km. The state is divided in to five fifth order basins. Out of which one basin viz Rangpo that covers an area of 1811.50 sq km is non-glacierised basin. The four glacierised basins cover an area of 5284.50 sq km.

As per the present work the Sikkim Himalaya, contain 193 glaciers covering an area of 647.23 sq km. The locked up ice in these glaciers found to be of the order of 52.57 cu. km. From the above it is clear that the number of glaciers in the current compilation has come down from 449 to 193 glaciers. This can attributed to the inclusion of very small glaciers, i.e., glaciers having surface area of less than 0.5 sq km in the earlier version of glacier inventory. However, during the current compilation glaciers having their surface area less than 0.5 sq km have not been included as decided during the 'Brain Storming Session on Glacier Inventory'. In addition, in case of some of the large glaciers, the tributaries had shown as independent glaciers due to non-availability of high-resolution space data, which has resulted in the increase in the number of glaciers. In any case, the reduction in the number of glaciers cannot directly link with 'Climate Change'. It may also be noted that during the field checks, and also as per the available literatures it has been observed that there has not been any alarming increase in the rate of retreat and even very small glaciers have survived the climate change scenario. The study objective for updation of the glacier inventory of Sikkim was successfully completed.



Study Title

Observed Rainfall Variability and Changes Over Tripura State

Implementing Institution

India Meteorological Department, Pune

Project Location/Completion Year

Tripura, 2020

Objective

- To identify the spatial pattern of the mean rainfall
- To understand district wise observed rainfall trend and variability in annual and SW monsoon season (June, July, August and September).

Study Recommendation

- The study have investigated the rainfall pattern and it its variability and also changes based on recent 30 years data.
- In the analysis it has considered monsoon months, the monsoon season and annual scale. The spatial scale has been considered from state to district for study of rainfall total and stations are being considered for seeing intensities of rainfall.
- The analysis brought many significant features of rainfall pattern and can be used for water agricultural managements.

Analysis and Outcome

The outcome of the present study shows Tripura receives about 60% of its annual rainfall in the southwest monsoon season. The highest mean southwest monsoon rainfall (1549.1 mm) is observed in South Tripura district and the lowest mean southwest monsoon rainfall (1260.9 mm) is observed in West Tripura district. The highest mean annual rainfall (2542.5 mm) is observed in North Tripura district and the lowest mean southwest monsoon rainfall ((2103.3 mm) is observed in West Tripura district.

The study shows there is a significant decreasing trend in the frequency of rainy days in the stations of Dhalai and South Tripura and a significant increase in the stations of Sipahijala district for the southwest monsoon season. The status of implementation of the recommendation is not known. It is inferred by the study team that the outcome and finding of the study will have certain impacts on infrastructure development, high impact on access to basic amenities like water, sanitation, and overall impact on livelihoods of the people in the region.

Agencies responsible for implementation:

- Ministry of Earth Sciences, Government of India
- Department of Environment and Forests, Government of Tripura

Study Title

Climate Vulnerability Assessment for Adaptation Planning in India using a Common Framework

Implementing Institution

Department of Science and Technology /
Indian Institute of Technology, Mandi/Indian
Institute of Technology, Guwahati / Indian
Institute of Science, Bengaluru

Project Location/Completion Year

More than one state, 2020

Objective

To carry out a current-climate state-level and district-level vulnerability assessment for India based on the starting point/contextual approach of vulnerability

Study Recommendation

- Need for development of climate change risk index, followed by risk ranking of states and districts, where: Risk = f (Hazard, Exposure, Vulnerability).
- Development of a common framework, methodology and guidelines for risk assessment.
- All State Climate Change Centres funded by the Department of Science and Technology, Government of India are interested in developing a Risk Index for states. It requires building capacity for risk assessment and adaptation planning.
- Generation of data for risk assessment is important. There is need of a strategy for data generation for climate change risk and vulnerability assessment and adaptation planning.

Analysis and Outcome

Assessing vulnerability to climate change is important as it helps to understand climate risks and provides information, on the location specific measures to be taken to adapt to climate change. Hence, a vulnerability assessment is the first step in adaptation planning. This project was initiated to inform the policymakers of India on the vulnerability profiles of different states using a common assessment framework. The present assessment has used the IPCC 2014 'Risk and Vulnerability Framework' as the base of such a common framework, which is a clear improvement over the IPCC-2007 framework. The purpose is to measure the comparable degrees of vulnerability for all Indian states for prioritization of the states for climate change adaptation planning and investment. The analysis also helps the states in understanding the major drivers of vulnerability and target the adaptation actions accordingly.

The present nation-wide vulnerability assessment report represents a significant contribution to India's National Action Plan on Climate Change (NAPCC), and in particular to the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) and the National Mission on Strategic Knowledge for Climate Change (NMSKCC).



Study Title

Understanding Mountain People's approach and Practices to Combating Climate Change in the Indian Himalayan Region Research to Renewal and Reforms

Implementing Institution

Integrated Mountain Initiative

Project Location/Completion Year

More than one state, 2020

Objective

- Operationalize young researchers forum in the Indian Himalayas
- Develop compedium of best practices linkngclimte change to sustainabl development
- Build awareness, communicate sectorial learnings and best practices and build capacity of stakeholders to identify ways for up scaling across mountain states.

Study Recommendation

- Increased involvement of youth and young researchers on cross cutting themes pertaining to climate change in ountans states through a collaborative 'Young Researchers' Forum.
- Documenting best practices across the 11 states of IHR contributing to climate change adaptation-Repository.
- Increased focus on evidence based fundamental and applied research on climate change through universities and gras root organizations in the Himalayan States.

Analysis and Outcome

The recommendation of the study was fully implemented. Based on the recommendation three Young Researchers' Forum was organized for all the 11 IHR (Indian Himalayan Region) Researchers followed by documenting the discussions. 11 policy briefs were developed from the states. 1 Compendium of case studies including 21 case studies from across IHR. 2 year Newsletters, State workshops were held in each of the 11 IHR states to share their findings, successfully organized Sustainable Mountain Development Summits and Meet of the Mountain States to advocate for adoption of mountain specific policies and developmental frameworks in the Government of India and Indian Himalayan States.

Study Title

Climate Vulnerability Assessment for the Indian Himalayan Region Using a Common Framework

Implementing Institution

Indian Institute of Technology, Guwahati

Project Location/Completion Year

More than one state, 2019

Objective

Climate change impact on water and livelihood and potential adaptive strategies for Eastern Himalayan region of India

Study Recommendation

- The study highlights that the vulnerability of the study region to climate change is not concentrated to physical or geographical factors alone, but mostly to the socio-economic factors like lack of access to education, health care, limited livelihood opportunities, limited resources, etc. People consider that these non-climatic factors act as barriers for them to overcome poverty, contribute to their weak resilience, and make it extremely difficult for them to manage the risk posed by climate change.
- The study therefore suggests that it is of utmost importance that the interventions are planned in ways that address the multidimensional poverty in the region which in turn will enhance community's inherent capacity to adapt to current as well as future climate risk.

Analysis and Outcome

The present study was initiated with an aim to equip relevant state government departments of 12 states in the IHR with a common methodological framework to develop the vulnerability profiles of the Himalayan states. This includes nine states in the eastern Himalayan region. The study focus on developing comparable vulnerability profiles of these states as well as the districts within the states where vulnerability is perceived as a system property composed of its sensitivity and adaptive capacity, and independent of the element of exposure as per IPCC 2014 guidelines. This was achieved through a series of Need Assessment Workshops followed by a common Methodological Workshop and a Dissemination Workshop. The process not only created an understanding of the methodological framework, but also initiated a dialogue between the states in the IHR. The common set of indicators to assess vulnerability was derived through prolonged debates and discussions during the workshops in the presence of participants from various state departments and academic institutes of the 12 states.

The recommendation of the study is fully implemented. The Government of Sikkim, Rural Development Department seriously considered the study recommendations and implemented them to assess climate change impact in depth. Based on the study recommendations further measures such as alternative livelihood options, better road network and access to health facility were also introduced. This study received accolades from all the states government of the Himalayan region with regard to its usefulness in climate vulnerability assessment. Based on the positive feedback Swiss Agency for Development and Cooperation (SDC) and the Department of Science and Technology (DST), Government of India, rolled out the climate vulnerability assessment at the national level.



Study Title

Climate Vulnerability and Risk Assessment: Framework, Methods and Guidelines for the Indian Himalayan Region

Implementing Institution

Department of Science and Technology
/ National Mission for Sustaining the
Himalayan Eco system / Indian Himalayas
Climate Adaptation Programme

Project Location/Completion Year

More than one state, 2018

Objective

To provide practical guidance on assessment and estimation of current climate vulnerability of regions, sectors and communities. The study is aimed at providing vulnerability framework, methodology and guidelines for assessing the vulnerability of biophysical or socio-economic systems. The Guidelines will focus on three major components:

- Climate Change Vulnerability and Risk Assessment Framework
- Climate Change Vulnerability and Risk Assessment Methods and Guidelines
- Integration of Climate Change Vulnerability and Risk Assessment into Adaptation Planning

Study Recommendation

Vulnerability assessment is required for multiple purposes, particularly for adaptation planning. Vulnerability assessment would assist in:

- Adaptation planning of developmental programmes and projects
- Prioritisation of adaptation interventions and investment at national, state, district and village levels
- Developing adaptation proposals for Green Climate Fund, World Bank, Asian Development Bank, Adaptation Fund, bilateral agencies, etc.
- Meeting the requirements of Paris Agreement, Article 9 that requires assessment of the impact and vulnerability Designing and implementing the 'Nationally Determined Contributions' component which aims to better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change
- Revision of the State Action Plan on Climate Change for assessing the vulnerability and prioritising adaptation programmes and projects

Analysis and Outcome

The present study will enable Adaptation planning of developmental programmes and projects; prioritization of adaptation interventions and investment at national, state, district and village levels; Developing adaptation proposals for Green Climate Fund, World Bank, Asian Development Bank, Adaptation Fund, bilateral agencies, etc; Meeting the requirements of Paris Agreement, Article 9 that requires assessment of the impact and vulnerability; Designing and implementing the 'Nationally Determined Contributions' component which aims to better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change and Revision of the State Action Plan on Climate Change for assessing the vulnerability and prioritizing adaptation programmes and projects. These Guidelines are aimed at practitioners involved in development, implementation and monitoring of climate change vulnerability reduction and adaptation programmes. This could include departments of agriculture, watershed, forest and health as well as development banks (World Bank and Asian Development Bank), United Nations (UN) agencies, bilateral agencies, non-governmental organizations (NGOs) and research institutions.

Study Title

Vulnerability of North-East India to Climate Change for Hydrological Extremes of Floods and Droughts

Implementing Institution

North Eastern Regional Institute of Science and Technology

Project Location/Completion Year

More than one state, 2018

Objective

- To develop an ArcGIS toolbar using ArcObjects for temporal trend analysis of meteorological parameters.
- To determine the temporal and spatial trends of meteorological parameters over north-east India.
- To assess vulnerability of north-east India To climate change for hydrological extremes of floods and droughts.

Study Recommendation

- Validation for three selected states (Arunachal Pradesh, Assam and Manipur) done by comparing state Govt. data, a global flood database and compilation of online news reports with results of this study (for both AHP and Iyengar and Sudarshan's method) proved to be quite matching and hence the results could be considered acceptable. Iyengar and Sudarshan's method was recommended.
- The aerial maps generated by spatial interpolation of point indices at an interval of approximately 10 years could be used for visual interpretation of vulnerability components and identification of priority area for reducing the vulnerability to flood.
- CWC needs to agree to provide monthly gauge data for all the GD sites of NE India, the results can be improved and forecasts can be made for future vulnerability hotspots which require corrective measures on priority basis to avoid or reduce losses from flood damages.
- If CWC agrees to provide monthly gauge data for all the GD sites of NE India, the results can be improved and forecasts can be made for future vulnerability hotspots which require corrective measures on priority basis to avoid/ reduce losses from flood damages.



Analysis and Outcome

The two unequal methods, namely, AHP and Iyengar and Sudarshan's method produced similar results. However, there were some differences in the indices due to difference in the assigned weights to indicators. Some of the major findings obtained from the present study were; for Arunachal Pradesh, Changlang, East Kameng, East Siang, Kurung Kumey, Lohit and Tirap were found to be highly vulnerable to flood. On the other hand, Changlang, East Kameng, East Siang, Kurung Kumey, Lohit and Tirap had very high exposure index and low adaptive capacity index. For Assam, Kamrup and N.C. Hills were found to be less vulnerable, whereas, Baksa, Barpeta, Darrang, Dhubri, Dhemaji, Karimganj, Lakhimpur, Hailakandi, Nalbari and Nagaon were found to be highly vulnerable to flood and had very low adaptive capacity index with high exposure index. Karimganj also had high hazard index in almost all the months. For Manipur, Chandel, Ukhul, Tamenglong and Senapati were found to be less vulnerable and had very low hazard index and low exposure index, whereas, Churachandpur was found to be highly vulnerable to flood.

For Meghalaya, East Khasi Hills was found to be less vulnerable while South Garo Hills was found to be highly vulnerable to flood compared to other districts. For Mizoram, Aizawl was found to be less vulnerable and Mamit was found to be highly vulnerable to flood compared to other districts. For Nagaland, Wokha was found to be less vulnerable while Mon was found to be highly vulnerable to flood compared to other districts. The recommendation of the study is not implemented as it is beyond the scope of the project. Its implementation depends on the policy makers. It is also inferred that the study recommendation will be highly impactful for overall livelihood improvement in NER.

Agencies Responsible for implementation:

- Ministry of Environment, Forest and Climate Change
- National Disaster Management Authority

Study Title

Agro-Climatic Zonal Planning Including Agriculture Development in North-Eastern India

Implementing Institution

Banaras Hindu University

Project Location/Completion Year

More than one state, 2012

Objective

The main objective of the study is to prepare a document for Agro-climatic Zonal Planning including Agriculture Development in North-Eastern India.

Study Recommendation

Some of the key recommendations of the study were:

- In order to address the issue of technology delivery in the present day context, capacities of existing ICAR institutes and Universities located in NE Region be enhanced in terms of equipment's and manpower.
- Regional referral laboratories needs to be established in CAU and ICAR NEH Region to promote organic agriculture/animal husbandry
- A regional consultative group needs to be established in the region to frame education and development agenda in a partnership mode so as to facilitate addressing farmers issues and propagation of intensive integrated farming system models developed for the region by ICAR Research Complex.
- NER imparts large quantities of animal products from outside the region. Besides, several other factors, the availability of higher cost of feed is the main limiting factor. The region is agro-climatically ideally suited to produce maize and soybean, the two important components of animal feed. It is recommended that cultivation of these crops should be popularized in a mission mode with forward and backward linkages.

Analysis and Outcome

The Planning Commission constituted 12 Working Groups to prepare the 11th Five Year Plan document on Agriculture. Of the 12 working groups, one Working Group was constituted with the specific objective of preparing a document for Agro-climatic Zonal Planning including Agriculture Development in North-Eastern India particularly. The focus Working Group were further divided into 5 sub-working groups viz., Priorities for Agricultural Development in various Agro-climatic Zones; Agricultural Extension, Management and Functional Linkages; Human Resources Development- Agriculture Education, Research & Training; North Eastern Region; and Value Addition/Infrastructure/Organic Farming. It has been observed that the recommendation of the study was partially implemented in the 12th Five Year Plan (2012–2017) Economic Sectors, Volume 2.



Study Title

North East Climate Change Adaptation Programme (NECCAP)

Implementing Institution

Ministry of Development of North Eastern Region (MDoNER), Govt of India

Project Location/Completion Year

More than one state, 2011

Objective

The overall objective of the programme is to strengthen the adaptive capacities of target groups, therewith reducing their vulnerability to climate change in a target-oriented manner. The FC measure is envisaged to provide three central services in all of the selected districts of the participating States:

- establishment of appropriate selection and planning mechanism of adaptation measures;
- implementation of selected adaptation measures; and
- support of mainstreaming of climate change awareness at all levels of government.

Study Recommendation

- System for integrated and participatory village-based land use planning (LUP) developed and implemented
- Sustainable CCA measures (micro-plan based and others) developed and implemented
- Water resource development in water stressed and erosion prone areas (e.g. construction of check dams and water reservoirs cum fish production; spring development);
- Watershed and wetland rehabilitation in all types of land; o Optimization of Jhuming (shifting cultivation) systems in hilly areas;
- Riverside plantation for improved flood protection and income generation, flood plain forest restoration; o Implementation of other improved agricultural models (e.g. introduction of flood and drought tolerant crops);
- Promotion of diversified income sources for vulnerable communities (e.g. in flood prone areas);
- Development and implementation of additional/other CCA relevant measures.

Analysis and Outcome

The recommendation of the study was successfully implemented in four states of North East Region viz., Assam, Meghalaya, Nagaland and Sikkim. Under Water Resource Development Activities - Installation of small water harvesting structures in water and erosion stressed areas, rain water harvesting structures for improved domestic water supply. Spring shed development. Watershed development in all types of lands. Establishment of riverside plantation for improved flood protection and income generation (selection of site- appropriate plant species taking into account expected climate changes etc. Agricultural farm models including construction of ponds as water reservoirs-cum-fish production and flood tolerant crops. Promotion of climate change resistant crops and climate proofing of traditional crops and developing market linkages. Support to income diversification activities in project villages (up to 15% of total investment) - in all the participating states/ districts.

Study Title

Feasibility Study of Involving Local Community in Tourism Related Activities in Kaziranga National Park

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2010

Objective

- To find out the existing tourism related infrastructure around Kaziranga National Park.
- To forecast the tourist inflow over a particular time period in the future and assess the needs and wants of the tourists coming to this destination.
- To assess the socio-economic and cultural dimensions of the local people and their willingness and ability to participate in tourism related activities.
- To find out avenues for involving local people in tourism related activities.
- To find out how different schemes for rural, social and economic upliftment in helping the local people in getting involved in tourism related activities.

Study Recommendation

- KNP should not be a destination for mass tourism, as it is now. If it remains a destination for mass tourism, the sustainability factor will be at stake.
- At present, per capita fees are less than per capita costs leaving no contribution to conservation. A high pricing policy would seem to control the number of tourists and contribute to conservation and sustainable tourism management.
- Various countries, including Kenya, Ecuador, Rwanda and Botswana limit the number of tourists and maximize revenues through pricing policies. The Department of Forest and the Tourism Department of the Government of Assam should take into consideration this factor to maintain the popularity of the Park.

Analysis and Outcome

This study was carried out with funding from NEDFI with the intention to find out the feasibility of involving the local community in tourism-related activities in Kaziranga National Park. The current project was aimed at investigating the existing tourism-related infrastructure, forecasting of tourism inflow in the future and evaluating the needs of the tourists coming to Kaziranga National park. In addition, the upliftment of socio-economic condition of local people by involving in tourism at Kaziranga was also one of its objectives. The present study is very useful in sustainable tourism and uplifting the standard of local people [83]. The report of the study recommended to avoid mass tourism at KNP. It also recommended to increase the pricing of tourism places for the purpose to reduce the mass gathering of people and to promote the sustainable tourism. The analysis of the report identified that the recommendations of the study were essential and considered seriously and implemented well. The recommendations of the study should be on focus in future also to meet the sustainable tourism.

Implementable recommendations:

- Avoiding mass tourism at KNP
- Increase the pricing of KNP
- Involving the local people

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- National Biodiversity Authority



Study Title

EIA Study for Nyamjangchhu Hydroelectric Project

Implementing Institution

WAPCOS Limited

Project Location/Completion Year

Arunachal Pradesh, 2012

Objective

To assess the existing status of physico-chemical, ecological, and socio-economic aspects of environment

Study Recommendation

As per the DPR, design flood value obtained by hydro-meteorological approach is recommended for preliminary design purposes as it is on conservative side as compared to flood frequency approach

Analysis and Outcome

The project involved 23.45 km long and 6.2 m diameter Head Race Tunnel (HRT) requiring extensive tunneling in geologically fragile landscape and comprised eight de-silting chambers and with underground Powerhouse having 6 x 130 MW Pelton turbines. The HRT bypasses around 35 km stretch of river between barrage and the powerhouse. The Appellant adds that the project also involved construction of captive hydropower project of 7.5 MW, Khangteng HEP to provide power during construction of 780 MW Nyamjang Chhu project [42]. The NGT suspended environmental clearance to the Rs 6,852.28 crore project in April when it became clear that the MoEFCC regional office in Shillong had taken cognisance of the construction of two units of the project for which forest clearance was not sought. The Nyamjang Chhu power project is being developed by the Bilwara Energy Limited, a private player.

Study Title

Environmental Impact Assessment for Lower Kopili Hydroelectric Project

Implementing Institution

Assam Power Generation Corporation Limited (APGCL)

Project Location/Completion Year

Assam, 2018

Objective

- To identify potential environmental impacts of the proposed project and formulate strategies to avoid/mitigate the same.
- A comprehensive EIA report including an Environmental Management Plan (EMP), will be prepared in compliance with ADB's SPS 2009 requirements as well as fulfil policy and regulatory requirements of the Gol.

Study Recommendation

- As per the ADB SPS 2009 EIA categorization process, the project hydropower development falls under Environment Category A. However, there are no environmentally sensitive areas protected areas within the PIA.
- The diversion of water for hydropower generation will result in change in the hydrological regime of the area, however minimum e-flow 5.345 m³/s (20% of average lean season flow at the dam, and increasing continuously downstream) will be maintained for maintaining ecological habitat in the downstream river sections.
- Overall, there are no significant negative environmental and socio-economic impacts associated with the proposed project that cannot be mitigated to negligible or acceptable levels. All significant issues have been screened during consideration of alternative locations.
- The diversion of water for hydropower generation will result in change in the hydrological regime of the area, however minimum e-flow 5.345 m³/s (20% of average lean season flow at the dam, and increasing continuously downstream) will be maintained for maintaining ecological habitat in the downstream river sections.
- Overall, there are no significant negative environmental and socio-economic impacts associated with the proposed project that cannot be mitigated to negligible or acceptable levels. All significant issues have been screened during consideration of alternative locations.
- There is full local community acceptance of the project. Affected persons/ households will be compensated as per provisions of the Resettlement and Tribal Development Plan developed for the project.
- The project will bring in significant power service reliability to the State and lead to local and national economic benefits while resulting in GHG emission reductions.

Analysis and Outcome

Given the observations and conclusions from the impact assessment processes, the project was accepted for implementation, as designed, according to Gol and ADB standards and policy requirements. As per Press Information Bureau, the Union Finance Minister Smt. Sitharaman took part in the foundation laying ceremony of 120 MW Lower Kopili Hydro Electric Project at Longku, Dima Hasao, on 07 October 2021 [43]. This project will add to Assam's power generation capacity from clean hydroelectric sources and improve electricity availability. Further, it is hoped that affordable and clean electricity facilitated through the project will help improve living conditions, promote business expansion, and increase employment opportunities in Assam.



Study Title

Assam Agri-business and Rural Transformation Project (APART): Conducting Environmental and Social Assessment of the Project APART and Preparation of Management Plans and/ or Framework for Managing Adverse Environmental and Social Impacts, Risks and Benefits

Implementing Institution

Assam Rural Infrastructure and Agricultural Services (ARIAS) Society, State Health Society, Government of Assam, Department of Health and Family Welfare

Project Location/Completion Year

Assam, 2017

Objective

- To increase value-added and improve resilience in the production and processing of selected agriculture commodities, focusing on small farmers and agro-entrepreneurs in targeted districts.
- Project beneficiaries will include farmers and entrepreneurs especially in the MSME segment.
- Others would include farmer producer organizations, sector management companies, and other value chain participants.
- During preparation, specific attention would be given to gender inclusion in project design and implementation arrangements.

Study Recommendation

- The report points to DPR for recommendations.
- Overall, the project has four components:
 - Component A: Support to Agriculture Enterprise Development;
 - Component B: Farm-Market Infrastructure Development;
 - Component C: Market Led Production and Resilience Enhancement; and
 - Component D: Project Management, Monitoring and Learning
- Activities in Component A are likely to have localised environmental impacts and component D which deals with capacity development will not have environmental impact.
- Activities from Component B and C are foreseen to have significant environmental impacts related to climate resilient production, infrastructure development and operation in the project clusters. Hence,
- The World Bank safeguard policies and other Government of India safeguard legislations are recommended.

Analysis and Outcome

APART ranges from small to largescale infrastructure projects. Development of these projects as per the envisaged objectives would have potential for negative environmental impacts. As an environmentally aware and socially responsible corporation, Assam Rural infrastructure and Agricultural Services (ARIAS) Society is cognizant to the need to mitigate the negative environmental impacts of projects in its portfolio and has developed systems to safeguard the environmental concerns through the preparation of an Environmental Management Framework. Compliance of the project with the relevant legislations of GoI (MoEF&CC), State level and local level and policies of World Bank has been ascertained. Applicable legislations during implementation of the project and necessary provisions for compliance have been examined and implemented. A review of the legislations of the Government of India (GoI) and the Government of Assam pertaining to environmental management in consideration with project interventions under APART has been carried out.

Safeguard policies of World Bank have been taken into account to assess the possible environmental risks and the impacts (positive or negative) associated with the development interventions proposed for Agriculture, Animal Husbandry & Veterinary, Fisheries, Common Service Centres (CSC's), Rural Roads and Sericulture. These safeguards helped in defining measures and also the processes to effectively manage risks and enhance positive impacts during the project implementation. The process of applying safeguard policies are important opportunity for stakeholder's engagement, enhancing the quality of project proposals and increase in ownership. All the safety measures laid down under environmental regulations and Safeguard Policies of World Bank were successfully implemented under the relevant sub-components of the project.



Study Title

Consultancy Services for Undertaking Environmental Assessment for the Rural Water Supply & Sanitation Project in Assam

Implementing Institution

IPE Global Private Limited

Project Location/Completion Year

Assam, 2013

Objective

- Bring about an improvement in general quality of life in the rural areas.
- Accelerate sanitation coverage in rural areas. Generate felt demand for sanitation facilities through awareness creation and health education.
- Cover schools/Anganwadis in rural areas with sanitation facilities and promote hygiene education and sanitary habits among students.
- Encourage cost effective and appropriate technologies in sanitation.
- Eliminate open defecation to minimize risk of contamination of drinking water sources and food.

Study Recommendation

Recommended Construction Practice and Pollution Safeguards for Twin Pit Pour Flush toilets: Twin Pit Pour Flush Latrines (TPPFL) is the most commonly adopted sanitation technology which is suitable in most of the environmental conditions except coastal areas with high groundwater table.

Analysis and Outcome

Environmental Assessment is a structured approach to predict the impacts of a proposed action before it is implemented. After knowing the impacts, measures are taken to avoid the environmental damage. The current project is aimed at improving the quality of life in rural areas, accelerating sanitation and creating awareness for the same. Improving the sanitation of schools/Anganwadis in rural areas and eliminating open defecation. Such kind of study is useful in upgrading the quality of life in rural areas [71]. The report of the study recommended to construct practice and pollution safeguards for twin pit pour-flush toilets. The report of the present study recommended the practice and pollution safeguards for Twin Pit Pour Flush toilets. The analysis of the report identified that recommendations of the study were important and considered on an urgent basis for enhancing the sanitation and open defecation free. It was noticed that the individual household toilets were constructed and water sanitation was improved. All the recommendations were implemented well [53].

Implementable recommendations:

- Construction of Practice and Pollution Safeguards for Twin Pit Pour Flush toilets
- Construction of individual household toilets was recommended by cost sharing.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Ministry of Jal shakti

Study Title

Environmental Assessment and Review Framework: Assam Urban Infrastructure Investment Program (AUIIP Program)

Implementing Institution

Guwahati Development Department

Project Location/Completion Year

Assam, 2013

Objective

To improve the urban environment and quality of life in the cities of Guwahati and Dibrugarh through the delivery of improved water supply, sanitation, solid waste management (SWM), drainage infrastructure, and a sustainable urban transport system such as a Bus Rapid Transit (BRT) corridor.

Study Recommendation

There should be safe access to safe drinking water and improved sanitation

Analysis and Outcome

The Assam Urban Infrastructure Investment Program (AUIIP Program) is a significant urban infrastructure initiative of Assam Government. The target of the AUIIP was to develop the urban environment and quality of life in the cities of Guwahati and Dibrugarh. The project used a Multi-tranche Financing Facility (MFF) modality and was implemented over a period of 6-year from 2012 to 2017 (December). Such kind of study is useful in upgrading the environment and quality of life in urban areas [69]. The report of the study recommended access to safe drinking water and improved sanitation. The recommendations were very essential. The analysis of the report indicated that the recommendations were partially implemented and needed to conduct continuous work on such issues to eradicate the anthropogenic impact [70].

Implementable recommendations:

- Access of safe drinking water and improved sanitation

Agencies responsible for implementation:

- Ministry of Water Resources, River Development and Ganga Rejuvenation
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board



Study Title

Draft Environmental Impact Assessment Report

Implementing Institution

SV Enviro Labs & Consultants

Project Location/Completion Year

Meghalaya, 2019

Objective

To systematically examines both beneficial and adverse consequences of the proposed project and ensure that these impacts are taken into account during the project designing.

Study Recommendation

- The project proponent will follow all the statutory norms and guidelines as per EPA, 1986 to safeguard environment. Wastewater generated from the proposed project will be treated in sedimentation traps & reused for greenbelt development.
- Sewage will be disposed through septic tank & soak pit. Ambient Air Quality of the project site are concerned viz. SPM (PM_{10} & $PM_{2.5}$), SO_2 , NO_x , VOC, HC, their concentrations in the ambient air at the proposed site were observed to be well within the prescribed limits.
- The operational phase noise shall be monitored and required PPE will be provided to work men as per sound level. No significant impact is seen on flora and fauna as no reserve forest and eco-sensitive zones are present within 10 km. Overall the project will have positive impact for socio-economic and cultural development.

Analysis and Outcome

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development. The developmental activities must have passed through EIA process. The objective of the current project was to identify the beneficial and adverse impacts of the proposed project. The report of the study recommended to follow the EPA guidelines to safeguard the environment. This study is very useful in identifying the likely impact of a developmental project and for the conservation of environment. The study revealed absence of any significant impact on flora and fauna which indicated a positive impact on socio-economic and cultural development. As per the recommendations, the wastewater was treated, sewage was disposed, operation noise was monitored, and PPE kit were provided to workers. The analysis of the study concluded that the recommendations made were important and implemented well.

Implementable recommendations:

- To follow the EPA guidelines
- Treatment of wastewater and its further use for the greenbelt development
- Monitoring of operational noise and providing the PPE to the workers as per the level of sound

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

EIA Report of Boulder Stone Mine in Village- Randhigopa, P.O.Zekabari, District –West Garo Hills, Meghalaya

Implementing Institution

Geogreen Enviro House Pvt Ltd

Project Location/Completion Year

Meghalaya, 2019

Objective

- To establish the present environmental scenario.
- To anticipate the impact of proposed project.
- To suggest preventive and mitigative measures

Study Recommendation

- Increase in traffic density will lead to air pollution so it is recommended Vehicles with PUC Certificate will be hired. Regular maintenance of vehicles will be done to ensure smooth running of vehicle.
- Movement of vehicles will cause noise pollution so it is suggested unnecessary blowing of horn to be avoided. Increased traffic may cause accidental incidences so suggesting the speed of vehicles to be low near habitation areas.
- The speed of dumpers/trucks on haul road will be controlled as increased speed increases dust emissions. Overloading of transport vehicles will be avoided. The trucks/ tippers will have sufficient free board.
- Spillage of ore on public roads will be cleared immediately and vehicles will play in safe speed. The shrubs and bushes located in the area, proposed plantation and drilling with sharp bits and control blasting will check the propagation of noise.
- Workers will be made aware of the importance of the wildlife and signage will be displayed at the sensitive areas to caution the workers & other passerby. The drain with parapet wall will be provided towards lower side of the dumps to check the wash off during the monsoon.



Analysis and Outcome

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development. The developmental activities must have passed through EIA process. The current report aimed at preparation of EIA report of boulder stone mine to establish the scenario of present environment, anticipating the impact of proposed project and suggestions of preventive and mitigating measures. Such study is very useful in identifying the impact of developmental project [107, 108]. The analysis of the report revealed several important recommendations. It is recommended to hire the vehicle with PUC certificate. It is also recommended to avoid unnecessary blow of horn, and lower the speed of vehicles near habitation areas. In addition, several important recommendations were made such as avoiding overloading, clearing of spillage, plantation, creating awareness about importance of wildlife, etc. All the recommendations given by the report were very essential, implemented and needed to be implemented in future also.

Implementable recommendations:

- Hiring the vehicle with PUC certificate
- Avoiding unnecessary blow of horn
- Lowering the speed of vehicles near habitation areas
- Avoiding overloading, clearing of spillage, plantation, creating awareness about importance of wildlife, etc.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Environmental Impact Assessment Report & Environmental Management Plan of Expansion of Lumshnong Limestone Mine

Implementing Institution

Perfact Enviro Solutions Pvt. Ltd.

Project Location/Completion Year

Meghalaya, 2018

Objective

To assess the impact on the environment while increasing the capacity of mining from current 9,00,000 TPA to 25 lacs TPA

Study Recommendation

- The study projects that it will impact the environment due project development but simultaneously bring economic benefits to the people around the project site. To address or contain the impacts on the environment the following mitigation measures have been suggested:
- Sprinkling of water for dust suppression on mine haul roads.
- Regular Compaction & grading of haul roads and service roads to clear accumulation of loose material.
- Avoid overloading of dumpers and consequent spillage on the roads.
- Good maintenance of vehicles & machinery.
- Water sprinklers of fixed type will be provided at the mine approach roads from mine face / benches to crush hopper to prevent the generation of dust.
- Trees shall be planted in the lease area as proposed in Conservation Plan. Mined out land reclamation shall be done by turning it into water recharge pit and fencing of pit will be done.

Analysis and Outcome

The process of identifying the possible effect of the developmental project is known as environmental impact assessment. Such kind of study is useful in investigating the possible impact of a developmental project on the environment and its mitigation [118]. The study was targeted to assess the environmental impact of a project while increasing its capacity of mining from current 9,00,000 TPA to 25 lacs TPA. The analysis of the report prescribed several recommendations such as sprinkling water, regular compaction and grading, avoiding overloading, maintenance of vehicle, plantation, etc. All the recommendations in the developmental area were genuine and must be implemented on urgent basis. It was found that the recommendations were implemented well.

Implementable recommendations:

- Sprinkling water
- Regular compaction and grading
- Avoiding overloading
- Maintenance of vehicle
- Plantation

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

MADAN PYRDA (BLOCK-I) Limestone Deposit for Public Hearing

Implementing Institution

Perfact Enviro Solutions Pvt. Ltd.

Project Location/Completion Year

Meghalaya, 2018

Objective

To assess the impact on the environment while increasing the capacity of mining of limestone mineral to 0.204 million TPA from lease area of 4.89 ha

Study Recommendation

The study reports anticipated impact and mitigation measures.

- Land Environment: Mining may cause land degradation. Hence, Green belt development shall be done from the top soil excavated during mining in the 7.5m statutory boundary and at ultimate stage whole area will be planted.
- Water Environment: Total water requirement in the proposed mining project is 10KLD. Dust suppression shall be done by collecting operational pit water collected during rain. Drinking water will be sourced by from Cement plant by water tanker.
- Air Environment: The air borne particulate matter is the main air pollutant contributed by opencast mining with drilling and blasting. Therefore, sprinkling shall be done and workers will be given protective gears.
- Noise Environment: Hydraulic excavator will be used in excavation. Hence workers will be given protective gears. Plantation will be done to create cover from high noise.
- Biological Environment: Forest area diversion is required in the proposed mining as the land is deemed forest land. The diversion application has already been submitted. There will be no impact on flora and fauna due to the proposed project.
- Socio- Economic environment: The project will enhance direct and indirect employment in the area.
- Mine Waste: Mine waste will be transported and backfilled in the fallow land near Cement plant. The quarry area will be extensively planted by using soil generated from proposed mining. Biodegradable waste will be composted and used as manure.
- Impacts due to transportation: The entire mineral will be transported to the client's own Cement plant through trucks.

Analysis and Outcome

Environmental impact assessment is the process of identifying the impact of a developmental project on the environment. The assessment of impact on environment of a project by increasing its capacity of limestone mining was its main objective. Such kind of study is very useful in assessing all the possible impact of a project on the environment [119]. The analysis of the report found several important recommendations given for the same project. It was recommended to develop green belt to restore the land. For reducing the noise pollution the report recommended to use hydrolic excavation. It also recommended forest diversions and transportation of mine waste to fallow land, plantation, and transportation of entire mineral to client's plant. The analysis of the report concluded that all the recommendations were important and completely implemented.

Implementable recommendations:

- Development of green belt to restore the land.
- Use of hydraulic excavation.
- Forest diversion
- Transportation of mine waste to fallow land
- plantation, and transportation of entire mineral to client's plant

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Environmental Monitoring Conducted From 01 April to September 2017 for Nongtraï Limestone Mine

Implementing Institution

Lafarge Umiam Mining Pvt. Ltd. (LUMPL)

Project Location/Completion Year

Meghalaya, 2017

Objective

- Enhancement of Nongtraï Limestone Mine with production capacity from 2.0 million TPA to 5.0 million TPA of limestone by Lafarge Umiam Mining Pvt Ltd, located at village Nongtraï, District East Khasi Hills, Meghalaya (MLA; 100.00 Ha).
- The compliance status of Conditions of the Environmental Clearance for the period April 1, 2017 to September 30, 2017 of Nongtraï Limestone Mine

Study Recommendation

- LUMPL should ensure plantation of only the Forest Department specified plant species during monsoon seasons. Recharging pits are being developed as per design guidance of "Manual on artificial recharge of ground water" published by CGWA.
- It is expected that the mitigation measures mentioned would help augment the groundwater resource. LUMPL is in the process of arranging 3 months' course of Associate Fellow Industrial Health to one of the medical doctors to get qualified as Occupational Health Specialist.
- Any construction labour to be deployed will be provided with necessary infrastructure within the existing project footprint and facilities including cooking, toilets, package STP, safe drinking water, health care facility etc.

Analysis and Outcome

Environmental monitoring is a method to examine the conditions of the environment which support the policy development and its implementation for improving the totality of environment. The major objective of the current project was to improve the existing environmental condition. Such kind of study helps in investigating the overall condition of environment [130]. For this, the report recommended several essential measures. The report recommended to increase the plantation of only those species specified by the forest department. It also recommended to recharge the groundwater artificially as suggested by CGWA. Further, it recommended to provide essential facilities to the labors such as cooking, toilets, drinking water, health care, etc. The analysis of the report revealed that all the recommendations were very important and found to be implemented well. At present, the recommendations made were achieved.

Implementable recommendations:

- Plantation of only those species specified by the forest department
- Ground water recharge
- Providing the essential facilities to the labors

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India
- Central Ground Water Authority (CGWA)

Study Title

Comprehensive Environmental Impact Assessment Study for Mawphu Hydro Electric Project (85 MW), Stage-II, Meghalaya: EMP Report Vol. III

Implementing Institution

WAPCOS Limited

Project Location/Completion Year

Meghalaya, 2016

Objective

- Assess the changes in environmental conditions, if any, during construction and operation of the project.
- Monitor the effective implementation of mitigatory measures.
- Warning of any significant deterioration in environmental quality so that additional mitigatory measures may be planned in advance.

Study Recommendation

- A meteorological laboratory can be set up at one of the ambient air quality monitoring stations. Integrating Sound Level Meter to monitor noise pollution.
- Qualitative and Quantitative assessment of flora and fauna.
- Monitoring of restoration of muck disposal area.
- Monitoring of edaphic properties such as pH, EC, texture, organic matter, available nitrogen, available phosphorus and available potassium. Construction of PHCs

Analysis and Outcome

The environmental impact assessment is a tool to identify the impact of a developing project on the environment. The development of hydroelectric project disturb the ecosystem of the proposed location and affect the biodiversity at a great extent. The current project was aimed at investigating the change in environmental parameters during the construction work. Such kind of study is very useful in studying the various changes in ecosystem due to a developing project [142]. The report of the study recommended very essential points and all of them were feasible. The analysis of the report identified that the assessment of flora and fauna was conducted and soil properties were monitored regularly. There is an urgent need to develop a meteorological lab. Therefore, it can be said that the recommendations were partially implemented.

Implementable recommendations:

- Setting up meteorological lab
- Assessment of flora and fauna
- Monitoring of flora and fauna

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Comprehensive Environmental Impact Assessment Study for Mawphu Hydro Electric Project (85 MW), Stage-II, Meghalaya

Implementing Institution

WAPCOS Limited

Project Location/Completion Year

Meghalaya, 2016

Objective

Prepare the Environmental Impact Assessment report and formulation of Environmental Management Plan for obtaining Environmental Clearance from the regulatory agencies

Study Recommendation

- Impacts on water Quality: sewage is proposed to be treated, prior to disposal; effluent from crushers be treated prior to disposal in a settling tank; muck disposal has to be done in line with the Muck Disposal Plan given in EMP; the effluent from workshop, washing of sites for parking of equipment and vehicles will have high oil and grease, which shall be treated prior to disposal.
- Impacts on Water Environment: there will be significant adverse impacts on riverine ecology, which needs to be ameliorated through the release of Environmental Flows.
- Impacts on Air Environment: appropriate management measures to reduce emission level from DG sets shall be commissioned to reduce the impacts on ambient air quality
- Impacts on Noise Environment: absorption by construction material, air absorption, atmospheric in homogeneities, and vegetal cover.
- Impacts on Land Environment: implement appropriate slope stabilization measures to prevent the possibility of soil erosion and landslides in the quarry sites; choose proper muck disposal sites.
- Impacts on Biological Environment: in order to reduce human interference of environment, Environmental Management Plan guidelines maybe followed.
- Impacts on Socio-Economic Environment: the project will directly or indirectly benefit the people in the area.

Analysis and Outcome

The environmental impact assessment is a tool to identify the impact of a developing project on the environment. The hydroelectric project affects the natural ecosystem at a great extent. It also affects the biodiversity at a large level. The aim of the current project was studying the impact of various developmental activities during construction work. Such kind of study is very useful in studying even the narrow changes in the environment and the pattern of biodiversity changes [142]. The report of the study recommended very essential points which were very feasible. The analysis of the report concluded that the treatment of sewage is still not initiated properly and partially treated and raw sewage is being disposed. Likely the air quality of ambient air was not improved and noise level was not reduced. Similarly, the others recommendations were also needed to be implemented completely.

Implementable recommendations:

- Water treatment
- Air quality monitoring
- Environmental Management Plan guidelines to be followed

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India
- Ministry of Water Resources, River Development and Ganga Rejuvenation



Study Title

Draft Environmental Impact Assessment Report of Adhunik Cement Limited - Limestone Mine in Umsoo-Mootang Area - Captive Limestone Mine of 6.88 LTPA Limestone Production at Umsoo-Mootang at Limestone Mine (Block III)

Implementing Institution

B S Envi-Tech Private Limited

Project Location/Completion Year

Meghalaya, 2016

Objective

Environmental Impact Assessment (EIA) to obtain environmental clearance from Ministry of Environment and Forests (MoEF) for the proposed Mining Lease of 128.52 ha area located at Umsoo-Mootang Area.

Study Recommendation

Recommendation is not outlined in the report

Analysis and Outcome

Environmental impact assessment is done to analyze the impact of a developing project. The current project was aimed at conducting an EIA of Adhunik Cement Limited. Such study help in investigating the possible impact on the environment and biodiversity of the area so that important steps could be taken earlier to save the environment [144]. The study was targeted to analyse all the impacts during the mining of limestone. The recommendations of the study were missing in the report.

Implementable recommendations:

- Recommendations were missing

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Environmental Impact Assessment of Expansion of Limestone Opencast Mining from 2.0 MTPA from 5.0 MTPA Project of Lafarge Umiam Mining Private Limited : Village Nongtraï, District East Khasi Hills, Meghalaya

Implementing Institution

ERM India Pvt.Ltd

Project Location/Completion Year

Meghalaya, 2015

Objective

Environmental Impact Assessment of Expansion of Limestone Opencast Mining from 2.0 MTPA form 5.0 MTPA project of Lafarge Umiam Mining Private Limited : village Nongtraï, District East Khasi Hills, Meghalaya

Study Recommendation

- The EMP summarises potential impacts associated with the proposed expansion Project and clearly sets out the corresponding control/mitigating measures that need to be implemented
- Set out organisation structure. Specific management plans including Biodiversity and Wildlife Conservation plan, Ground vibration Control Plan, Emergency Response Plan and Progressive Mine Closure Plan have been included in the EMP.

Analysis and Outcome

Environmental impact assessment is done to analyze the impact of a developing project. The current project was aimed at conducting an EIA of expanding opencast mining for limestone. Such study help in investigating the possible impact on the environment and biodiversity of the area so that important steps could be taken earlier to save the environment [118]. The analysis of the report recommended to impelement the mitigating measures, setting the structure of organisation and several management plans. The recommendations were feasible and essential for the mentioned cause. It was analysed that the mitigating measures were applied, and some plans like biodiversity management plan was also developed. All the recommendations were implemented well.

Implementable recommendations:

- Setting mitigating measures and organisation structure
- Developing environmental management plans

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Environmental Impact Assessment and Environmental Management Plan for Wah Pynkon Limestone Deposit Over an Area of 13.58 Ha. in Lumshnong Village

Implementing Institution

Geomin Consultants (P) Ltd

Project Location/Completion Year

Meghalaya, 2013

Objective

The proposed production target of limestone is 12, 00,000 TPA from the lease. The limestone to be produced will be utilized in the existing cement plant of the company. Opencast mechanised means of mining will be adopted for mining of limestone

Study Recommendation

- Mining activities and related operations can cause several beneficial and adverse impacts on the environment.
- The adverse impacts are proposed to be mitigated. Using Matrix method' the impact on the environment has been assessed.
- The expected beneficial impacts on the society are Health, Population/Migration, Employment, Literacy, Services and Aesthetic sense. The proposed mining operation will generate direct employment for 30 nos. of employees and indirectly for 50 people. Communication, education, medical, power and employment facilities will be improved. Various mining operations will generate dust and gaseous pollutants.
- With a view to the scale of mining and existing environmental back ground condition it is anticipated that increment impact due to the mining operation will be within the prescribed limit.
- Further mitigation measures like water sprinkling and plantation will reduce the pollution level in the area. The contamination of surface water may cause diseases in the area. Treatment of water will be done. Medical treatment will be provided as per the requirement. The impact on ground water will be marginal since proposed mining activities will be much above the ground water table.

Analysis and Outcome

The process of investigating the possible impact of a developmental project on environment is known as environmental impact assessment. The objective of the current study was to produce limestone for cement industry. It was a new mining project which will disturb the natural environment. The report of the study suggested several important recommendations such as providing health, education, employment, etc. services to the people. It also suggested to do plantation and sprinkling water, water treatment, and providing medical facilities to mitigate the impacts. The analysis of the report analyzed that the recommendations made were implemented well.

Implementable recommendations:

- Plantation
- Sprinkling water,
- Water treatment, and
- Providing medical facilities

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Comprehensive Environmental Impact Assessment of Umngot Hydro-Electric Project (3 X 80 MW)

Implementing Institution

Agricultural Finance Corporation Ltd

Project Location/Completion Year

Meghalaya, 2010

Objective

- Assess the environmental impact of the proposed hydro-electric power generation project on land, water, air, climate, flora and fauna, public health, etc., and
- Formulate a suitable environmental management plan for minimising or avoiding the negative impacts that are likely to occur due to construction of the project in the area.

Study Recommendation

Recommendation has not been outlined in the report.

Analysis and Outcome

The Umngot is one of the major southwardly flowing rivers of Meghalaya originating at an altitude of 1840 m from the junction of Nongkrem road and NH-44 which is at a distance of 11 km from Shillong, situated in Khasi Hills district of Meghalaya. The Umngot Hydro-Electric Project is expected to generate 240 MW in a dependable year. The power from this project would be very much useful in mitigating the hardships of power crisis in the state as well as in the region besides providing employment in two districts of East Khasi hills and Jaintia hills.

The present study carried out comprehensive Environment Impact Assessment of the proposed Umngot Hydroelectric project. This includes assessment of positive and negative impacts likely to occur with its economic evaluation, and preparation of EMP. It also studied the Socio-Economic aspects and preparation of R& R plan for the project affected people. The scope also includes Disaster Management plan along with Dam Break analysis besides formulation of implementation plan.

The recommendation of the study is fully implemented.



Study Title

Draft Environmental Impact Assessment Report Adhunik Cement Limited - Limestone Mine in Umsoo-Mootang Area - Captive Limestone Mine of 1.5 MTPA Cement Plant

Implementing Institution

B S Envi-Tech Private Limited

Project Location/Completion Year

Meghalaya, 2010

Objective

Environmental impact assessment for Adhunik Cement Limited to produce 2.0 MTPA from current 1.5 MTPA Limestone mine in Umsoo-Mootang Area - captive limestone mine of cement plant.

Study Recommendation

- The study recommends measures to control different environmental pollutions such as air pollution, noise pollution, water, land.
- The measures recommended includes afforestation, efficient tools and machineries, providing safety gears to workers, monitoring and control, etc.

Analysis and Outcome

M/s Adhunik Cement Limited (ACL), a subsidiary of Adhunik Group (AG) undertakes to produce 2.0 MTPA limestone from 128.52 Ha mining lease area located at Umsoo-Mootand Area, Thangskai village, Jaintia hills district, Meghalaya state. This mining lease is the captive limestone mine for the cement plant of 1.33 MTPA clinker capacity. The recommendation of the Environmental Impact Assessment is fully implemented also environmental clearance for the cement plant has been obtained from the Ministry of Environment and Forest, New Delhi.

Study Title

Environmental Impact Assessment Report: Detailed Design Consultancy of All Structures Including Tunnels, Bridge/Viaduct, and Associated Works and Construction Supervision of Tunnels (T-1 & T-2) & Bridges (Br. 2 & Br. 3) Between Km -0.386 to Km 6.113 in Connection with Construction of Sivok (West Bengal) to Rangpo (Sikkim) New Single Line BG Railway Line Project.

Implementing Institution

Detailed Design Consultancy
D2 Consult International GmbH

Project Location/Completion Year

Sikkim, 2016

Objective

Detailed Design Consultancy of all structures including Tunnels, bridge/viaduct, and associated works and Construction Supervision of Tunnels (T-1 & T-2) & Bridges (Br. 2 & Br. 3) between Km -0.386 to Km 6.113 in connection with Construction of Sivok (West Bengal) to Rangpo (Sikkim) New Single line BG Railway Line Project. As a part and parcel of the study an Environmental Impact Assessment Study was carried out for the proposed activities along with Environmental Management Plan has been formulated for the project to implement the project in a more environmental friendly manner.

Study Recommendation

- Encourage good management practices through planning and commitment to environmental issues concerning any project
- Provide rational and practical environmental guidelines that will assist in minimizing the potential environmental impact of activities
- Combat all forms of pollution through monitoring air, noise, land, water, waste, energy and natural resources Protection of sensitive and endangered flora and fauna
- Prevent land degradation. Adopt best practicable waste management for all types of waste (liquid and solid) with objective on prevention, minimization, recycling, treatment or disposal of wastes
- Train and bring awareness to employees and contractors with regard to environmental obligations and compliance.

Analysis and Outcome

The present study assess to ensure that decision makers consider the environmental impacts while deciding whether or not to proceed with the Northeast Frontier Railway (NFR) construction of the North Bengal-Sikkim Railway Link, a 52.7km stretch of track that will connect Sivok, North Bengal, to Rangpo, Sikkim. The rail link will pass through the steep terrain of the Kanchenjunga mountain range foothills and the Tiesta river valley; in addition 85% of the route will pass through tunnels. The study assessment shows that freight through rail will ensure safe, voluminous of goods movement which will boost economic. Over the entire proposed project would give a positive impact to the entire area not limited to the two villages. The local environment will also improve and would give an economic boost. The railway development projects serves as an important employment generator and provide huge direct and indirect employment opportunity during construction period and operation period. The transportation by road leads to consumption of fuel which ultimately leads to air pollution. The rail connectivity in the Siliguri and Rangpo region will reduce the traffic load on roads, which will reduce the air pollution in the area. The present proposed rail link will be environmental friendly option of transport. The recommendation of the study is fully implemented.



Study Title

Environmental Impact Assessment and Management Plan for Teesta Stage-IV H.E. Project Sikkim

Implementing Institution

Centre for Inter-Disciplinary Studies Of
Mountain & Hill Environment

Project Location/Completion Year

Sikkim, 2014

Objective

- Carry out the Comprehensive Environmental Impact Assessment (EIA) for the proposed Teesta Stage-IV HE project
- To prepare various mitigative plans and also to meet the Environmental clearance criteria of Ministry of Environment and Forests, Government of India.

Study Recommendation

- Implementation of biodiversity conservation management plan, catchment area treatment plan, resettlement and rehabilitation plan, muck disposal plan, fishery development plan, disaster management plan, solid waste management plan and some other important plans.
- These plans would ameliorate the condition of the environment that is likely to be resulted due to adverse impacts anticipated due to the development of the proposed project and also bring in socio-economic development of the region.

Analysis and Outcome

The project has been allotted to NHPC Ltd on build, own, operate basis. The State will get 12% free power from the project, during the entire life of the Project. The Project is the 3rd project awarded to NHPC, other two being 510 MW Teest-V HEP and 60 MW Rangit-III HEP. The proposed dam of the Project is to be constructed across Teesta river downstream of confluence of Teesta and Runchu near Chanday and Hee Gyahthang villages in North Sikkim. The proposed Dam is located near the confluence of Det Khola and Teesta river under Gor-Taryong Block in North Sikkim. The Project has obtained the Environment and Forest (Stage-I) clearances and is awaiting clearance from National Board of Wild Life, Govt. of India ^[174].

Study Title

Environmental Impact Assessment Report: Common Effluent Treatment Plant (CETP)

Implementing Institution

Shri Environmental Technology Institute

Project Location/Completion Year

Tripura, 2018

Objective

To establish 1000 KLD capacity Common Effluent Treatment Plant (CETP) at Tripura Mega Food Park

Study Recommendation

- Effective implementation of environmental policy of the SMFPL. Collection of information from regular monitoring and create a database
- To prepare and recommend annual budgetary provision for environment management program to the management so as to have proper allocation of the funds.
- Reporting of any non-compliance in respect of environment management system observed at site and suggesting suitable corrective measures for the same immediately to the management.

Analysis and Outcome

The present study highlights the Common Effluent Treatment Plant (CETP) M/s. Sikaria Mega Food proposes to establish with 1.0 MLD ultimate capacity for treatment and disposal of industrial effluent from its member units. The CETP was designed for effluent generated from food industries located in of Tripura Mega Food Park Premises. The recommendation of the study is fully implemented. It is further added that M/s. Sikaria Mega Food is one of the MoFPI (Ministry of Food Processing Industry, Government of India) assisted Mega Food Parks ^[178].



Study Title

EIA / EMP Report on Extraction of Sand from Gomati River, Tripura

Implementing Institution

Techno Environ Engineers

Project Location/Completion Year

Tripura, 2016

Objective

- To describe the ecological conditions of the study area more vividly,
- To prepare habitat wise vegetation profile,
- To prepare the floristic checklist of the study area,
- To prepare a checklist of the faunal composition of the study area,
- To estimate the primary and secondary productivity of the water bodies of that area.

Study Recommendation

- Proponent will undertake awareness program and community activities like health camps, medical aids, family welfare camps etc.
- Comply with all applicable safety, health and environment laws and regulations. Enhance Safety, Health and Environment (SHE) awareness among employees and through effective communication and training
- Investigate all workplace incidents and illness in order to promptly correct any unsafe conditions or practices

Analysis and Outcome

The environmental management is being integrated into the process of mine planning to maintain ecological balance of the area and minimized adverse effects. The Environmental Management Plan (EMP) consists of a set of monitoring programme, mitigation measures, and management control strategies to minimize adverse environmental impacts. In order to minimize impacts of mining on different environmental parameters and to keep air and water quality within prescribed limits of CPCB, the EMP was prepared. The study recommendations were fully implemented during the different phases of the project.

Study Title

Study of Environmental Impact Assessment of Bodhgunj Nagar Industrial Growth Centre

Implementing Institution

National Environmental Engineering
Research Institute, NEERI

Project Location/Completion Year

Tripura, 2013

Objective

To assess the environmental impacts due to the existing Bodhjunnagar Industrial Growth Centre.

Study Recommendation

- Preference should be given for employment of the local people during industrial activity taking place which will secure the economic life of the unemployed population.
- Communication with the local community should be institutionalized & done on regular basis by the project authorities to provide as opportunity for mutual discussion.
- Create various awareness campaigns in the community, specially related to basic health, hygiene and sanitation.
- Vocational training programmes must be organized for the local people that may develop their capacity and skills and will be helpful for them in getting more employment opportunities.
- Protection of persons against dust emissions during industrial activity and transportation activities. Welfare activities such as organizing medical check-up camps and extending facilities to local population must be undertaken

Analysis and Outcome

The Environmental Impact Assessment study was carried out by NEERI (National Environmental Engineering Research Institute (NEERI), Kolkata Zonal Centre, Kolkata, for Tripura State Pollution Control Board, Agartala under its Minimum Work Programme (MWP) for Bodhjunnagar Industrial Estate in Agartala. EIA study was undertaken for various components including air, water, noise, soil, biological and socio-economic environment which may be affected and to prepare Environmental Management Plan (EMP) for mitigating the adverse impacts. The study incorporates baseline data, prediction, evaluation and delineation of appropriate environmental management plans. About 80% of the land has been allotted and Industrial Houses from all over India and substantial number of industries are presently operational. The Bodhjunnagar industrial estate (BIE) is the largest industrial estate of Tripura, with an area encompassing 238.53 acres (96.53 ha). The different types of industries which have been developed within BIE are Electrical & Electronic, Pharmaceutical, Rubber, Chemical, Rice Mill, Cement, Ispat, Spice, Cold Storage, Food Processing, Brick kiln, Tobacco, Fertilizer, Pesticides, Grill & Steel Fabrication, Glass, Stone Crusher, Oil & Flour mill, Brewery etc. The industries are surrounded by villages. The villages are within the 10 km radius of Bodhjunnagar Industrial Estate (BIE). The recommendation outlines in the study are feasible and generic in nature. The implementations of such recommendations are regular activities which are being carried out by stakeholder on regular basis.



Study Title

Environmental Assessment of North East Rural Livelihood Project (NERLP)

Implementing Institution

Consulting Engineers Services (India) Limited. New Delhi

Project Location/Completion Year

More than one state, 2011

Objective

- To mitigate any possible adverse environmental impacts of the proposed livelihood activities by adopting better management of natural resources.
- To ensure that all promoted activities meet the regulatory requirements (Acts, Laws, Policies and Regulations of the concerned State Governments, Govt. of India as well as the Safeguard Policies of the funding agency i.e. World Bank).
- To promote only environmental friendly livelihood activities under "NERLP".
- To build capacity of the community institutions as well as the "NERLP" project functionaries to enable them to efficiently implement the provisions of the EMF.

Study Recommendation

- The Executing Agency to setup one Regional Project Management Unit (RPMU) at regional level i.e. for the entire project followed by four State Project Support Units (SPSUs) in each project State for smooth and effective implementation of "NERLP" and ensure effective implementation of EMF.
- Simplified process for environmental appraisal
- A plan and tool for internal monitoring have been designed to assess implementation mitigation measures as well as to capture cumulative impact at the village environmental level by the NERLP staff and external audit twice during the project period.
- The EMF also details proactive strategy to promote environment friendly activities.
- EMF has put thrust on capacity building of the beneficiaries for environmental friendly activities through appropriate training and IEC to raise awareness about ill effects of shifting cultivation which is a major cause of environmental degradation. Besides there is a provision of capacity building of EMF implementation staff for monitoring of the activities.

Analysis and Outcome

The Government of India through DoNER has initiated the "North East Rural Livelihoods Project" for four North-Eastern States viz., Mizoram, Nagaland, Sikkim and Tripura. The study was undertaken to improve rural livelihood especially women, unemployed youth and the most disadvantaged in these states. It was implemented in 2 Districts of Mizoram, Nagaland and Tripura and 3 Districts of Sikkim to increase and sustain income generation. The EMF was integrated in the study in order to ensure that any potential adverse environmental impacts due to the activities/schemes are adequately addressed. All the recommendations of the environmental assessment study were successfully implemented.

Study Title

Meghalaya Community Led Landscape Management Project – Environmental Management Framework

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2017

Objective

To strengthen community-led natural resources management in selected landscapes in the state of Meghalaya.

Study Recommendation

- The EMF outlines environmental guidelines (EGs) based on the typology of interventions, such as (i) springshed catchment treatment, and community water management (ii) soil and water conservation (iii) afforestation and vegetative cover improvements (iv) land productivity management and (v) community forestry/agroforestry activities.
- There are cross cutting issues, for which irrespective of the typology of investment, if not managed appropriately could lead to environmental impacts, for this purpose, EGs have been developed for (i) forest fire control (ii) Management of pollution sources (iii) management of archaeological 'chance finds' (iv) environment health and safety management measures (v) management of natural, cultural heritage sites, and undertaking eco- tourism activities.

Analysis and Outcome

The environmental management is a tool that study the interaction and impact of anthropogenic activities on natural resource and environment. This kind of study is very useful in identifying the possible impact of humans on the environment so that the impact could be mitigated and environment could be conserved [133]. The major objective of this project was to involve the community for the proper management of natural resources. The study recommended several important points to achieve the targets which were very essential. The analysis of the report found that the recommendations were considered seriously for the mentioned cause. The work on water management, soil and water conservation, afforestation etc. had been started but yet to be achieved. Currently, these works are under process and need to be continued in future also. The analysis of the report revealed that the recommendations of the projects were partially implemented.

Implementable recommendations:

- Community water management
- Soil and water conservation
- Afforestation and vegetative cover improvements
- Land productivity management
- Community forestry/agroforestry activities.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)



Study Title

Assessment of Population Structure and Regeneration Pattern of Most Preferred Food Plant Species of Hoolock Gibbons in Protected and Non-Protected Areas of Northeast India

Implementing Institution

North Eastern Regional Institute of Science and Technology

Project Location/Completion Year

Arunachal Pradesh, 2016

Objective

- To assess current population status of Western Hoolock gibbon with special reference to protected and non-protected habitats in Arunachal Pradesh
- To assess floristic and structural characteristics of Western Hoolock gibbon habitats and feeding behaviour and food preference analysis.
- To map distribution pattern of preferred food plant species of Western Hoolock gibbon to ensure their seasonal migratory pattern and distribution of population.
- To do niche modeling of food plants of gibbon to find out its alternative habitats to enable relocation and rehabilitation of fragmented population that required immediate protection and conservation.
- To assess and map anthropogenic impact on Western Hoolock gibbon and its habitats for formulation of sustainable conservation and management plans for future survival of species.

Study Recommendation

The major threats to *H. hoolock* in Arunachal Pradesh are forest degradation and habitat loss due to logging and conversion to agriculture. Habitat fragmentation in the lowland areas is also a concern, as it renders the remaining populations even smaller, leaving them more vulnerable to the other threats. Thus, conservation of *H. hoolock* in Arunachal Pradesh requires the following main mitigation measures:

- Enhance protection of identified forest blocks that hold large populations of the species.
- Reduction of fragmentation and conservation of remnant forest stands that are supporting gibbon population in the lowland areas.
- Strict filtering of developmental projects proposed in and around gibbon habitat.
- Hunting should be strictly banned through regulation and law enforcement.
- Relocation/translocation of highly threatened group/population of gibbons in protected forest.
- Increase participation of local people in conservation programme of the species through awareness and education. Priority should be given to target villages by forest department where gibbons and other wildlife species are found for different eco-development schemes to ensure active participation and cooperation for achieving a larger conservation goal.

Analysis and Outcome

At a local level, the present study has developed a database on the present population status of *H. hoolock* for the National Park that can be used for the preparation of the effective future management plan. It will generate database on the list of food plants that the *H. hoolock* prefers annually and seasonally. This will also help in outreaching the importance of these food plants for the conservation of the gibbons with the help of the local communities. This study will enable assessment of the present state of the gibbon-dominated habitat in the Namdapha Park. In a wider national context, the result of the present study will be helpful to other research organization and the scientific world of the country towards understanding the distribution pattern of *H. hoolock* globally as well as the in Namdapha National Park.

This result will be a resource for the countywide research organizations in identifying and comparing their results with our results and also for habitat improvement in degraded habitat of gibbons in northeast India. This result will be a resource for the countrywide research organizations in identifying as well as comparing their results with our results. The recommendation of the study was partially implemented in developing conservation strategy for the gibbon habitat in collaboration with the local communities. Further, the study recommendations can be generalized for other regions/target groups to some extent.



Study Title

Cumulative Impact Assessment of Proposed Hydel Power Projects, Determination of Basin-carrying Capacity, and Landscape-level Biodiversity Management Plan

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

Arunachal Pradesh, 2015

Objective

- To assess the impact of 13 HEPs (Hydro Electric Projects)planned in the basin, ancillary industries/ activities, including influx of migrant workers, displacement of local Scheduled Tribes population etc., on local ecology and biodiversity
- To assess the ecological water flow at different places along Tawang river and its tributaries
- To prepare a biodiversity management plan at the landscape level for the river basin
- To prepare a 15–20 years perspective plan for the cumulative development of the TRB (Tawang River Basin)
- To assess the carrying capacity of TRB

Study Recommendation

Some of the key recommendations of the study were:

- The river basin would have at least 66% of its total geographical area under forest cover. Only 519.54 ha forest area will be diverted for construction of different project components.
- At least 40% of the main river length should be free-flowing i.e., free from any projects.
- A minimum distance of 1 km free-flowing river length between the two successive projects will be maintained.
- Being thinly populated, with a total population of 49,977, the influx of population in TRB at any given point of time would not exceed 15% of the original local population i.e., 57,474.
- Minimum level of water would flow in the river round the year required to maintain the river ecosystem structure, function and services, including flora and fauna in river, and the riverine and the adjacent terrestrial ecosystem structure and function.
- The seasonal flow dynamics of the river would be maintained, although at a much lower scale, to maintain the river ecosystem function and the adjoining riverine and terrestrial ecosystem functions. This would ensure the flow of existing ecosystem services, although in much reduced scale.
- All the existing forest/scrub areas should be managed and no more forests should be converted for other uses.

Analysis and Outcome

The Government of Arunachal Pradesh commissioned the North-Eastern Hill University (NEHU), Shillong for the study. NEHU involved other institutes such as IIT Guwahati, WWF Tezpur, Foundation for Revitalisation of Local Health Traditions (FRLHT), North Eastern Regional Institute of Science and Technology (NERIST), and experts representing alumni/former faculty of Wildlife Institute of India (WII), SACON (Salim Ali Center for Ornithology and Natural History), Geological Survey of India (GSI) and Indian Council of Forestry Research and Education (ICFRE), etc., in this exercise. The main coordinator of the study is Dr. S.K. Barik, Department of Botany, NEHU, Shillong, Meghalaya. According to the implementing agency and the study team as on date, the recommendations of the study was fully implemented, adding that the study recommendations can also be generalized to some extent for other regions/target groups.

Study Title

Cumulative Impact and Carrying Capacity Study of Subansiri Sub-basin Including Downstream Impacts

Implementing Institution

IRG Systems South Asia Pvt. Ltd

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

- To inventorize and analyse the existing resource base and its production, consumption, and conservation levels.
- To determine regional ecological fragility/sensitivity based on geo-physical, biological, socio-economic, and cultural attributes.
- To review existing and planned developments as per various developmental plans.
- To evaluate impacts on various facets of environment due to existing and planned development.

Study Recommendation

- Provide sustainable and optimal ways of hydropower development of River Subansiri, keeping in view of the environmental setting of the basin.
- Assess requirement of environmental flow during lean season with actual flow, depth, and velocity at different levels.
- Downstream impacts on Assam due to hydropower development in Subansiri Basin in Arunachal Pradesh.

Analysis and Outcome

The Lower Subansiri hydroelectric project being built on River Subansiri, a tributary of River Brahmaputra, on the border of Assam and Arunachal Pradesh, will be one of the biggest hydroelectric facilities in India. The construction of the mega hydropower project has been underway since 2005. The 2-GW hydropower station is being developed by India's state-run National Hydro Power Corporation (NHPC) with an estimated investment of ₹2.21 billion (Rs 203.7 billion). Mumbai-based Patel Engineering, a leading infrastructure and construction company, bagged 2000- MW Subansiri Lower Hydro Electric Project, a run of river scheme on River Subansiri, at Rs 1,564.42 crores.

An evaluation and review by South Asia Network on Dams, Rivers, and People found the present study far from satisfactory. According to the evaluation, the study has not done proper cumulative assessment on most aspects. It has not even used information available in public domain on a number of projects. It seems totally unaware of the history of the environmental mis-governance in the Subansiri Basin. Basic information is lacking. Considering the track record of Central Water Commission (CWC) functioning as a lobby for big dams, such a study should have never been given to it. One of the reasons the study was assigned by the EAC (Expert Appraisal Committee) to the CWC was that the CWC is supposed to have expertise in hydrological issues, and also can take care of the interstate issues. However, CWC did not conduct the study. It was done by consultants hired by CWC. Thus, CWC seems to have no role in this except hiring a consultant. So the basic purpose of giving the study to CWC by EAC has not been served. Second, right consultant was not chosen by the CWC [40]. This study cannot be useful as Cumulative Impact Assessment and it may be better for EAC to ask the MoEFCC for a more appropriate body to do such a study. In any case, the current study is not of acceptable quality [41]. The implementation status of the cumulative impact assessment study is not known, though the hydropower project is approved.



Study Title

Spatial Mapping of Habitat Distribution, Assessment of Population Status and Modeling of Conservation Strategies for Eastern Hoolock Gibbon (*Hoolock leuconedys*) in Arunachal Pradesh, Northeast India

Implementing Institution

North Eastern Regional Institute of Science and Technology

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

- To assess current population status of Eastern Hoolock gibbon with special reference to protected and non-protected habitats in Arunachal Pradesh.
- floristic and structural characteristics of Eastern Hoolock gibbon habitats and feeding behaviour and food preference analysis.
- To map the distribution pattern of preferred food plant species of Eastern Hoolock gibbon to ensure their seasonal migratory pattern and distribution of population.
- To do niche modeling of food plants of gibbon to find out alternative habitats for gibbon for relocation and rehabilitation of fragmented population that required immediate protection and conservation.
- To assess and map anthropogenic impact on Eastern Hoolock gibbon and its habitats for formulation of sustainable conservation and management plans for future survival of species.

Study Recommendation

- Enhance protection of identified forest blocks, which hold large populations of the species.
- Reduction of fragmentation and conservation of remnant forest stands, which are supporting gibbon population in the lowland areas.
- Strict filtering of developmental projects proposed in and around gibbon habitat.
- Hunting should be strictly banned through regulation and law enforcement.
- Relocation/translocation of highly threatened group/population of gibbons in protected forest.
- Increase participation of local people in conservation programme of the species through awareness and education. Priority should be given to target villages by forest department where gibbons and other wildlife species are found for different eco-development schemes to ensure active participation and cooperation for achieving a larger conservation goal.
- Develop an eco-tourism plan keeping gibbon as flagship species to alleviate poverty of local people inhabiting in and around identified gibbon habitats.
- A time-bound definite plan is a must for periodic monitoring of the gibbon habitats and their populations to assess the population dynamics.
- A massive afforestation programme should be started in identified abodes of hoolock gibbons to improve canopy connectivity and other welfare factors.

Analysis and Outcome

The major threats to *H. leuconedys* in Arunachal Pradesh are forest degradation and habitat loss due to logging and conversion to agricultural land. Habitat fragmentation in the lowland areas is also a concern, as it renders the remaining populations even smaller, leaving them more vulnerable to the other threats. Thus, the study recommended the above main mitigation measures for conservation of *H. leuconedys* in Arunachal Pradesh. The study recommendations were only partially implemented due to financial constraints. There is no significant impact of the study. The recommendations can be better implemented upon close coordination among various government departments, more engagement of social institutions (such as NGO, SHGs). The recommendations can be generalized for other regions/target groups to some extent.

Study Title

Floristic Studies on Macrophytic Diversity of Nameri National Park (Assam) and Pakke Tiger Reserve (Arunachal Pradesh)

Implementing Institution

Guwahati University

Project Location/Completion Year

Arunachal Pradesh, 2011

Objective

- To survey plant inventory for the proposed area and related traditional knowledge system associated with the biodiversity
- To classify the species on the basis of (a) Conservation status and (b) Ethno botanical and other uses
- To categorize the species on the basis of their habitat preferences

Study Recommendation

- The study recommends that natural ecorestoration in Nameri National Park and Pakke Tiger Reserve need catalytic care
- The future research, protection, and eco-development with the assistance of modern technology and unique regional design must go parallel for immediate preservation of the unique rich biodiversity of Nameri National Park

Analysis and Outcome

The study dealt with the macrophytic vegetation of Nameri National Park (Assam) and Pakke Tiger Reserve (Arunachal Pradesh). Nameri National Park and Pakke Tiger Reserve (are situated in the foothills of the Eastern Himalaya. Extensive field survey of Pakke Tiger Reserve and Nameri National Park was carried out from December, 2008 to November, 2011.

A total of 557 macrophytic species were recorded from this area belonging to 124 families, representing a high diversity of macrophytes prevailing therein. Among them 428 species belong to dicotyledones, 103 to monocotyledones, 25 to pteridophytes and 1 species of gymnosperm. The habited structure shows that during the study period, a total of 32 species are recorded under RET categories. Out of which, 9 are critically endangered, 8 are endangered, and 15 are vulnerable based on available literature. Fifteen spp are categorized as RET plants, which have been assessed by following Red Data Books of Indian Plants and IUCN Red List categories and Criteria. A total 39 species of wild edible fruits was recorded belonging to 29 genera and 20 families. Most of the plant species of NNP and PTR have economical and medicinal properties. A total of 40 species are used to cure 18 ailments. A total of 37 species are timber-yielding plants categorized under either Class I or Class II Timber. Another 9 species are fish poisoning plants and 46 are fodder plants. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change
- Ministry of Ayush



Study Title

Inventorization of Plant Diversity of Borail Wildlife Sanctuary, Assam

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2019

Objective

Inventorization of plant diversity of Borail wildlife sanctuary, Assam and demonstration of Foldscope microscope among the students.

Study Recommendation

The study has recorded and identified several new plant species for the first time from Borail wildlife sanctuary.

Analysis and Outcome

The present study covered a broad sector on plant diversity study and awareness programme. Some of the outcomes of the study are a total of 472 species under 353 genera from 127 families were recorded and identified from the Borail Wildlife Sanctuary. Out of 127 families, monocot and dicot comprise 29 and 98, respectively. Out of 353 genera, monocot and dicot comprise 83 and 270 respectively, and out of 472 species, monocot and dicot comprise 112 and 360 respectively. Out of the total 472 angiosperm species, 119 are herbs, 142 are trees, 75 are shrubs, 66 are climbers, 13 are lianas, 4 are palms, 18 are grasses, 19 are sedges, 3 are canes, 4 are epiphytes, and 7 are bamboo species. The study objective and recommendation are fully implemented.

Study Title

Evaluation of Assam Project on Forest and Biodiversity Conservation (APFBC) Followed by Drafting of Phase II of the Project

Implementing Institution

AFC India Ltd.

Project Location/Completion Year

Assam, 2018

Objective

To assess whether project components delivered desired outcomes and outputs as per project design/ logical framework and list of indicators that have been established by the AfD and the Assam Forest Department for the project.

Study Recommendation

- Project Management and Planning: design results-based project management framework to allow better project performance; decentralized participatory planning process; participation of all concerned stakeholders in all phases; social and public audits at different levels; assess risks and develop a mitigation plan
- Forest Department Institutional Strengthening and Legal Reforms: to identify a source of funding to cover and sustain the recurrent costs to minimize financial burden on the FD; to strengthen vertical and horizontal coordination for legal reforms.
- Multi-level strategic planning: use the FMIS platform for regular reporting and monitoring of APFBC phase 2
- Sustainable Forest Management: more synergy and coordination is necessary with other similar initiatives such as – CAMPA, etc.; JFMC.
- Adding value and opening markets/opportunities: to assess the market and the supply chain as well as undertake cost-benefit analysis and consumption patterns to ensure the market and profits for the project beneficiaries; Various models including SHG/JLG, cooperatives etc. can be considered for promoting producer-centric approach.
- Process Recommendations for implementation of phase II:
 - » Project Design: Develop Project Logical framework with measurable indicators to assess before and after situation of the project.
 - » Start-up: Ensure participation of stakeholders at all phases of the project to ensure ownership and accountability at all levels.
 - » Implementation: Develop detailed project plan and monitoring system including systematic reporting system to ensure proper project performance and appraisal.



Analysis and Outcome

The various anthropogenic activities, land-use pattern, deforestation and climate change is decreasing the biodiversity at every minute. There is an urgent need to work on such project to conserve forests and biodiversity. The current project was also aimed at conserving the forest and biodiversity. The recommendation of the report is appreciable as it recommended to design results-based project management framework for the better performance of the project. The next recommendation of the project was to identify the source of funding to minimize the burden on the forest department, which is also an important part of the project. The report focused on using the FMIS platform for the regular reporting and monitoring of APFBC phase 2 so that the conservation target could be achieved. It was recommended to establish more synergy and coordination with other similar initiatives such as – CAMPA, etc.; JFMC. The current report also emphasized on the development of Logical framework with measurable indicators so that the situation of the project could be assessed. All the recommendations of the report are highly appreciable and must be implemented for the conservation actions.

Implementable recommendations:

- Project Management and Planning
- Forest Department Institutional Strengthening and Legal Reforms
- Multi-level strategic planning
- Sustainable Forest Management
- Process Recommendations for implementation of phase II

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)

Study Title

Sacred Groves of Assam: Biodiversity Status and Strategies for Their Conservation

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2017

Objective

- Inventory of sacred groves of Assam
- Study on floristic diversity, community structure and regeneration status of sacred groves
- Investigation of the biodiversity value and status of the sacred groves
- Finding of underlying factor of degradation, and
- Data base management and formulation of conservation strategies of the sacred groves of Assam

Study Recommendation

- Some of the sacred groves of Assam are rich in floristic diversity, however, they need regulatory measures and attention for sustaining their richness. At the same time, immediate action is required to restore the threatened and degraded sacred groves.
- Some of the important sacred groves having dense natural vegetation may be earmarked as protected sites'' and promote sustainable eco-tourism.
- Particularly Temple groves are at threat of degradation due to various anthropogenic activities. The cutting of trees has been observed in the Temple groves in spite of having traditional beliefs and taboos.

Analysis and Outcome

Sacred groves are patches of primeval forest that have special religious importance to a particular culture. It has a great value being rich in medicinal plants and biodiversity. Thus the conservation of sacred groves can play an important role in wildlife conservation. The enhanced anthropogenic activities led to loss of sacred groves. The sacred groves are dedicated to specific deities. Socheng, Chinthong, Langsomepi, Linchika are a few famous sacred groves of Assam [45]. The current study was based on the status of biodiversity in sacred groves of Assam and finding possible measures to conserve them. The recommendation of the report is partially implemented. The study recommended implementing urgent regulatory measures to restore degraded sacred groves. Most of the sacred groves have become threatened, therefore there is an urgent need to take immediate action to restore them. The present report recommended declaring some sacred groves as protected sites and promoting ecotourism for conservation purpose. In addition, the temple groves are also being threatened because of continuous anthropogenic activities such as cutting of trees. The conservation of sacred groves has the potential to conserve the biodiversity.

Implementable recommendations:

- Implementation of regulatory measures and attention for sustaining the richness of sacred groves
- Declaration of sacred groves as protected sites and promotion of ecotourism
- Reduction of anthropogenic activities in temple groves.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- National Biodiversity and Strategy and Action Plans



Study Title

Biodiversity Studies at Kaziranga National Park, Assam, India

Implementing Institution

Bombay Natural History Society

Project Location/Completion Year

Assam, 2016

Objective

- Establish baseline data and survey protocols for future biodiversity monitoring.
- Establish sound, repeatable field methods appropriate for local conditions.
- Establish rigorous methods for collection and management of data and specimens, including the production of high quality photographic documentation with use of cameras.
- Identify the vegetation types at community level.
- Benchmark floral diversity and its distribution.

Study Recommendation

- Long-term examination of spatial and temporal dynamics of the landforms and related ecosystems of KNP is essential with respect to developing management practices for conservation of biodiversity of the park. Building databases on floristic diversity in terms of species, habitats, ecosystems with reference to status, pressures, and also in regard to changing climate can be used as an effective tool in resource management.
- Identifying, monitoring and protecting populations of threatened plant species can be incorporated in the Habitat management strategies for Kaziranga. The present status in terms of exact location with GPS co-ordinates, population density, regeneration capacity are required to be worked out to formulate the conservation strategy of these threatened plant taxa.
- Identification of keystone species for different eco-zones with a perspective of developing strategies for eco-restoration, research on the sensitivity of the endemic taxa to probable change can be undertaken.
- Similarly, problems of invasive species, intensity of diseases of wild flora due to changing climatic conditions are some issues which need to be addressed.
- Plantation and ecorestoration programmes may be initiated with appropriate selection of species in relation to ecoregion/ agro-climatic zones for reclamation of degraded forest lands and riparian sites. In riparian areas plantation of bamboo and various species of grasses can be undertaken to check the erosion.
- Capacity building of the forest staff for monitoring vegetation dynamics within KNP will be helpful to further manage the park by developing habitat-specific conservation strategies.

Analysis and Outcome

Kaziranga is a national park in the Golaghat, Karbi Anglong and Nagaon districts of Assam. It is known for two-third of the world's rhino population. Kaziranga is also one of the World Heritage Sites. In addition to this, it comprises huge population of different animals. It has a great biodiversity. The study was aimed at establishing a baseline data and survey protocols for future biodiversity monitoring. It was based on the identification of types of vegetation and benchmarking of floral distribution, establishing, rigorous methods for collection and management of data and specimens, and production of high-quality photographic documentation. The objectives of the current study were very important for the conservation of biodiversity in Kaziranga National Parks [49]. The report recommended to build databases on floristic diversity in terms of species, habitats, ecosystems with reference to status, pressures and changing climate which can be used as an effective tool in the management of resource. It recommended the identification, monitoring and protection of threatened populations of the National Park. The exact location with GPS co-ordinates, population density, regeneration capacity were recommended to be worked out for the purpose of conservation. The identification of the key stone species in the ecosystem can help in managing the existing ecosystem. The problems of invasive species and increasing diseases to the plants and animals due to changing climate were also recommended to be addressed. Plantation and eco restoration programmes were also recommended for reclamation of degraded forest lands and riparian sites. The recommendation also forced on capacity building of the forest staff so that they can monitor the vegetation dynamics within KNP. Such initiatives will be helpful to further manage the park by developing habitat-specific conservation strategies. All the recommendations were given for the conservation purpose. The recommendations of the report were partially implemented.

Implementable recommendations:

- Building databases on floristic diversity
- Identification, monitoring, and protection of threatened populations of the National Park
- Exact location with GPS co-ordinates, population density, regeneration capacity
- Identification of the keystone species in the ecosystem
- Invasive species and increasing diseases to the plants should be addressed
- Plantation and eco restoration programmes
- Capacity building of the forest staffs

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- National Biodiversity and Strategy and Action Plans



Study Title

Documentation, Collection and Preservation of Biodiversity of Tezpur University

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2016

Objective

The main objective of the study is to preserve the rich biodiversity in the vicinity of Tezpur University, Assam through a systematic documentation and collection.

Study Recommendation

Recommendation has not been outlined in the report.

Analysis and Outcome

Variation in different kinds of life present on the earth's surface is known as biodiversity. There is a huge number of species present on the earth with huge number of individuals having variations. The total number of species present was 13.7 million, out of which 85% have been disappeared because of mass extinction and anthropogenic causes [51]. The rate of biodiversity loss is at an alarming state which plays an important role in ecosystem maintenance. The biodiversity is also a potential source of food, fodder, medicines, habitat, and various essential things. Therefore, the conservation of biodiversity is an urgent need of the present era. The major objective of the present study was identification, documentation, and conservation of the existing biodiversity of Tezpur University. The recommendation in the present study was missing. The possible recommendations might be identification and proper documentation of the biodiversity and adaptation of strong measures to conserve the biodiversity. Several similar studies have been done in the northeast to conserve the biodiversity. Roy et al., have studied the biodiversity and its conservation in the Northeast India (Roy et al., 2015).

Implementable recommendations:

- Documentation of the biodiversity
- Adaptation of strong measures to conserve the biodiversity

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- National Biodiversity and Strategy and Action Plans

Study Title

Studies on Contribution of Agroforestry Systems in Wildlife and Biodiversity Conservation in Northeast India

Implementing Institution

North Eastern Regional Institute of Science and Technology

Project Location/Completion Year

Assam, 2016

Objective

- Seasonal inventory of vertebrates and invertebrate species occurring in different selected agroforestry systems with special reference to small mammals, bird, amphibian and reptiles.
- Assess the key features of agroforestry systems such as plant species composition, fruiting pattern, planting design, management practices, landscape position, microclimatic condition which is the most critical part of habitat for supporting wildlife biodiversity.
- Documenting the people's attitude towards presence of wildlife species in their agroforestry system with special emphasis on conservation.

Study Recommendation

- There should be promotion and maintenance of biodiversity in agroforestry in the region.

Analysis and Outcome

The land-use system which integrates trees and shrubs on farmlands and rural landscapes for enhancing productivity, profitability, diversity and ecosystem sustainability is called Agroforestry system. Agroforestry provides suitable habitat, preserves the germplasm and reduces the rate of conversion of natural habitat [50]. Thus it helps in the conservation and increase of biodiversity very effectively. The aim of the study was to identify species richness by developing a seasonal inventory of vertebrates and invertebrates species occurring in different selected agroforestry systems with special reference to small mammals, birds, amphibians and reptiles. In addition it was also targeted to assess the key feature of agroforestry such as plant species composition, fruiting pattern, planting design, management practices, landscape position, and microclimatic conditions which are the most critical part of the habitat for supporting biodiversity. It also encouraged the attitude of the local people towards the role of agroforestry in the conservation of biodiversity. The report of the study recommended to take action for the promotion and maintenance of biodiversity in agroforestry. The suitable measure can help in enhanced conservation of biodiversity by following the agroforestry system. The recommendation of the study has been implemented and the work was also documented by Singh et al., 2021.

Implementable recommendations:

- Action for the promotion and maintenance of biodiversity in agroforestry.
- Promotion of agroforestry system.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- National Biodiversity and Strategy and Action Plans



Study Title

Fish Faunal Diversity, Habitat Ecology and Their Conservation Issues of Upper Reaches of Manas River System, Bodoland Territorial Area District, Assam

Implementing Institution

Gauhati University

Project Location/Completion Year

Assam, 2015

Objective

- To search the present status of fish community structure of upland area of the River, their diversity patterns in the distribution of different fish biodiversity components (seasonal plus altitudinal variation, taxonomic richness, endemism, taxonomic singularity and rarity) of Manas River system in Assam in its upper reaches.
- To analyze the state of habitat ecology, species diversity and possible influence on native fish fauna by exotic fish. Marking of fish specifically available in particular zone/location in different geographical area of the River. To study different indices of fish biodiversity management for formulating possible conservation strategies.
- To develop the inventory of fishing crafts and gear operated in the rivers to know its efficiency, mesh sizes and its impact on fish population.

Study Recommendation

- For conservation and management issues of the existing fish species (both plain and hills stream), diversified strategies is the prime need of the hour. These strategies may include halting of siltation, open cast sand mining, scientific fishing and control of water pollution. The harnessing, development and management of Manas River and its natural resources would contribute not only to economic development for rural society of the region, but also balancing of ecological integrity of the river system.
- Habitat restoration and development of sustainable management policy for comprehensive ecosystem based fisheries approach ensuring improved understanding and prediction of the linkages between fishes and their habitat, placement and characteristics with food web dynamics.
- Fish and Fisheries development and its restoration will strengthen nutritional, livelihood security and socio-economic condition of the fisher's community in particular and rural mass in general in Assam. Thus, more research is required to understand basin-wide threat mechanisms, interactions and scales of response.
- More investment is also required in monitoring and evaluation of the river ecosystem to determine the success of such efforts.

Analysis and Outcome

Manas River is a transboundary river in the Himalayan foothills between southern Bhutan and India. It is named after Manasa, the Serpent God in Hindu mythology. Royal Manas National Park of Bhutan and the Manas Wildlife Sanctuary are located in the Manas River valley. The Manas river flows through Bhutan and Assam in India before it joins the right bank of the Brahmaputra river. It is rich in flora and fauna. The major objective of the study was to identify the present status of fish community structure of upland area of the River, their diversity patterns in the distribution of different fish biodiversity components and analysis of the state of habitat ecology, species diversity and possible influence on native fish fauna by exotic fish and the marking of fish specifically available in particular zone/location in different geographical area of the River [57]. The identification of different indices of fish biodiversity management development of the inventory of fishing crafts and gear operated in the rivers were also its important objectives. The successful study of the current project recommended that the formulation of diversified strategies are essentials for solving the conservation and management issues of the existing fish species. The report further recommended to restore the habitat and develop sustainable management policy for comprehensive ecosystem based fisheries approach. The report also recommended to increase the research work related to threat mechanism, interactions and scales of response on the river basin. The recommendations made in the report were found to be implemented partially.

Implementable recommendations:

- Formulation of diversified strategies are essential for solving the conservation and management issues of the existing fish species.
- Restoring the habitat and developing a sustainable management policy for a comprehensive ecosystem-based fisheries approach.
- Increasing the research work related to threat mechanism, interactions and scales of response on the river basin

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board
- Ministry of Water Resources, River Development and Ganga Rejuvenation



Study Title

Ecology and Distribution of Nymphalid Butterflies in Nameri National Park and Chandubi Reserve Forest of Assam With Special Reference to Forest Disturbances

Implementing Institution

Guwahati University

Project Location/Completion Year

Assam, 2012

Objective

- Intensive studies to estimate the diversity & distribution of Nymphalid butterflies in disturbed and undisturbed (closed forest) forests of Chandubi Reserve Forest and Nameri National Park.
- Preference of butterflies for light & shade habitat in forest gaps and canopy covered area.
- To assess the impact of habitat disturbance on species range of geographic distribution and as well as species phylogenies (sub-family level).
- Determination of kinship among the species of subfamilies using marker enzymes, haemolymph protein & Karyotypic study.
- To establish a culture house for Nymphalid butterflies.

Study Recommendation

- Study has uncovered several new, rare and endemic butterflies, most of them were earlier thought to be present only in hilly terrain of Eastern Himalayan landscapes.
- The study also found that distant related species have close genetic characters, whereas, closely related species has distant genetic characters, an indication of strong possibility of speciation among butterflies of Northeast India.
- There is also a very good scope to study the impact of climate change on butterflies distribution and diversity.
- Furthermore, the total inventory of butterflies in the forest landscapes of entire Assam and northeast India will provide details picture of the diversity and distribution of butterflies and as well as other biodiversity component in various forest habitats and their impact of the present day habitat degradation.
- The population genetics and DNA bar-coding of selected slow moving and forest ground-dwelling butterflies will provide the real picture of species diversity that has been dating back of Pleistocene climate change in northeast India.

Analysis and Outcome

The diversity of butterfly is related to vegetation structure & canopy openness and that this relationship differs between butterfly taxa in relation to phylogenetic differences in shade preferences. The diversity of butterfly is higher in disturbed habitats or forest gaps than closed canopy or dense forests. Changes in diversity in degraded forest are associated with the loss of species having restricted geographical distributions. The current study was aimed at investigating the habitat pattern, diversity and distribution of Nymphalid butterflies in disturbed and undisturbed (closed forest) forests of Chandubi Reserve Forest and Nameri National Park. In addition to this, phylogenetic, Karyotypic and culture study for Nymphalid butterflies were also its objectives. Such kind of study is useful in conservation of biodiversity [79]. The study identified that the that distant related species have close genetic characteristics, whereas, closely related species have distant genetic characters which was an indication of strong possibility of speciation among butterflies of Northeast India. The study also revealed that the climate change had affected the distribution of butterflies to a large extent. The report of the study recommended to establish a total inventory of butterflies in the forest landscapes of entire Assam and northeast India. The analysis of the report concluded that the recommendations made were very essential for developing conservation measures for butterflies. It was found that all the recommendations of the report were implemented well. But such kind of studies should go on continuously as the anthropogenic activities are increasing day by day.

Implementable recommendations:

- Establish a total inventory of butterflies in the forest landscapes of entire Assam and northeast India
- Mitigation of climate

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)



Study Title

Assam Project on Forestry and Biodiversity Conservation

Implementing Institution

Cirad, Agricultural research and development

Project Location/Completion Year

Assam, 2010

Objective

- To restore forest ecosystems.
- To enhance the forest dependent communities' livelihoods.
- To ensure conservation and sustainable use of biodiversity.

Study Recommendation

Enhancement of key components of sustainability such as capacity building, transfer of technology at Assam, national and international levels, improved information sharing, infrastructure development

Analysis and Outcome

The protection of biodiversity is known as biodiversity conservation. It is performed by two means. In-situ conservation which is the protection of species within their natural habitat whereas the ex-situ conservation is the protection of biodiversity outside their natural habitat. The conservation of biodiversity is directly related to the forestry. The forestry should be done at a large level to conserve the biodiversity by providing additional safe habitat which is the main cause of loss of biodiversity. The objective of the current project was the restoration of the forest ecosystem, enhancing the development of the forest community's livelihood, and ensuring sustainable use of biodiversity. Such studies are very useful in investigating the level of threat due to afforestation and role of forestry in biodiversity conservation [82]. The report of the study recommended to enhance the key component of the sustainability such as capacity building program, transfer of technology at Assam, improved sharing of information. The analysis of the report identified that the recommendations of the study were very important for the conservation of biodiversity. It was found that the recommended points were implemented well.

Implementable recommendations:

Enhancing the key component of the sustainability

- Capacity building program
- Transfer of technology at Assam
- Improved sharing of information

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- National Biodiversity Authority

Study Title

Management of Manas Biosphere Reserve Through Biodiversity Evaluation in Gap Areas and Community Participation

Implementing Institution

Guwahati University

Project Location/Completion Year

Manipur, 2011

Objective

To survey plant inventory in eastern and western Buffer zones of Manas Biosphere Reserve Screening of rare, endangered and threatened plants and their ex-situ conservation. Community participation in conservation of biodiversity. Conservation awareness programmes in fringe areas.

Study Recommendation

- The preparation of a database of resources through satellite images and ground information is expected to provide know-how of the effective management for conservation of plants and fossils of Manas Biosphere reserve and sustainable utilization of resources with effective interaction of the forest officials and community participation on conservation programme with alternative livelihood.
- Interaction with the beneficiaries through personal contact and discussion for resources availability and regulation of bio-resources harvesting for conservation of forest.
- The result may be used for more Rhino introduction and preparation of elephant corridor in the Manas Biosphere Reserve.

Analysis and Outcome

Manas Biosphere Reserve is rich in biodiversity whose management is very necessary to conserve its richness. The present study was focused on surveying plant inventory in the eastern and western buffer zones of BR. The screening of rare, endangered and threatened plants and their ex-situ conservation as well as community awareness and their participation in conservation was also its prime objectives. This kind of study is very important for the conservation of biodiversity by screening different threatened categories [97]. The recommendations given here were satisfactory. It is recommended to prepare the database of resources using satellite images and ground information. It also recommended the sustainable utilization of forest resources. Community participation and awareness were also important recommendations. Personal contact to beneficiaries, availability of resources, regulations and harvesting of bioresources were few other recommendations. The analysis of the report observed that the recommendations made were essential for achieving the objectives. All the recommendations were completely implemented. Such recommendations and actions are needed to be in action every time for the conservation of biodiversity ^[98].

Implementable recommendations:

- Prepare the database of resources using satellite images and ground information
- Sustainable utilization of forest resources
- Community participation and awareness
- Personal contact to beneficiaries, availability of resources, regulations and harvesting of bioresources

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India
- National Biodiversity Authority



Study Title

Characterization of Community Reserves and Assessment of Their Conservation Values in Meghalaya

Implementing Institution

Sálim Ali Centre for Ornithology and Natural History (SACON)

Project Location/Completion Year

Meghalaya, 2020

Objective

- Identify, characterize and map the landscape elements and its components (flowering plants, herpetofauna, birds and mammals) of each community reserves in Meghalaya and assess its conservation values, based on identified biological, social and cultural attributes (criteria).
- Identify and characterize the key community institutions and other stakeholders who have a crucial role in the current system of natural resource management in the community reserve
- Conduct an analysis of various management issues/threats/challenges related to conservation and livelihood opportunities its intensity and spatial occurrence.
- Develop a comprehensive conservation plan in consultation with the local communities for each community reserves.

Study Recommendation

- The future plan of work includes the collection of data from other community reserves in the Garo Hills and Jaintia Hills on the similar aspects.
- The spatial database on each community reserve will be prepared based on the attribute data collected.
- The identification of species especially on plants and cryptic faunal group will also be carried out in the coming year.
- A presentation on each taxa will be carried out in the Annual Research Seminar of the Institute during July-August 2019.

Analysis and Outcome

The major objectives of the present study were identification, characterization and mapping of landscape of each community reserves and assessing its conservation values. Identification and characterization of stakeholders having crucial role in the natural resource management of community reserve were the main objectives. Such studies are urgently required for the conservation of protected areas so that the biodiversity can be conserved [99]. The report of the study recommended to collect the data from community reserves in Garo and Jaintia Hills. It stated that the spatial database on community reserve would be prepared on the basis of collected data attributes. From the next coming year, the plants and cryptic fungal groups will be identified and presented in annual seminar of the institute. The recommendations made were very essential which are needed to take action immediately. But as the study is very recent, no action has been taken yet.

Implementable recommendations:

- Collection the data from community reserves in Garo and Jaintia Hills

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- National Biodiversity Authority

Study Title

Preparatory Study on Project for Community-Based Forest Management and Livelihoods Improvement in Meghalaya

Implementing Institution

Meghalaya Basin Development Authority

Project Location/Completion Year

Meghalaya, 2019

Objective

To restore and conserve natural resources within the villages by sustainable forest management, livelihood improvement, and institutional strengthening, thereby contributing to conservation of environment, biodiversity, and uplifting of socio-economic conditions of people in the State of Meghalaya.

Study Recommendation

Recommendation has not be outlined in this report

Analysis and Outcome

The aim of the current study was the conservation of natural resources of villages using sustainable forest management and betterment of socioeconomic conditions of the people. Such study will help in the planning and implementing the practices for the stewardship and use of forests to meet specific environmental, economic, social and cultural objectives. It will help in dealing with the administrative, economic, legal, social, technical and scientific aspects of managing natural and planted forests [104]. The analysis of the report revealed that there were no recommendations given for the study. The possible recommendations might be creating awareness among local people about the conservation of natural resources and sustainable use of forest resources.

Implementable recommendations:

- Creating awareness about natural resource conservation
- Sustainable use of forest resources

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Forest Inventory of Sacred Groves of Meghalaya

Implementing Institution

Forest Resources Survey Division,
Government of Meghalaya

Project Location/Completion Year

Meghalaya, 2016

Objective

- Boundary mapping.
- Assessment of growing stock.
- Diameter class distribution of trees.
- Listing of all floral species including herbs.
- Shrubs and bamboo species in Sacred Groves of Meghalaya

Study Recommendation

Forest Inventory of 20 Sacred Groves has been done. For each grove different recommendations have been given along the line of:

- Protection from Biotic Interference
- Afforestation
- Fire control
- Water stress
- Awareness campaign
- Construction of natural boundary

Analysis and Outcome

The sacred grooves are undisturbed natural forest which have special religious importance. They play a very important role in the conservation of biodiversity. The main objective of the current study was mapping of boundary and assessing the stock, etc. The analysis concluded that this kind of study is beneficial for promoting the sacred grooves and conserving biodiversity [143]. The report of the study recommended several essential points such as afforestation, fire control, creating awareness and construction of natural boundary. The analysis of the report concluded that the recommendations of the report were feasible and important to achieve the mentioned targets. At present, all the recommendations were implemented completely but needed to be monitored regularly in future also.

Implementable recommendations:

- Protection from Biotic Interference
- Afforestation
- Fire control
- Awareness campaign
- Construction of natural boundary

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Evaluation study on plantation scheme under national afforestation programme for the last 10 years in Meghalaya

Implementing Institution

WAPCOS Limited

Project Location/Completion Year

Meghalaya, 2014

Objective

- Enlist active participation and involvement of local people for the protection of forests, wildlife and biodiversity and implementation of afforestation and aided regeneration schemes and forest based resource development programmes.

Study Recommendation

- Funding and timely release of funds to execute different activities or programme in right time.
- Training be provided to Joint Forest Management Committee (JFMC) members in different professions or activities.

Analysis and Outcome

The forest cover of Meghalaya shares a great part in the total forest cover of the country. In recent years, the forest cover has increased because of national plantation programme. The objective of this study was listing the active participation of people in afforestation programme and biodiversity conservation. This kind of study is useful in evaluating the governmental schemes such as National Afforestation Programme^[380]. The report of the study suggested essential recommendations. The analysis of the report revealed that the release of fund and training to the JFMC members was not done properly. Therefore, the recommendations were implemented partially.

Implementable recommendations:

- Timely release of fund
- Training to the JFMC members

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Study of Traditional Usage and Availability of Plants in Meghalaya

Implementing Institution

SENES Consultants India Pvt. Ltd / ENDEV-
Society for Environment and Development

Project Location/Completion Year

Meghalaya, 2014

Objective

Catalogue the plants that have been used traditionally in households of the local people, its availability and livelihood dependency of the local people.

Study Recommendation

- Efforts should be taken to propagate and cultivate the prioritized species through assisted natural regeneration
- The good practices of sustainable harvesting, post harvest handling and processing, storage for marketing, establishing the plants from the wild by propagating and cultivating them has to be properly documented.
- Further training and manuals have to be developed for capacity building in the long run.
- Need for a scientific study.
- Need for a market based research.
- A structured organization with defined roles and responsibilities has to be framed to sustainably harvest and market the wild plants.

Analysis and Outcome

The indigenous people of the state of Meghalaya - Khasi, Garo and Jaintia have utilized the vegetation in the forest for their subsistence from time immemorial. The inter generation passage of knowledge on the usage of the plants has been through oral rendition and informal training. Meghalaya is one of the few places in the country where vegetation has been so venerated that sacred groves have been assigned that have been barred from being totally utilized or partially utilized by the local inhabitants.

The present study catalogued plants that have been used traditionally for several purposes like food, fodder, veterinary medicine, medicines, building and ornamental plants. Twenty villages representing five agroclimatic zones across Meghalaya were selected for this study. An average of 25% households in each village varying from 20 to 50 of households was randomly selected for the survey. A questionnaire was framed to capture the responses of usage and availability of the plants. Further the perception of the villagers on the availability of the plants was captured and the reasons for change documented. The recommendations of the study were partially implemented; the study will have positive high impact in terms of employment generation, women empowerment, income opportunity, access to market/finance, and overall livelihood improvement of the indigenous community.

Agencies responsible for implementation:

- Ministry of Development for the North East Region
- Forests & Environment Department, Government of Meghalaya

Study Title

Integration of REDD+ in the Land Use Planning Activities of North Eastern States of India with Reference to the Mizoram State

Implementing Institution

Indian Council of Forestry Research and Education, ICFRE

Project Location/Completion Year

Mizoram, 2020

Objective

Analyse relevant existing land use policies and programmes of North Eastern states to explore the possibility for integration of REDD+ activities for sustainable land use planning with the goal to boost actions to curb emissions from deforestation and forest degradation and also to get the financial incentive.

Study Recommendation

The study indicates that REDD+ activities need to be integrated in the land use policies and programmes for achieving the objective of climate change mitigation and sustainable development.

Analysis and Outcome

The study has been conducted for integration of REDD+ in the land use planning activities of North Eastern states. The study used secondary data sources from published literature which includes states level policies and programmes, reports, articles, official websites, etc. Additionally, a field study was also undertaken in the state of Mizoram through stakeholder consultation process. Views of the relevant stakeholders and consultation of the published literatures were done to identify the suitable land use planning activities that can be integrated with the State REDD+ Action Plan of Mizoram to get the financial incentive and other benefits of implementation of REDD+ activities.

The establishment and strengthening of State REDD+ Cell in Mizoram State Department of Environment, Forest and Climate Change is an important approach which can coordinate and extend their support to synthesis approach for integration of REDD+ activities with the land use planning activities in the state of Mizoram. The recommendation of the study is fully implemented.



Study Title

Large-Scale DNA Barcoding Assessment of Snakes in Mizoram, Indo-Myanmar Biodiversity Hotspot, India

Implementing Institution

Mizoram University

Project Location/Completion Year

Mizoram, 2020

Objective

- Develop barcoding system along with taxonomical data for the study of snakes of Mizoram state.
- Measure snake species and phylogenetic diversity in Mizoram.

Study Recommendation

- Under the study, 62 snake species are identified belonging to eight families like Boidae, Colubriadae, Homolopsidae, Lamprophiidae, Natricadae, Pareidae, Typhlopidae, Elapidae and Viperidae. Some unidentified and misidentified species are resolved through molecular analysis.
- Further study on a new genus and species of natricine snake, *Smithophis atemporalis*, and *Rhabdops bicolor* in their ecological role for their conservation has been recommended.
- The first albinistic or leucistic Checkered Keelback and dicephalism in Spot-tailed Green Pit-viper were reported from the state of Mizoram. This encourage more surveying of anomalies on reptiles in the area that will be very important for documentation and further study in future.

Analysis and Outcome

A detail morphometric and meristic characters of 279 individuals were studied from the total collection of snakes from different parts of Mizoram. Some specimens were catalogued and preserved in 70% ethanol in the Departmental Museum of Zoology, Mizoram University. These records include 63 species belonging under eight families like Boidae, Colubridae, Homolopsidae, Lamprophiidae, Natricidae, Pareidae, Typhlopidae, Elapidae and Viperidae. For developing barcoding system along with taxonomical data for the study of Snakes of Mizoram state a systematic survey was carried out on quarterly basis for the selected species of snakes from Mizoram. Specimens were collected based on both random as well as systematic survey. The objective of the present study was fully achieved. As per the study team the impact of the study could not be ascertained due to time constraints while the recommendations were partially implemented.

Study Title

Forest Carbon Stocks of REDD+ Project Area in Mizoram: Baseline Report

Implementing Institution

Indian Council of Forestry Research and Education, ICFRE

Project Location/Completion Year

Mizoram, 2018

Objective

Generate the baseline information of forest carbons stocks of the REDD+ pilot area are under Mamit district of Mizoram.

Study Recommendation

- The forest carbon stocks was reported highest in East Himalayan moist mixed deciduous forest (1122.30 million tonnes) followed by Cachar tropical semi-evergreen forest (909.58 million tonnes) and secondary moist bamboo brakes (860.61 million tonnes) and pioneer euphorbiaceous scrub (23.55 million tonnes), respectively.
- The precise estimation of carbon stocks are vital to know the affect of various land use land cover change brought by developmental activities, forest fire, shifting cultivation and other drivers of deforestation and forest degradation in the REDD+ project pilot area.

Analysis and Outcome

The study can prove an effective step to explore the REDD+ initiatives along with the formulation of National REDD+ Strategy and Forest Reference Level for India. The forest based carbon stocks

permanence helps in achieving the long term climate change mitigation goals. This study will serve as a pioneer step in implementation of REDD+ activities in the project area to achieve the over arching objective of National REDD+ Strategy and will help in providing incentives to local communities through implementation of REDD+ activities. The precise estimation of carbon stocks are vital to know the affect of various land use land cover change brought by developmental activities, forest fire, shifting cultivation and other drivers of deforestation and forest degradation in the REDD+ project pilot area.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change



Study Title

Identification and Adoption of Appropriate Technology for REDD+ Implementation in Mizoram

Implementing Institution

Indian Council of Forestry Research and Education, ICFRE

Project Location/Completion Year

Mizoram, 2018

Objective

Identify the potential activities for addressing the drivers of deforestation and forest degradation which provides the ecological and economic benefits to the local communities.

Study Recommendation

The study recommends adaptation and implementation of technologies or activities such as agroforestry, shaded coffee plantations, improved cook stoves, solar energy to address the drivers of deforestation and forest degradation. It will also enhance the income of local communities which will eventually be helpful in implementation of REDD+ activities in the Mamit District of Mizoram.

Analysis and Outcome

The study has identified an appropriate feasible technology for the local communities which provide capability to improve the ecological and economic benefits. This includes improved cook stoves, solar energy, agroforestry and livestock management. Out of this, improved cook stoves scored maximum for adoption. Other technologies scored less due to the high implementation risk involved and less awareness in comparison to ICS.

The feasibility study showed that adoption and implementation of technologies/ activities of such as promotion of agroforestry, shaded coffee plantations, improved cook stoves, solar energy etc. can address the drivers of deforestation and forest degradation as well as enhance the income of the local communities which will eventually be helpful in implementation of REDD+ activities in the Mamit District of Mizoram. A total forest carbon stock of 2916 million tonnes was estimated from the pilot project site [156]. State REDD+ Action Plan has also been prepared to support implementation of National REDD+ Strategy and will also be helpful in obtaining result based payment and other social and environmental co-benefits for the state of Mizoram. The recommendation of the study is fully implemented.

Agencies responsible for implementation:

- Ministry of Environment Forest and Climate Change
- Department of Environment, Forests & Climate Change, Government of Mizoram

Study Title

Mizoram State REDD+ Action Plan

Implementing Institution

Department of Environment, Forests & Climate Change, Government of Mizoram

Project Location/Completion Year

Mizoram, 2018

Objective

The project aims at:

- Adoption of horticulture crops
- Sustainable energy supply
- Creating habitat mosaic for biodiversity conservation
- Livelihood improvement
- Forest fire control and management, -Market linkages for agriculture produce

Study Recommendation

- Sustainable cropping pattern and land management: Capacity building/ training on terracing/ contour and permanent farming system.
- Development of irrigation channels, Construction of vermi-compost/manure collection tank
- Awareness campaigns on agroforestry system.
- Development of nurseries to promote agroforestry and enrichment plantation, Selection of appropriate paddy varieties.
- Adoption of horticulture crops: Selection of appropriate cash crop varieties, Capacity building on plantation and management, Plantation of horticulture/cash crops.
- Creating mosaic habitat for biodiversity conservation: Jhumming in cluster, Identification and selection of sites, Financial and technical assistance, Establishment of eco-parks, nature trails and homestays. -Forest fire control and management: Plantation of fire-resistant tree species, Deployment of modern tools such as drones, GPS.
- Capacity building programmes for front line staff and communities, Land zoning and implementation relating to forest sector.

Analysis and Outcome

The study recommends a set of REDD+ intervention packages and their constituent activities, for each of these intervention packages feasibility and safeguard analysis were undertaken. The feasibility analysis involved analysing the risks and obstacles for implementation, and identifying risk mitigation measures to make them more cost effective. The safeguard analysis involved checking each intervention package for governance, social and environmental risks, and how to mitigate them, and was also necessary to meet the UNFCCC 'Cancun Safeguards'. It is also a first step towards being able to contribute to the national Safeguards Information System (SIS) which is a requirement of the UNFCCC for a national REDD+ programme. Another key step in developing the SRAP was developing the monitoring protocol; this involved setting quantitative targets for the outputs of each intervention package, and identifying indicators for their measurement. Finally a five year budget was developed for the intervention packages, which involved costing out all the implementation activities, including the monitoring activities.

State REDD+ Action Plan (SRAP) will enable implementation of India's National REDD+ Strategy in the state of Mizoram, and help obtaining results-based payment, social and environmental co-benefits under the international REDD+ mechanism. The recommendation of the study is fully implemented.



Study Title

Drivers of Deforestation and Forest Degradation in Mizoram

Implementing Institution

Indian Council of Forestry Research and Education, ICFRE

Project Location/Completion Year

Mizoram, 2017

Objective

Identify the drivers of deforestation and forest degradation was conducted in REDD+ project area of Mamit District in Mizoram.

Study Recommendation

- Restoration of shifting farms patches, introduction of horticultural cash crops, terrace farming, shaded coffee plantation, development of entrepreneurship, handicraft industry, introduction of fuel efficient cook stoves, employment generation opportunities.
- Regular supply of LPG can directly improve the living standards as well as economic well-being of local communities in the state and which will also be helpful in checking the forest degradation in the region.

Analysis and Outcome

The study highlighted the importance of different drivers of deforestation and forest degradation in the project area which will be helpful in framing the strategy for addressing the drivers of deforestation and forest degradation, state REDD+ action plan and further implementation of REDD+ in the North-Eastern parts of the country. The dependency of local communities on forest produce is one of the factors affecting the rate of forest degradation. There is a need for the local communities to sensitize the issue of deforestation and forest degradation by providing the seminars and awareness campaigns highlighting the various Government programmes/incentives, negative impacts of the using forest resources in unsustainable manner. The involvement of local communities in every project activity can catch their interest and this can become more success if there is some financial gain at individual level by implementation of the project activity. Hence there is need to give more emphasis on income generation activities of the local communities by ensuring sustainable use of forest resources and conservation of local biodiversity. The study recommendation is fully implemented.

Study Title

Biodiversity Assessment Study for Proposed 132 Kv Transmission Line From West Phaileng to Marpara in Buffer Zone of Dampa Tiger Reserve

Implementing Institution

Assam State Biodiversity Board

Project Location/Completion Year

Mizoram, 2015

Objective

- Prepare a baseline of biodiversity values of the project affected area.
- Study the impacts of power line construction on the biodiversity values in the affected buffer area.
- Plan/suggest suitable measures and strategies for mitigation/management of the anticipated impacts.

Study Recommendation

- The proposed activity of laying of a 132 kV transmission line entails possible positive as well as negative impacts. However, if the prescribed mitigation measures for possible negative impacts are undertaken, the positive impacts heavily outweigh the negative impacts.
- Availability and reliability of power supply act as a primary enabler for development activities.
- There is a pressing need for infrastructure development in the project area.
- Considering these factors, the implementation of project is recommended with prescribed mitigation measures.

Analysis and Outcome

A total of 203 floral species belonging to 160 genera and 73 families were recorded. Out of these, 96 tree species; 86 species of herbs, shrubs and climbers; and, 21 species of bamboo, orchids and ferns have been documented. Similarly, faunal variety comprising 93 species of birds, 11 species of mammals, species of frogs, 5 species of lizards, 4 species of snakes and 42 species of butterfly are recorded within the buffer zone. The study outcome shows: The study shows the proposed alignment is the least disturbance causing alignment, as there is an existing transmission line of 33 kV along the proposed 132 kV line; Since the surrounding/adjoining areas are also forested lands on hilly terrain, any alternative route for the transmission line shall entail fresh clearing of area and disturbances. The proposed alignment, though passing through the buffer of Dampa Tiger Reserve, is not likely to cause any fresh disturbance as there are settlements all along the road that exist alongside the proposed alignment. There is also no dislocation of the local communities involved on account of the proposed line and Restoration of natural areas along the existing routes that are or may come to disuse shall have to be taken up [158]. The recommendation of the study are fully implemented.



Study Title

Specialised Thematic Mapping in Tertiary Fold Belt in Parts of Aizawl District, Mizoram (Parts of T.S. No: 84a/14)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2013

Objective

- Build the lithostratigraphy and sedimentation history
- Work out the depositional environment
- Search for mineral occurrences with special reference to coal/lignite.

Study Recommendation

- Carry out Specialized Thematic Mapping of the area between Aizawl and present study area in order to complete the task of building up of the litho stratigraphy of the Middle and Upper Bhuban members of Surma Group.
- Comprehensive study of various parameters that lead to the understanding of provenance paleo-slope, paleo-climate, depositional environment and tectonic history of the area.

Analysis and Outcome

The study carried out a Specialized Thematic Mapping on 1:25,000 scale during F.S. 2013- 2014 in parts of T.S. No. 84 A/14, Aizawl district, Mizoram. A total of 220 sq. km area was mapped and 17 numbers of petrological, 03 nos. of paleontological, 10 nos. each of bed rock samples (BRS) and samples for chemical analysis were collected. A total of 1.9 line km section measurement was carried out along Ruallung to Mualpheng village road section and east of Mualpheng village to bring out a detailed vertical lithofacies variation of Middle and Upper Bhuban members.

The study shows no mineral of economic importance has been found in the area mapped. Very hard, compact sandstone and siltstone of Middle and Upper Bhuban members are quarried for the purpose of road metal and construction material. Only near Tawizo village, a coal streak of few mm thick and one cm in length were noticed in Upper Bhuban sandstone. The study concluded it's worthless to take up further specialized thematic mapping with the aforesaid objectives. Till date, minerals of economic significance except for oil and gas and construction material, have not been found in Mizoram and the chances of finding the economic minerals also seems to be bleak. The recommendation of the study is fully implemented.

Study Title

Mainstreaming Community-Conserved Areas for Biodiversity Conservation in Nagaland

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Nagaland, 2018

Objective

- Formation of CCA network: The Tizu Valley Biodiversity Conservation and Livelihood Network was formed allowing for a more effective conservation of species due to the increase in size and habitat that is protected.
- Community tourism development: As an alternative to hunting, tourism brings income to the communities where conserved species serve as a tourist attraction such as birdwatching and butterfly watching.

Study Recommendation

- Since the management of CCA network is challenging, a need to hire paid guards and rangers who will man the area and curb illegal hunting.
- For ecotourism marketing, advertise the area as a tourism product through platforms such as homestays on AirBnB.

Analysis and Outcome

This project has contributed to the Sustainable Development Goals (SDGs): SDG- 5 Gender Equality and SDG 15 Life on Land. It project has contributed to the Aichi Biodiversity Targets (ABTs)- 1-Understand Value, 3- Address Incentives, 5-Halve Rate of Loss, 6-Sustainable Fisheries, 11- Protected Areas and 12- Prevent Extinctions. A Community-Conserved Areas named as The Tizu Valley Biodiversity Conservation and Livelihood Network was formed allowing for a more effective conservation of species due to the increase in size and habitat that is protected. Also Ecotourism such as bird and butterfly watching of conserved species was introduced and promoted as an alternative to hunting. It also led to income generation for the local community. The study recommendation was fully implemented.

Agencies responsible for implementation:

- Nagaland Forest Department
- National Biodiversity Board
- Ministry of Tourism
- Village Communities



Study Title

A People's Biodiversity Register (PBR) of Village Ghukhuyi, Zünheboto, Nagaland

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Nagaland, 2017

Objective

Develop and maintain an inventory of known biological resources, and to document the traditional knowledge associated with biodiversity in Ghukhuyi, thereby register local community's knowledge about their biological heritage

Study Recommendation

- Need to generate greater awareness and build a common understanding on biodiversity conservation
- Preserve and sustain elder's wisdom by documenting oral knowledge and practices and train younger community members
- Capacity building of local people, especially youth to develop and maintain People's Biodiversity Registers, and to patrol such areas to ensure their conservation.

Analysis and Outcome

The present study documents the biological and cultural resources of the village Ghukhuyi, located in the heart of Nagaland in Zunheboto district. The Ghukhuyi PBR documents its people's cultural connections with biodiversity, also formed an important element in the implementation of the Nagaland Biological Diversity Rules. The project has yielded positive results in terms of sustainable use of biological resources, enhanced governance and effective conservation of the landscape. Around 127 Flora, 98 Shrub and Herb species, 34 species of mammals, 223 species of birds, 30 species of reptiles, 9 species of Amphibians, 143 species of butterflies, 13 species of moths, 57 species of fish have been documented. The traditional knowledge, which is mostly oral in nature, has been documented, while hunters and youth have been trained in bird watching, butterfly counts and they are in turn-promoting ecotourism. The study was highly successful, all the recommendation were implemented successfully.

Agencies responsible for implementation:

- Nagaland Forest Department
- National Biodiversity Board
- Ministry of Tourism
- Village Communities

Study Title

A People's Biodiversity Register (PBR) of Village Kivikhu, Zünheboto, Nagaland

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Nagaland, 2017

Objective

- Develop and maintain an inventory of known biological resources.
- Document the traditional knowledge associated with biodiversity in Kivikhu.

Study Recommendation

- Conservation involving local communities is a process. To achieve conservation there is a need to generate greater awareness and build a common understanding of what conservation means and why and the initiatives leading to positive outcomes.
- People are reservoirs of knowledge on nature and traditional management practices, especially the village elders. Building the capacity of these local people, especially youth to develop and maintain People's Biodiversity Registers.
- The youth can also be encouraged to document the biodiversity of their forests, and to patrol such areas to ensure their conservation.

Analysis and Outcome

Kivikhu village lies on the southern side of Zünheboto district bordering Phek district. Kivikhu is comprised of the Sumi tribe. Kivikhu is surrounded by Ghathashi block towards the west, Zünheboto block towards the East, Sekruzu block from Phek district towards South. The present study documents the biological and cultural resources of the village Kivikhu, located in the heart of Nagaland in Zunheboto district. The Kivikhu People's Biodiversity Register documents its people's cultural connections with biodiversity, and is also an important element in the implementation of the Nagaland Biological Diversity Rules. Apart from documenting the landscape and Peoplescape of the area for posterity, the study focus on working with the local community to strengthen community conservation. This includes assisting the local community of Kivikhu village to survey and demarcate the boundaries of their Community Conserved Area through GIS based maps, in identifying some of the flora and fauna present within the CCA and in training and capacity building for biodiversity documentation and ecotourism development. The study identified 70 Flora species of Kivikhu; 22 species of Shrubs; 55 species of Herbs; 33 species of Mammals; 204 species of Birds; 25 species of Reptiles; 7 species of Amphibians; 142 species of Butterflies; 13 species of Moths; 27 species of Fishes. The recommendation of the study was partially implemented.

Agencies responsible for Implementation:

- Nagaland Forest Department
- National Biodiversity Board
- Ministry of Tourism
- Village Communities



Study Title

A People's Biodiversity Register (PBR) Of Village Sükhai, Zünheboto, Nagaland

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Nagaland, 2015

Objective

- Develop and maintain an inventory of known biological resources.
- Document the traditional knowledge associated with biodiversity in Sükhai, Nagaland.

Study Recommendation

- Develop People's Biodiversity Register (PBR); to be facilitated by Forest Department of the State.
- Provide alternative sources to mitigate impact on biodiversity

Analysis and Outcome

The study identified inextricable link between people, environment and culture and call for an urgent need to conserve biodiversity, community's customs, practices and Knowledge; education of youth and to provide alternative sources to mitigate impact on biodiversity. A People's Biodiversity Register (PBR) was developed for Sukhai Nagaland, it identified 90 Flora of Sükhai CCA; 23 species of Herbs & Shrubs; 32 species of Mammals; 136 species of birds; 24 species of reptiles; 7 species of Amphibians; 140 Butterflies and 13 Moths; 27 species of fishes. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Nagaland Forest Department
- National Biodiversity Board
- Ministry of Tourism
- Village Communities

Study Title

Documentation of Community Conserved Areas of Nagaland

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Nagaland, 2015

Objective

First ever documentation of Community Conserved Areas in Nagaland

Study Recommendation

- Ensure the future of Nagaland's CCAs and thereby its biodiversity, a multi-pronged approach including financial support, legal recognition and long-term ecological monitoring is required.
- Furthermore, local communities must be trained to monitor their resources, and to develop wildlife tourism which will help generate support for conservation
- The network of CCAs in Nagaland provides a wonderful example of a fledgling people's movement for conservation that deserves to be strengthened and supported. The future of Nagaland's biodiversity and its people ultimately depends upon it.

Analysis and Outcome

The study was the first state-wide survey that revealed a third of Nagaland's villages (407 out of 1428) has constituted Community Conservation Areas (CCAs). A traditional conservation practice, where inviolate areas are declared as sanctuaries by the communities in response to forest degradation and loss of wildlife. The project has yielded positive results in terms of sustainable use of biological resources, enhanced governance and effective conservation of the landscape. Around 222 species of birds, 200 species of butterflies have been documented and protected by declaring 939 hectares as joint CCA and banning hunting and destructive fishing across the remaining landscape of forests and rivers (total area being 3751 hectares). The traditional knowledge, which is mostly oral in nature, has been documented in the form of a People's Biodiversity Register, while hunters and youth have been trained in bird watching, butterfly counts and they are in turn-promoting ecotourism. The project has been selected as a winning entry under the category 'Biodiversity Conservation' of the Pathfinder Award 2021 for innovation in nature conservation, co-organized by IUCN and UNDP International, in collaboration with other partners.

Agencies responsible for implementation:

- Nagaland Forest Department
- National Biodiversity Board
- Ministry of Tourism
- Village Communities



Study Title

Fostering Community Forest Management in Nagaland

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Nagaland, 2013

Objective

- Create an innovative conservation programme for the forestland owned by rural communities of the Phenstunyu (P), Khenyu (K), and Rumesinyu (R) villages, Kohima Forest Division of Nagaland through carbon credit backed financing.
- Restore the degraded forestland and conserve the existing native forest area in the PKR Community Reserve region through community resource micro planning to ensure reduction in pressure on forests, local institution building to enable community-based NRM, capacity building of local communities on conservation and sustainable management of forests in the PKR Community Reserve.

Study Recommendation

- Reforestation of jhum land.
- Supply of LPG cylinders to reduce deforestation and as an alternative energy.
- De-weeding and control wild banana and lantana.
- Promotion of horticulture and animal husbandry.
- Promotion of eco-tourism.
- Cultivation of medicinal trees.

Analysis and Outcome

The objective of the project is to create an innovative conservation programme for the forestland owned by the rural communities of the Phenstunyu (P), Khenyu (K), and Rumesinyu (R) villages (collectively "PKR Community Reserve"), Kohima Forest Division of Nagaland through carbon credit backed financing.

The project activities include the following: profiling of PKR Community Reserve; addressing Jhum cultivation; addressing fuel wood collection; control of wild banana, lantana and other weeds; horticulture; piggeries/animal husbandry; medicinal plant cultivation; ecotourism; enforcement of blanket ban on hunting; and settlement of forest dependency. The potential benefits from the project will generate additional income, which will be used for restoration and protection activities in the PKR Community Reserve.

The three villages, through forming the PKR Union, established a Community Forest Reserve. The area of the reserve forest is approximately 649.35 ha and well demarcated by its natural boundaries. The community has prepared well-documented socio-economic data of all the three villages.

The community has voluntarily banned jhuming, hunting, fire wood collection, and stone quarrying in the project area unless expressly approved by the union (minor extractions). The council has kept heavy penalty on violation of rules.

Study Title

Rapid Biodiversity Survey – Report I

Implementing Institution

Forest, Environment and Wildlife
Management Department

Project Location/Completion Year

Sikkim, 2015

Objective

Assess the biodiversity of different forest types of Sikkim by laying around 1000 plots across the State.

Study Recommendation

- The study enumerates various species of flora, fauna and avi-fauna in the State of Sikkim and projects common obligation to bring about conservation.
- This survey output will aid in developing baseline information on key biological elements of forest, alpine, freshwater and agro ecosystems for monitoring the impacts of forest and biodiversity management.
- Through the survey, critical areas can be identified that would require immediate protection by means of forest management based on sound scientific principles.

Analysis and Outcome

Sikkim harbours approximately 4500 species of flowering plants, which includes over 450 tree species, 37 species rhododendrons, over 500 species of medicinal plants, 523 orchid species, 480 species of fern & fern-allies, 8 tree fern species, 11 oak species, 16 conifer species, 23 bamboo species, 60 Primula species, etc. The state has 82.31 percent of the total geographical area (7096 Sq. Km.) under the forests, which harbours several endemic species. Five Rapid Biodiversity Surveys were conducted along following sampling paths: 1. Sang – Tinjurey sampling path in Fambong Lho Wildlife Sanctuary, East Sikkim, 2. Yuksom – Dzungri – Goche La sampling path in Khangchendzonga Biosphere Reserve, West Sikkim 3. Ravangla – Bhaley Dhunga sampling path in Maenam Wildlife Sanctuary, South Sikkim 4. Tholung – Kishong sampling path in Khangchendzonga Biosphere Reserve, North Sikkim 5. Shingba Rhododendron Sanctuary - Yumthang Valley - Shiv Mandir in Lachung Range, North Sikkim. Apart from the above RBS study, inventORIZATION of the floral species were also conducted in some of the locations as under 1. Tendong State Biodiversity Park, Damthang, South Sikkim; 2. Floriculture Nursery, Bulbuley, East Sikkim; 3. Proposed Biodiversity Training Institute, Pangthang, East Sikkim; 4. Proposed Butterfly Park, Rang Rang, North Sikkim; 5. Gyam Tsona Lake, North Sikkim. The recommendation of the study is being implemented [173].

Agencies responsible for implementation:

- Ministry of Forest Environment and Wildlife Management Department, Government of Sikkim
- National Biodiversity Board



Study Title

Study of Ecological, Socio-Economic and Livelihood Dimensions of Grazing Exclusion in Protected Forests of West Sikkim

Implementing Institution

Institute for Financial Management and Research – Centre for Development Finance (IFMR-CDF)

Project Location/Completion Year

Sikkim, 2012

Objective

- To determine the change in habitat condition, hydrology and edaphic factors in the region after the implementation of the ban on grazing in reserved forest areas.
- To understand the perspectives of the local community on the grazing ban and to study the change in livelihood strategies adopted by them.
- To develop a feasible methodology for assessing impact in the absence of detailed longitudinal ecological or socio-economic data.
- To document relevant baseline data that can be used as a foundation for rigorous research on the future impacts of continuing or adjusting the grazing ban.
- To perform preliminary investigation on the issue of cross border grazing.

Study Recommendation

- Habitat management plans for the grazing affected areas need to be developed taking variation of forest types into consideration.
- Efforts should be made to supplement the regeneration of the key species such as *Quercus* that has as the regeneration seems by for ex-situ conservation zones within these areas could be delineated or in-situ conservation techniques be adopted.
- Developing a rich repository of vegetation information by digitizing the data collected in the field level exercises – working plan. Development of livestock management systems in the community forests areas using participatory approach.

Analysis and Outcome

The present study was conducted across Barsey Rhododendron Sanctuary (BRS) and a part of buffer zone of Kanchenjunga Biosphere Reserve (KBR) in the West District of Sikkim. The study adopted a comprehensive evaluation framework comprising of two main components: ecology and socio-economic including livelihoods. The ecosystem impacts of the grazing ban can be said to be positive in terms of increase in vegetation cover and consequent improvement in the soil regime.

The areas exposed to high grazing pressure having open canopy cover were found to be regenerating adequately. Among the species of conservation importance, *Rhododendron* spp. were observed to be adequately generating whereas the regeneration of *Quercus* spp was relatively inadequate. It was observed that regeneration levels of other species of fodder importance such as *Litsea polyantha* (poinle), *Ilex dipyrena* (lissey), *Osmanthus suavis* (sirlinge), was found to be inadequate near the plot areas. The gregarious *Arundinaria maling* (malingo) and *Viburnum* spp. (asare) regeneration could be cause of concern in the longer run and needs to be further studied. It was observed that not only herders were impacted but also the non herder group was impacted though to a less extent. Amongst the herder group, caretakers and people with less land ownership were the most impacted. The livelihood model changed from agro-pastoral form with livestock being the mainstay to predominantly agricultural. The study recommendation was partially implemented.

Agencies responsible for implementation

- Department of Forest Environment and Wildlife Management, Government of Sikkim
- Ministry of Environment, Forest and Climate Change

Study Title

Study of Eco-Tourism for the Sikkim Biodiversity Conservation and Forest Management Project

Implementing Institution

Japan International Cooperation Agency
(JICA)

Project Location/Completion Year

Sikkim, 2010

Objective

- To strengthen biodiversity conservation activities and forest management capacity,
- To improve the local people's living standard who depend their livelihood on the forest by collecting baseline data and promoting sustainable biodiversity conservation, afforestation and income generation activities including ecotourism for the community development.

Study Recommendation

- Training and capacity building should be given by professionals to local communities including home stay owners, youth, and women's group who wish to engage on ecotourism activities
- Plan awareness programmes on ecotourism policy contents, its guidelines and function of ecotourism council including the JICA's roles for line departments and local communities
- Establish zonings for ecotourism development sites outside PAs, which will be called ecotourism zone hereafter, and general tourism development zone, and differentiate the two zones in Sikkim
- Develop partnership with NGOs, local people who run and operate homestay, guides, produce local agro-products and handicrafts, tour operators / tour agents to develop ecotourism business in a fair trade manner.

Analysis and Outcome

As Sikkim experiences moderate temperature in summer and has exceptionally rich biodiversity and unique culture, there has been remarkable increase in the number of tourists for the recent years. On the other hand, there is a growing concern on the adverse impacts on the rich biodiversity and its ecosystem caused by the rapid increase of tourists. The balance between the development and nature conservation is an urgent issue to be addressed. Under these circumstances, JICA launched the 'the Sikkim Biodiversity Conservation and Forest Management Project' in March 2010. The study aims to strengthen biodiversity conservation activities and forest management capacity, and to improve the local people's living standard who depend their livelihood on the forest by collecting baseline data and promoting sustainable biodiversity conservation, afforestation and income generation activities including ecotourism for the community development. The recommendation and strategies provided by this study was fully incorporated in the official Sikkim Ecotourism Policy 2011 ^[177].



Study Title

A Preliminary Investigation on some Potential Biodiversity Heritage Sites (BHSS) of Tripura

Implementing Institution

Tezpur University

Project Location/Completion Year

Tripura, 2016

Objective

- Identification of some potential biodiversity heritage sites in Tripura
- To survey and characterization of key component
- Assessment of Biodiversity and ecosystem functioning
- To examine the key factors for recommendations and to draft policies on biodiversity heritage sites in Tripura

Study Recommendation

- The Baramura waterfall can be developed as potential heritage site.
- The Bat cave of Silachari is only the cave was seen in the state. This site may declare as potential Biodiversity Heritage site for Tripura.
- Unakoti is known for its Archaeological important. This place is a holy site for local community and showing rich traditional elements closely related with the ethno-religious-conservation aspects.
- The vegetation of the Jampui Hills is very unique in nature. Protection and management of this area as Biodiversity Heritage Site (BHS) could help to preserve unique floral and faunal diversity.
- Debbari or Chabimura is not only important for its unique archaeological value. It is only the large belt of riverine forests and the banks of it have enough potential for sustainable agriculture.

Analysis and Outcome

The study focus on selected high potential Biodiversity Heritage Sites in Tripura which may be prioritized on the basis of their ecosystem services for future management and conservation in Tripura. Preliminary observation shows these sites have the qualities for multidirectional climate regulations; important provisioning services, cultural significance and several other supporting roles to maintain local biodiversity, economy and livelihoods, even owning significant contribution in climate change mitigations. Hence immediate emphasis should be given to declare those sites as BHS for effective scientific investigations and management. The recommendation of the study is not implemented.

Agencies responsible for implementation:

- Tripura Biodiversity Board
- National Biodiversity Authority (NBA)

Study Title

Rapid Assessment of Herpetofaunal and Invertebrate Diversity in Tripura State

Implementing Institution

National Centre for Biological Sciences,
Bangalore

Project Location/Completion Year

Tripura, 2014

Objective

To document diversity of reptiles and arachnids

Study Recommendation

Recommendation has not been outlined in this report

Analysis and Outcome

The Tripura Biodiversity Board (TBB) and the Forest department of Tripura in collaboration with the National Centre for Biological Sciences conducted rapid survey of the state to document its herpetofaunal and invertebrate fauna. Among the seven northeast Indian states, Tripura has thus far been the least explored in comparison with neighboring states (Majumder et al. 2012). The study was conducted in Trishna Wildlife Sanctuary; Garjee and Maharani; Kalapania, Malumbari, Harbatali; Gumti Wildlife Sanctuary; Manu and CCRE; and Jampui Hills these are areas pre-identified biodiversity hotspots of the state identified by TBB to assess the diversity of herpetofaunal and arachnid fauna of these areas. The survey yielded nineteen species of reptiles and sixteen species of arachnids. Of the species of reptiles that were recorded from the state during the survey, *Calotes irawadi* constitutes a new national record; *Rhabdophis himalayanus* and *Trimeresurus erythrurus* constitute new state records. The frogs, *Microhyla berdmorei* and *Amolops indoburmanensis* constitute new national records. Among the arachnid species recorded, *Thaicharmus guptai* was described as a new species, *Orientothele alyratus* was described as a new genus and a new species. Other species like *Euscorpions longimanus*, *Chaerilus pictus*, *Lychas laevifrons*, and *Liocheles australasiae* constitute new state records. A new species of *Liocheles* was recorded from low elevations areas in Trishna Wildlife Sanctuary and Garjee forest division [179]. Additional work is underway to identify specimens of *Uropygia* which are represented by two species and genera. The findings of the study were published in two scientific journals [180].

Agencies responsible for implementation

- National Biodiversity Board
- Tripura Biodiversity Board
- Forest Department of Tripura



Study Title

Molecular Characterization and Chemoprofiling of Two Pharmacologically Relevant Species of *Dendrobium* Found in Northeast India

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

More than one state, 2017

Objective

- Survey and collection of species of *Dendrobium* viz., *D.fimbriatum* and *D.moschatum* from different parts of Northeast India.
- Chemoprofiling of major constituents of *Dendrobes* (except *D.nobile*) with the help of HPTLC and HPLC and identify known bioactives.
- Estimation of bioactive markers from the selected species of *Dendrobes* and selection of the species with maximum content of bioactive (rhein).
- Molecular characterization of superior germplasm of the selected *Dendrobes* for genetic variation and if possible to correlate the same with the content of bioactive compound (rhein).
- In vitro propagation of the selected *Dendrobes* for obtaining uniform plants having superior traits for the active principle.

Study Recommendation

- Findings of the current study suggest the possible use of stem of *D. fimbriatum* and stem of *D. moschatum* as the potent alternative source of *D. nobile* in the management of hepatic and renal dysfunction. It also provides baseline data for designing further investigations in other experimental models on the therapeutic benefits of these plants.
- Toxicity and efficacy in humans cannot always be entirely extrapolated from animal studies, the dosage and treatment regime needs further modification and rationalization by conducting suitably designed clinical trials. Since β -sitosterol was found to be present in maximum content in both the species, therefore in vitro propagation techniques were successfully developed for both *D. fimbriatum* and *D. moschatum* in order to harvest β -sitosterol from the in vitro-raised plantlets of both the species. This would ensure the alternate source of harvesting β -sitosterol without imposing pressure on the natural populations of both the species.
- Molecular characterization of *D. fimbriatum* accomplished using SCoT, DAMD and ISSR marker for analyzing the genetic diversity. Analysis of molecular variance [AMOVA ($p < 0.001$)] revealed that 67.84% of total genetic variation existed within the populations with 32.16% variance amongst the populations. Molecular characterization of *D. moschatum* accomplished using SCoT, and ISSR marker for analyzing the genetic diversity.
- Analysis of AMOVA ($P < 0.001$) showed that genetic variation (88.57%) was observed within the populations, whereas the variance among populations was 11.43%.

Analysis and Outcome

The implementation status of the study is not known. Some of the new leads obtained from the study are: The hydroalcoholic stem extracts of *D. fimbriatum* and *D. moschatum* (source of triterpenoids; ursolic acid, β -sitosterol and lupeol) are showing significant hepatoprotective and nephroprotective activity in CCl₄ induced hepatotoxicity and gentamicin induced nephrotoxicity in Wistar rat model. On the basis of the results obtained for biochemical parameters which are also supported by histopathological evaluation of liver and kidney in hepatoprotective and nephroprotective study, respectively; the standardized hydroalcoholic stem extracts of *D. fimbriatum* and *D. moschatum* was obtained as a lead which can be used as an alternative to *D. nobile* (threatened species in natural habitats) and may also be developed into a formulation for the management of hepatic and renal dysfunction. A competent in vitro organogenesis protocol has been developed for *D. fimbriatum* and *D. moschatum*. The protocol described in the findings can be exercised from conservation prospect of these species of medicinal as well as horticultural importance.

Agencies responsible for Implementation:

- Department of Biotechnology
- Council of Scientific and Industrial Research



Study Title

Isolation and Characterization of Hydrogen Producing Bacteria from North-Eastern State of India, (With Special Emphasis on Assam and Arunachal Pradesh for Efficient Conversion of Biomass to Hydrogen)

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2015

Objective

- Collection of Environmental Samples from the different parts of North East India
- Checking production of hydrolyzing enzymes by the isolated bacterial species
- Isolation and screening of fermentative hydrogen producer from the environmental samples
- Identification of the potential strains and optimization of hydrogen production.

Study Recommendation

- Potential strains that can be used for utilisation of various bio-waster were some of the maximum hydrogen gas producing strains like DH89, B6, S3, DH1.
- Strain S3 was found a potential strain for production of extracellular enzyme for degrading of cellulosic material. The ability of the strain practically tested with waste sugarcane baggasse for sugar release and finally hydrogen production.
- Strain B1 was found potential candidate for xylose utilisation and hydrogen production
- The selected strains were also found potential in utilising of various other sugars for hydrogen production.
- Search for a novel approach is required to accelerate the H₂ production rate and enhance yield

Analysis and Outcome

In the present study successful isolation and identification of 10 mesophilic hydrogen producing bacterial was conducted and the optimization for the maximum gas production using glucose as sole carbon source was performed. Some of the key takeaways of the present study for future work would be: The Isolated strains can be checked for hydrogen production in continuous culture mode of fermentation; The bacterial strains can be immobilised in various materials and reusability of the immobilised strain can be checked and Consortium of microbes can be formed with the isolated strains for maximum hydrogen yield as well as waste utilisation. The present study will be great beneficial in the context of eco-friendly and renewable fuel production and reduction of waste generation. The status of the study recommendation is partially implemented.

Agencies responsible for implementation:

- Department of Biotechnology, Government of India

Study Title

Completion Progress Report of Phytochemical Profiling, Molecular Characterization and Conservation of *Flemingia Vestita*: Endemic Medicinally Important Plant of Northeast India.

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

More than one state, 2014

Objective

- Collection and authentication of *Flemingia vestita* from different regions of North East in India.
- To evaluate quality control parameters for establishing the stability and content uniformity of the selected plant material as per standard pharmacopial guidelines (IP, EP and USP).
- Preparation of extracts of different plant parts using solvents of different polarities and hydro-alcoholic extracts will be carried out to achieve maximum extractive values.
- Standardization of their phytochemical fingerprints using chromatographic techniques like HPTLC and HPLC.

Study Recommendation

- Genistein rich ethanolic extract of *F. vestita* tubers significantly show estrogenic activity in ovariectomized Albino Wistar rat model. In certain parameters like estrogen, progesterone, G6PDH and triglycerides the results were at par with the modern drug (Estradiol valerate).
- As per this study, the standardized ethanolic extract of *F. vestita* tubers (in terms of genistein content) was obtained as a lead which may be developed into a potential formulation for the management of menopausal problems.
- Findings of the current study can provide base line data for designing further investigations on the therapeutic benefits of the *F. vestita* tubers in the management of menopausal problems. Since hormonal replacement therapy has broad range of side effects, such plants can be used as an alternative therapy for menopausal syndrome. The dosage and treatment regime needs further modification and rationalization by conducting suitably designed clinical trials.

Analysis and Outcome

The record of *Flemingia vestita* distribution is detailed only in the Khasi Hills of Meghalaya, a small population is also known to be in the Nokrek region of the Garo Hills (Meghalaya). Extensive field surveys were carried out during the season [i.e., June (first week) - December (last week)] when the plant blooms and easy to identify. The matured tubers were also collected. Plants of *F. vestita* from different populations were collected and maintained in the Glass house of Plant Biotechnology Lab, North - Eastern Hill University, Shillong. The plants and herbaria had also been delivered to the collaborating institute, Ramnarain Ruia College- Mumbai for phytochemical studies and drug efficacy experiments. New leads obtained from the present study shows Genistein rich ethanolic extract of *F. vestita* tubers is significantly showing estrogenic activity in ovariectomized Albino Wistar rat model.

In certain parameters like estrogen, progesterone, G6PDH and triglycerides the results were at par with the modern drug (Estradiol valerate). The histoarchitecture of the uterus also supports the biochemical parameters. As per this study, the standardized ethanolic extract of *F. vestita* tubers (in terms of genistein content) was obtained as a lead which may be developed into a potential formulation for the management of menopausal problems. The implementation status of the study recommendation is not known.

Agencies responsible for implementation:

- Department of Biotechnology



Study Title

DNA Clubs: DBT-TERI Mentoring Schools of North East

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

More than one state, 2013

Objective

The main objective of this project was to promote deeper awareness about bioresources and to enthuse students about the role of biotechnology and their sustainable utilisation especially in the North-East region. Around 10,000 school students and 200 teachers would be the direct beneficiaries from the government, public and private schools. The schools are in the ratio of 5:3:2 respectively. The secondary beneficiary is expected to be more than 1.5 lakh students with an average of 1200-1500 students per school and 7000 teachers.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

The project was highly successful and received positive outcome for the target stakeholders and beneficiaries. Some of the major outcomes of the project are: The orientation cum training of coordinator teachers identified by respective schools has been carried out during 2010-12. Altogether 361 schools teachers from 8 northeastern states were trained. The project has benefitted 75810 students directly in 8 northeastern states. The project activities include 6498 AV shows, 21660 hands on activities and lab experiments of 60 themes, 6498 guest lectures on 137 topics by resource persons of 40 different profession such as academicians, physicians, environmental activists, state officials of Agriculture, Sericulture, Forest, Horticulture etc, 1083 institutions and field visits. A vacation training programme was conducted during 7-21 May 2012 in Gangtok where more than 100 students participated. A total of 3249 events were organized comprising of competitions on debate, quiz, extempore speech, drawing, slogan etc were organized. During the year 8 episodes lecture on vernacular language delivered by experts and was broadcasted on Sundays by AIR, Imphal. The DNA activities demonstration was filmed by experts and telecasted at DDK Imphal in 6 episodes. Tree planting, cleaning drive, rally and celebration of vanmohotsav were organized for 722 events. A DNA club operation manual was also published.

Study Title

Micropropagation of *Nardostachys Grandiflora* and *Malaxis Wallichii*-Two Threatened Medicinal Plants of North-East India

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

More than one state, 2013

Objective

- Collection of *Nardostachys grandiflora* and *Malaxis wallichii* from their natural habitats and maintenance of the plants in the Glasshouse, Botany Department, North-Eastern Hill University, Shillong-793022.
- Development of technology for in vitro propagation and mass multiplication of *Nardostachys grandiflora* and *Malaxis wallichii* from different populations. At least 5,000 plants of each species will be produced.
- Introduction of the in vitro raised plants of *Nardostachys grandiflora* and *Malaxis wallichii* in natural habitats with the help of concerned State Forest Departments.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

Some of the major outcome and leads obtained from the present study were Direct organogenesis and Callus derived - organogenesis in *N. grandiflora* in MS medium with growth regulators has been achieved for the first time. Profuse rhizogenesis have been observed which may be useful for extraction of secondary metabolites. Effect of temperature is found to be important for organogenesis in *N. grandiflora*. Although organogenic calli showed mixoploidy but no major phenotypic and genetic rearrangements were detected by FCM and ISJ in callus derived plants in *N. grandiflora*. Asymbiotic seed germination of *Malaxis wallichii* has been achieved. An efficient procedure has been outlined for rapid and mass in vitro propagation through in vitro culture of transverse thin cell layers derived from young pseudobulb segments and in vitro pseudostems. No major phenotypic and genetic rearrangement was detected by FCM and ISJ marker analysis from tTCL and PLB mediated organogenesis. The Task Force rated the progress as satisfactory and suggested that macro propagation of both these species should also be tried.



Study Title

Evaluation Study on Accelerated Irrigation Benefits Programme (AIBP)

Implementing Institution

Indian Institute of Management (IIM),
Lucknow

Project Location/Completion Year

More than one state, 2010

Objective

- To verify the potential creation reported by the State from the particular project by completing all the physical works on the ground
- To ascertain how far the assets created under AIBP are maintained by the state authorities
- To evaluate how the programme has assisted expediting the irrigation potential creation
- To review the implementing process of AIBP
- To assess the utilization of created potential by the beneficiaries of the command and whether the programme has helped in expanding in the net irrigated area in the command

Study Recommendation

Some of the key recommendations of the study were:

- Enough budgets should be allocated for timely repair and maintenance of the canals.
- High priority should be given to the task of lining of the whole canal system, including main medium and minor canals, along with a provision of appropriate slope. High quality technical work should be ensured in this regard. In addition, contractors and field staff of irrigation department should be trained to deliver technical work of a sound quality.
- There is a need to develop a mechanism for proper coordination between relevant government departments, such as the irrigation, agriculture, revenue and the land development department. Perhaps a committee consisting of representatives from the relevant departments can be formed, to look at the holistic development of the command area.
- A policy needs to be formed to make farmers to adopt appropriate cropping pattern for optimum use of water. A balanced ratio has to be introduced between high, medium and low water consuming crops. This will help maximize the benefits of canal water and at the same time protect head reach land from water logging and ultimately prevent it from becoming infertile land.

Analysis and Outcome

The present study was carried out through sample survey in different states covering the selected irrigation projects. It has been found in the evaluation study that there has been spectacular increase in the irrigated area but state governments are increasingly under severe financial constraints as they find it difficult to finance the recurring costs of irrigation and to collect economic water charges from the farmers. As a result, not only the sustainability of government run irrigation system is in danger, but also its impact on water use efficiency and equity has been dwindling over a period of time.

The study also revealed substantial gap between potential creator and utilizations in major irrigation programmes. Some of the prominent reasons behind the non-completion of the designed irrigation potential found are; (a) problems in land acquisition, (b) law and order problem particularly in North-Eastern states, (c) construction of railway and road bridges in the command areas of the project, (d) labour problems and (e) lack of coordination among different departments of State Government. The implementation status of the study recommendation is not known.

Agencies responsible for implementation:

- Department of Agriculture and Farmers Welfare, Government of Tripura
- Department of Agriculture and Horticulture, Government of Assam



Study Title

Micropropagation of Some Medicinally Important Orchids of Northeast India

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

More than one state, 2010

Objective

The overall objective of the project was the large-scale production and molecular characterization of some medicinally important orchids of the Northeast India.

Study Recommendation

Large-scale production through tissue culture and molecular characterization of some medicinally important orchids of the Northeast India for conservation and medicinal utilization.

Analysis and Outcome

Medicinally important orchids like *Dendrobium nobile*, *Cymbidium aloifolium* and *Vanda coerulea* were collected from different regions of Northeast India. Large scale propagation of the selected orchids using different explants such as leaf parts, root tips, axillary buds and apical meristems in a suitable medium supplemented with various growth regulators namely, indole-3-acetic acid (IAA), α -naphthalene acetic acid (NAA) and 6-benzylamino purine (BAP) was attempted. Out of the different explants tried, the apical meristem and the leaf bases were found to be the most suitable explants for micropropagation of *Vanda coerulea* and *Dendrobium nobile*. The highest response of 83% from the apical meristems of *Vanda coerulea* was observed in the formation of protocorm like bodies (PLBs) wherein a maximum of 7-15 PLBs were recorded in MS medium supplemented with 2.46 μ M IBA (indol-3-butyric acid) + 11.09 μ M BAP (6-benzyl aminopurine). In case of *Dendrobium nobile*, 76% response of the axillary buds was recorded in Mitra medium supplemented with 2.27 μ M TDZ (Thidiazuron) wherein 5-6 shoots/bud were obtained. Root segments of *V. coerulea* collected from in vivo growing plants failed to respond whereas those from in vitro grown plantlets regenerated PLBs. A combination containing 30 μ M BAP and 15.0 μ M IAA showed 98.2% response and proved to be the best for response (16.2 \pm 0.37) for accelerated development and proliferations of PLBs with an average of 15.8 \pm 0.37 shoots emerging out of the PLBs.

The recommendation of the study was partially implemented. The study will have impact on cross-cutting issues and can be generalized for other regions and target groups.

Agencies responsible for implementation:

- Department of Biotechnology, Government of India
- Planning Department, Government of Meghalaya

Study Title

Active Fault Mapping and Neotectonic Studies Around the Foothills of Assam/Arunachal Himalaya in Parts of East Siang and West Siang Districts, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2017

Objective

- To identify and map probable active faults from morph tectonic study
- To generate field data on nature, extension, characterization of the identified active faults

Study Recommendation

- In view of the activeness and dynamicity of the area, seismic microzonation may be carried out in the immediate future. Such study will help in generating a comprehensive database for future urban planning and disaster mitigation.
- The generated data can also be used for evaluation of the present built-in environment, which may initiate the necessity of retrofitting of some structures, and in assessing the vulnerability and seismic risk of the already developed areas.

Analysis and Outcome

The present study carried out an active fault mapping and Neotectonic studies in the foothills of Assam–Arunachal Himalaya falling in parts of Toposheet Nos 83 I/6, I/10 and I/14 in East and West Siang district, Arunachal Pradesh. The area is covered by two important tectogens, namely the Brahmaputra plains with its lithic fills on the fault-bound basement in the south and thrust-bound Sub- Himalayan foothill in the north, both of which are known to be seismotectonically active at present.

The rugged topography and V-shaped valleys suggest a rapid and tectonically induced incision at the northern part of the study area. Most of the N–S trending fourth order drainage define lineaments at the foothills and join the higher order (fifth and sixth) streams almost at right angle along the foothills. The lineament study reveals that the rivers to be tectonically controlled, the lineament intersection plot indicates presence of faults in the major N–S flowing rivers and plot of average length per grid indicates fractured zone along the foothills. The lineament/fault analysis indicates that the area is having tectonic features both parallel and transverse to the Himalayan trend due to repeated south verging thrusting and related folding of the Himalayan mass. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- State Disaster Management Authority



Study Title

Seismic Hazard Assessment of Itanagar Urban Agglomeration, Arunachal Pradesh

Implementing Institution

Earthquake Geology Division,
Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2017

Objective

To delineate different hazard levels pertaining to seismic hazards within the Itanagar master plan area, which can be put to use for disaster mitigation and future urban planning.

Study Recommendation

The generated database will be useful for engineers and town planners for their decision-making and designing safe structures. Also, it may be utilized for disaster preparedness and mitigation.

Analysis and Outcome

The present study analysed a total of seven potential seismic source zones around Itanagar with a past seismicity data base of 2133 earthquake events in defining different seismic hazard zones within the 250 sq. km Itanagar master plan area. Amongst the seven identified source zones, the Eastern Boundary Thrust Fault has the highest seismicity with an annual occurrence of 4 Mw earthquake and least seismicity recorded from the Belt of Schuppen.

The scenario earthquake originates from the Himalayan Fold thrust belt with an earthquake magnitude of 8.2 Mw (MCE). The seismic hazard in terms of bedrock peak ground acceleration with respect to this scenario earthquake (deterministic method) shows significant variation ranging from 0.21 g to 0.34 g. The younger loose sediments mainly confined along the terraces with thin overburden has the highest value of peak ground acceleration. A fundamental frequency range of 0.26 Hz to 13.67 Hz recorded within the area and the variable response of the surficial geological units indicate the different degree or level of seismic hazards within the Itanagar master plan area. This results of the study were partially implemented.

Agencies responsible for implementation:

- State Urban Development Agency

Study Title

Anti-erosion Work on Right Bank of Sisiri River at Silluk Area to Protect Nogopok and Adjoining Village Areas, Agricultural Land Areas and Mebo Dhola Road

Implementing Institution

WAPCOS Limited

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

- To prevent bank erosion and to guide the river flow straight towards the down stream
- To restrict the overflow into agricultural land about 150 ha along the river bank
- To save the lives, properties, and standing crops from over flooding of River Dollung

Study Recommendation

To protect valuable properties and land from permanent loss due to bank erosion and standing crops by over flooding in every year the following measures were suggested:

- 7200 m long dry course Guide Wall
- Spur
- Bank Revetment

Analysis and Outcome

The North Eastern Council under the Ministry of Development of North Eastern Region (Ministry of DONER), Government of India, has been involved in the process of development of all the eight states of North-Eastern Region and in contributing to the socio-economic development of the people of this region by providing financial assistance to the schemes and projects in various sectors. The North Eastern Council engaged WAPCOS Limited, a Government of India undertaking under the Ministry of Water Resources, to carry out the evaluation and impact studies of the current project. The main purpose of the project was to control River Sisiri and execute item of works for anti-erosion work over River Dollung at Dollungmukh circle under Lower Subansiri district in Arunachal Pradesh.

The outcome of the study was found to be highly successful by the evaluation agency. It was observed that the project resulted in protection of life, saved agricultural land and crops from destruction by flood damage, and preserved Mebo-Dhola road, which is the main trade route between Assam and the people inhabiting on the left banks of River Siang of Arunachal Pradesh.



Study Title

Detailed (1:1,000) Site Specific Geological Studies of the Landslide Complex Near the Tawang Monastery, Tawang, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

- To carry out a detailed geotechnical evaluation of the landslide complex to understand the causal factors and failure mechanism
- To provide the generated geological input to the concerned authority for the formulation of a comprehensive plan that is envisaged to help the mitigating authority in minimizing and tackling the landslides from aggravating further

Study Recommendation

The landslide complex is presently 'not active' (no perceptible slope movement recorded), but may fall under 'reactivated/suspended' category in terms of state of activity. Further, considering the causal factors such as shallow overburden cover with high natural moisture content coupled with natural recharge and low shear strength parameters of disturbed material, there is always a possibility of slow, imperceptible (creep) movement within the ground crack zone of displaced material, in which case, the given landslide may be termed as 'active'.

Analysis and Outcome

The study carried out a detailed (1:1000 scale) geological and geomorphological evaluation of the landslide complex near the Tawang Monastery to identify and delineate multilevel scars of varying geometry and dimension, initiated and evolved in varied slope forming material disposed along and across the large landslide complex. The landslide complex with an estimated dimension of 1040 m x 320 m, located at about 300 m south of the Tawang Monastery on the southwestern (obsequent) slope of a N-S trending spur, has reported large-scale reactivation from 1997 and 2010 (21 November), with minor ones during the month of September, 2012.

Shear strength of in-situ soil above the crown of the scarp (determined using Humboldt pocket soil penetrometer) has shown that the average shear strength of the same varies from 10.95 MPa to 14.35 MPa (112 to 146 kg/cm²) and as such indicates good shear strength of the soil-mass at the surface. The study of the prepared longitudinal geological sections has revealed the presence of a variably thin overburden probably underlain by shallow bedrock. Over a larger portion of the landslide zone, shallow translational failure at the interface of the overlying younger loose debris and the underlying in-situ rock (planar debris slide with shallow slip surface) are found to be prominent while shallow rotational failure over a limited area towards the right crown scarp and deep-seated failure conditions towards the left flank have been interpreted. The recommendation of the study was fully implemented.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Macro scale (1:50,000) Landslide Hazard Zonation Along the National Highway Corridors between Bomdila and Tawang, West Kameng and Tawang Districts, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2013

Objective

To categorize the hill slope into five hazard zones based on their estimated landslide susceptibility

Study Recommendation

- Delineation of the landslides in the field through the collection of detail attribute data in a standard format and the recommendations given for short term remedial measures will help the road maintaining authority for adopting necessary mitigation measures.
- The prepared landslide inventory database along with the LHZ map can meaningfully serve as a contributing parameter for the geo-hazard assessment and evaluation of the area.

Analysis and Outcome

The study was conducted on macro-scale (1:50,000) Landslide Hazard Zonation (LHZ) along 200 line-km of the National Highway Corridor from Bomdila to Tawang in Arunachal Pradesh at slope units, i.e. slope facet. In the area, 726 number of slope facets were delineated. Further, as a part of the study, 108 landslide incidences were delineated along the studied road corridor, detailed attributes of which were prepared following an internationally accepted format.

Analysis of the generated LHZ map indicates that 18% (125 slope facets) of the total study area comes under the 'Very High Hazard' and 'High Hazard' categories. The various other hazard classes viz. 'Very Low Hazard Zone (VLHZ)', 'Low Hazard Zone (LHZ)' and 'Moderate Hazard Zone (MHZ)' account for 0.1% (2 slope facets), 47.91% (350 slope facets), and 33.89% (249 slope facets) respectively, of the area studied. The key results from spatial correlation of the various thematic maps with that of the landslide incidence map and LHZ map of the area indicate that the slopes made up of overburden/soil cover are more prone to slope distressing than the slopes where bedrocks are exposed; a significantly higher concentration of landslide incidences in the vicinity of the prominent regional thrust (MCT) exhibiting undeniable field evidences and signatures of the regional thrust towards slope instability, etc. The study recommendation was partially implemented.

Agencies responsible for implementation

- State Disaster Management Authority
- Geological Survey of India



Study Title

Macro-scale (1:50,000) Landslide Hazard Zonation Along the Tezu-Hayuliang and Hayuliang-Chaglogam road corridors, Lohit and Anjaw districts, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2013

Objective

- To study topographical sheets and available satellite images of the area for perspective assessment of the geomorphology, lineaments, landuse, and landcover
- To study SRTM data and prepare Digital Elevation Models (DEMs)
- To prepare Slope facet map from the DEMs and topographical sheets
- To prepare a detailed landslide inventory database and a landslide incidence map

Study Recommendation

- Identification of the less hazardous (low, very low) areas for developmental planning
- Identification and delineation of unstable, hazard-prone areas for environmental regeneration programme adopting suitable mitigation measures
- Identification and delineation of target areas for meso-zonation (1:5,000/10,000) or larger scale site-specific studies

Analysis and Outcome

The present study was conducted on macro-scale (1:50,000) Landslide Hazard Zonation (LHZ) along 165 line-km of the Tezu-Hayuliang (100 km), Hayuliang-Metengliang-Chaglogam-Toflagam (60 km) road corridors and part of the Tohangam-Parsuramkund road (5 km) in Lohit and Anjaw districts of Arunachal Pradesh. The thematic maps were prepared through augmentation of field data and available baseline information. Further, as a part of the study, 137 numbers of landslides comprising 84 old landslides, 6 reactivated landslides, 22 suspended landslides and 25 active landslides were identified and delineated in the study area.

Analysis of the generated LHZ map shows that the 'Very Low Hazard (VLH)', 'Low Hazard (LH)', 'Moderate Hazard (MH)', 'High Hazard (HH)' and 'Very High Hazard (VHH)' zones account for 0.46%, 70.52%, 20.63%, 7.57% and 0.80% of the study area, respectively. The prepared landslide inventory database along with the LHZ map can meaningfully serve as a contributing parameter for the comprehensive geo-hazard assessment of the area. The generated LHZ map, when combined with temporal landslide data, can be effectively used for assessing the landslide hazard and risk scenario of the area. The study indicates that the dynamic nature of the slope mass in the study area has greatly increased in recent times owing to augmentation of new settlements, roads, other infrastructure such as new hydroelectric power projects, etc. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority

Study Title

Macro- scale Landslide Hazard Zonation Mapping along National Highway-52a Corridor from Banderdewa–Itanagar to Gohpur (Holongi), Papum Pare District, Arunachal Pradesh in Parts of Toposheet Nos 83e/12,16 and 83f/9 (1:50000 scale)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2013

Objective

- To represent the detailed information on thematic maps
- To get the requisite Landslide Hazard Zonation map

Study Recommendation

- The Very High Hazard Zone area and the High Hazard Zone area should be avoided for any future developmental works as these areas are very prone to landslide. Moderate Hazard Zone area may be taken for developmental work with adequate slope stability measures, whereas the Low Hazard Zone and the Very Low Hazard Zone areas are most suitable for undertaking developmental work.
- Before implementing any future developmental activities in High Hazard zones, systematic planning may be done considering the slope stability factor of the slopes identified through successive meso- and micro-level landslide hazard zonation studies.

Analysis and Outcome

The present study did a macro-level Landslide Hazard Zonation map of 50 km² area on 1:50,000 scale along National Highway-52A 1 km wide corridor from Banderdewa - Itanagar - Gohpur (Holongi) (in parts of Toposheet Nos 83E/12,16, and 83F/9), Papum Pare District, Arunachal Pradesh. The study involved 500 m wide strip mapping on both sides of National Highway-52A from Banderdewa - Itanagar - Gohpur (Holongi, Papum Pare district in Arunachal Pradesh, bounded by Latitude 26.96599° to 27.12805° and Longitude 93.62113° to 93.84335° covering approximately 50 km² area. The area is characterized by steep to moderately steep hill slopes carved by young drainage system. The altitude varies from a mere 50 m in the river valley to 400 m on the hill tops. The important tributaries of Dikrong and Ganga flow through the study area.

The Landslide Hazard Zonation Map has been prepared according to Total Estimated Hazard (TEHD) of each facet. The TEHD of the facet is calculated after adding the Landslide Hazard Evaluation Factor (LHEF) values of all 10 geo-environmental parameters encompassing the particular facet. This would serve as the base map to identify the geo-environmentally favorable sites for the planning of any developmental scheme as well as for adopting appropriate remedial measures in unstable hazard-prone areas. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority



Study Title

Anti-erosion Work over Dollung River at Dollungmukh Circle under Lower Subansiri District in Arunachal Pradesh

Implementing Institution

WAPCOS Limited

Project Location/Completion Year

Arunachal Pradesh, 2011

Objective

- To prevent bank erosion and to guide the river flow straight towards the down stream
- To restrict the over flow into agricultural land about 150 ha along the river bank
- To save the lives, properties, and standing crops from over flooding of River Dollung

Study Recommendation

- The village administration should be brought down to Taluk level so that all the development programmes under NREGA can reach the villages situated at a distance from development block
- Present target of 100 days employment per household should be increased to at least 150 days
- Wage rate should have parity with outside rate and ongoing price hike, which would reduce the migration of labour from village to nearby township or city
- Auditing may be done through an extra government agency in addition to Gram Panchayat to check mishandling of fund
- Panchayat should be empowered financially and job responsibility should be distributed to all the elected members
- All natural water bodies and forest areas should be brought under NREGA programme to make it income-generating units

Analysis and Outcome

The purpose for which the project proposal was approved by the North East Council has been fully achieved. Under Water Resource Department, a number of works related anti-erosion were successfully implemented over River Dollung at Dollungmukh circle in Lower Subansiri District in Arunachal Pradesh.

Study Title

Final Report on Seismic Microzonation of Dibrugarh City, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2020

Objective

To generate a comprehensive database for future urban planning and disaster mitigation based on standard operation procedures given by GSI and MoES.

Study Recommendation

- Design and Construction of Buildings – code of practice and ISS 6922:1973 criteria for safety and Design of structures Subject to Underground Blast is recommended for future Dibrugarh development.
- In addition to this, fault indication is observed in geophysical and subsurface geological studies, as discussed in Chapter 5. Hence, a detailed neotectonic study in and around Mancotta, Sessa Nalla, and along Brahmaputra River will give more details on the active nature of the underlying fault, which will be essential for predicting an earthquake and future urban planning.

Analysis and Outcome

Seismic microzonation of any region is done with the aim of creating database for the future developmental activities and mitigating disaster. The recommendation of the present study is very potential. It suggested to follow the ISS 6922:1973 criteria for safety and design of structures. As the recommendation is very recent, it is partially implemented. To implement the recommendations, such a kind of study should be carried out for each seismic active region for safety purposes. The current study also indicated the presence of fault in geophysical, which are key to predict earthquake. Therefore, the neotectonic study of Mancotta, Sessa Nalla and along Brahmaputra River should be studied thoroughly. In addition, there is an urgent need to do such study in all regions with seismic active areas and having fault to avoid earthquake and for safe urban planning.

Implementable recommendations:

- Code of practice and ISS 6922:1973 Criteria for safety and design of structures subject to underground blast
- Detailed neotectonic study in and around Mancotta, Sessa Nalla, and along Brahmaputra River

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Directorate of Geology & Mining (State Government)



Study Title

Macro - Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83 F/1, 2, 5, 6, 10, 15 and 83 B/9, 13 In Karbi Anglong, Sonitpur, Nagaon and Golaghat Districts of Assam.

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2019

Objective

To prepare landslide susceptibility map using heuristic method and multi-class index overlay technique on GIS platform.

Study Recommendation

- If end users intend to use only the susceptibility map for land use planning, then no public or personal utility projects should be considered in highly susceptible areas, strict land-use policies and regulations should be imposed in moderate susceptible areas and constructions with simple slope stability measures be allowed in low susceptible areas.
- Geological and/or geotechnical studies of the area, slope stability assessment, appropriate civil structure designs for mitigative measures depending on the varied results of the aforementioned aspects be carried out earlier in the development process.
- It is recommended that more priority should be given in spreading awareness amongst people through Community Based Disaster Management Programme (CBDMP). The awareness should include information about the potential danger, its identification and its communication; the physical significance of hazard and inherent uncertainties; ways to reduce landslide risk and the available local mitigation options.

Analysis and Outcome

The geophysical mapping epitomize the geology of an area by illuminating those features and subsurface which are not apparent from a geologic map alone. The macro - scale (1:50,000) mapping of toposheets Nos. 83 F/1, 2, 5, 6, 10, 15 and 83 B/9, 13 In Karbi Anglong, Sonitpur, Nagaon and Golaghat Districts of Assam was done to prepare landslide susceptibility map of the same. The report analysed that the susceptibility map is very useful for the users intended to developmental activities. The report recommended not to consider any public or personal utility projects in highly susceptible areas which is highly appreciable. In moderate susceptible areas, there should be strict land use policies and regulations. The report allowed the construction with simple stability measures in low susceptible areas. The study suggested that the developmental activities in the moderate susceptible zones should be treated with utmost care. It advocated that the prior analysis of slope stability, geological studies, and appropriate civil structure designs should be done before starting any kind of developmental activities to mitigate the landslide. One of the important recommendation of the current study was spreading awareness amongst the people through community based disaster management program. Further, it suggested that the awareness program should include the level of hazard, identification and communication of hazard, the possible mechanism of safety from these hazards and other local mitigation measures.

Implementable recommendations:

- Spreading awareness amongst people through Community Based Disaster Management Programme.
- No public or personal utility projects should be considered in highly susceptible areas
- High and moderate susceptible zones should be treated with utmost care while carrying out any developmental activities.
- Identification of potential landslide hazard
- Possible ways to reduce the risk of landslide

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Directorate of Geology & Mining (State Government)



Study Title

Macro-scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet NOS. 83 B/15, 83F/3 & 83 F/4 in Karbi Anglong and Nagaon Districts of Assam

Implementing Institution

Geological Survey of India, State Unit: Assam

Project Location/Completion Year

Assam, 2019

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs,
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input thematic maps
- To prepare landslide susceptibility map using Multi-class index overlay method in a GIS platform.

Study Recommendation

Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Surma and Barail country rocks since it has been established that the response of the overburden material on hillslopes to landsliding is largely or directly controlled by the underlying lithology.

Analysis and Outcome

The macro-scale mapping (1:50,000) in Karbi Anglong and Nagaon districts of Assam was done to prepare landslide inventory database using various remote sensing data and field input. This study was intended to prepare landslide susceptibility maps to help the future developmental activities in low susceptibility slopes. The recommendations of the project have been implemented in hillslopes underlain by Surma and Barail country rocks. Such kind of study must be encouraged in the other hilly regions of country too. The incident of landslide of the overburdened material on hillslopes is directly controlled by the lithology of the underlying mass. Therefore, the macro scale mapping (1:50000) in parts of Toposheet NOS. 83 B/15, 83F/3 & 83 F/4 would help to future developmental planning. The recommendations of the current report are highly acceptable.

Implementable recommendations:

- Expansion of township
- Development of infrastructures
- Development of passes, roads, etc.

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Directorate of Geology & Mining (State Government)

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83 F/7 and 83 F/8 In Karbi Anglong District of Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2019

Objective

To prepare a landslide susceptibility map using the heuristic method and multi-class index overlay technique on GIS platform.

Study Recommendation

- In the current study, only 3.3% (45.6 sq. km) of the total area is classed as highly susceptible. Moderately susceptible area accounts for 14.86% (205.51 sq. km), while low susceptible area accounts for 81.85% (1131.98 sq. km).
- If end users intend to use only the susceptibility map for land use planning, then no public or personal utility projects should be considered in highly susceptible areas, strict land-use policies and regulations should be imposed in moderate susceptible areas and constructions with simple slope stability measures be allowed in low susceptible areas.
- Slope modification and construction on slopes are inevitable due to development, increase in human population, and flat land becoming a scarce resource. Therefore, the identified high and moderate susceptible zones should be treated with utmost care while carrying out any developmental activities.
- Geological and/or geotechnical studies of the area, slope stability assessment, appropriate civil structure designs for mitigative measures depending on the varied results of the aforementioned aspects are carried out earlier in the development process



Analysis and Outcome

The purpose of macroscale mapping in parts of toposheets Nos. 83 F/7 and 83 F/8 in Karbi Anglong District of Assam was to prepare a landslide susceptibility map. The study revealed that out of the total area, only 3.3% area (45.6 sq. km) was classified as highly susceptible region, 14.86% area (205.51 sq. km) was considered as moderately susceptible whereas 81.85% area (1131.98 sq. km) was accounted as low susceptible. The recommendations of the project have been implemented. The report analysed that the susceptibility map is very useful for the users intended to developmental activities. The report recommended not to consider any public or personal utility projects in highly susceptible areas which is highly appreciable. In moderate susceptible areas, there should be strict land use policies and regulations. The report allowed the construction with simple stability measures in low susceptible areas. The study suggested that the developmental activities in the high and moderate susceptible zones should be treated with utmost care. It advocated that the prior analysis of slope stability, geological studies, and appropriate civil structure designs should be done before starting any kind of developmental activities to mitigate the landslide.

Implementable recommendations:

- No public or personal utility projects should be considered in highly susceptible areas
- High and moderate susceptible zones should be treated with utmost care while carrying out any developmental activities.
- Development of passes, roads, etc.

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Directorate of Geology & Mining (State Government)

Study Title

Flood of North Lakhimpur vis-a-vis Ranganadi Hydropower Project

Implementing Institution

Indian Institute of Technology, Guwahati

Project Location/Completion Year

Assam, 2018

Objective

To explore what kind of measures NEEPCO, State Government and other relevant organization can take, so that flood hazard/havoc in the downstream of the dam can be avoided

Study Recommendation

- An improved inflow forecasting model along with adequate infrastructure for capturing spatio-temporal variation of precipitation in the upper catchment is necessary.
- NEEPCO should make arrangements for increasing the frequency of recording reservoir level/storage to know what flow actually has reached the reservoir.
- Automated system can be introduced to have record of water level in a data logger after every 15 minutes.
- A mechanized Trash Rack cleaner should be installed by NEEPCO. Operation of already installed siren should be ensured.
- Embankments should be completed with full specification to avoid failure in the coming flood season.
- A multi-purpose storage reservoir can be planned at upstream of the existing dam with flood cushioning provision.
- Steps should be taken for reducing sediment loss from the basin through implementation of Ecological Management Practices (EMPs) in the catchment area of reservoir.

Analysis and Outcome

As per [44] NEEPCO 43rd Annual Report 2018 – 19 under Technology Adsorption all the recommendations of the present study have been implemented successfully. Installation on of state of the art dam safety monitoring system of existing dams by installing Global Navigation Satellite System (GNSS) Equipment, Geodetic Equipment, Seismic Sensors, dam safety monitoring software etc., with 24x7 connectivity between control room located at respective project sites and central control center at NEEPCO HQ, Shillong has been commissioned at Kopili HEP on 06.08.2018, Ranganadi HEP on 01.10.2018 and Doyang HEP on 20.02.2019. The system shall provide real-time information / data for monitoring the safe performance during normal operation by providing more comprehensive information and to manage or predict unsatisfactory performance. Integration of all the remote-controlled centers with Central Control Center at Shillong is in progress. Inflow forecasting system for 405 MW Ranganadi H. E. Plant (RHEP), Arunachal Pradesh is in progress with the assistance of the North-Eastern Space Applications Centre (NESAC), Department of Space, Govt. of India, by using state of the art technology involving installation of 17 nos. Automatic Weather Station (AWS) and 4 nos. Doppler-based Digital Water Level Recorder (DWLR). Installation of 4 nos. of DWLR and 17 nos. of AWS have been completed. Manual collection of data from the instruments is continuing.



Study Title

Critical Decision Pathways on Urban Flooding in Guwahati

Implementing Institution

Center on Globalization
and Sustainable Development (CGSD) at
the Earth Institute of Columbia University

Project Location/Completion Year

Assam, 2014

Objective

To describe processes and decisions that comprise the Kamrup (Metro) District and Guwahati City governments' key attempts to mitigate, prepare for, and respond to urban flooding.

Study Recommendation

- Mitigation: comprehensive planning of commercial and residential development, protection of crucial ecosystems, and systematic and modern designing and maintenance of key infrastructure. Protection of water bodies, and clear and permanent delineation of water body boundaries.
- Preparedness: regular coordination among many different government departments, clear delineation and proper execution of responsibilities for managing the city's drainage system, and reliable and comprehensive solid waste management.
- Response: pumping equipment; a city-wide Standard Operating Procedure for coordinating pumping operations, based on practical spatial considerations (and not agency isolation) should be drawn up to replace the current pumping operations that function purely as reaction to localized water levels.

Analysis and Outcome

In most years, Guwahati experiences frequent urban flooding events that bring the city to a standstill, disrupting traffic, shutting businesses, hampering daily routines, and inflicting substantial property damage. The current study described the processes and decisions that attempt to mitigate, prepare for, and respond to urban flooding. Such kind of study is useful in the mitigation of the impact of flood [64]. The report recommended an inclusive planning for the development of commercial and residential areas. The report also recommended to build co-ordination in intergovernmental departments and execution of responsibilities. Such responsibilities will help in managing the drainage system of the city. The city-wide standard operating procedure for coordinating pumping operations was also recommended. The analysis of the report revealed that the recommendations were very essential for mitigating the flood problems. The recommendations were considered and implemented completely [65].

Implementable recommendations:

- Comprehensive planning of commercial and residential development
- Protection of crucial ecosystems
- Systematic and modern designing and maintenance of key infrastructure
- Regular co-ordination among many different government departments
- Execution of responsibilities for managing the drainage system of the city
- Coordinating pumping operations were also recommended

Agencies responsible for implementation:

- Ministry of Water Resources, River Development and Ganga Rejuvenation
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Assam State Disaster Management Authority

Study Title

Flood Damage Mitigation Measures for Barak Valley in South Assam Including Effects of Climate Change

Implementing Institution

National Institute of Technology, Silchar

Project Location/Completion Year

Assam, 2014

Objective

To study effectiveness of the existing flood control measures in Barak valley and to recommend suitable measures for mitigating flood damages

Study Recommendation

- Flow section details and sectional profiles may be used by Water Resources Department and Inland Water Transport Department etc. for various planning works such as planning anti river bank erosion measures; in designing and construction of bridges across the rivers; designing of sluice gates etc. for adopting flood control measures and selecting navigational routes.
- The department may utilize the UH developed for the watersheds to generate runoff from these area corresponding to a selected rainfall event obtaining drainage patterns, volumes of runoff generated, time to peak flow, peak flow volume etc. such information is required for planning and designing of bridges, designing anti erosion measures, planning and designing flood control measures etc. Slope map, drainage map and digital elevation models developed for the watersheds are useful to Agricultural department and water resources,
- Forest, Soil Conservation department and also to the district administration for various planning works.



Analysis and Outcome

A flood is an overflow of water that submerges land that is usually dry. Flood is one of the greatest natural hazards which result in disastrous loss to biodiversity, economy, human settlements, etc. on a wide range [59]. Assam is very prone to flood because of its vast network of rivers. Therefore, have a negative impact on overall development of the state. The Brahmaputra and Barak River with more than 50 numbers of tributaries feeding them, causes the flood devastation in the monsoon period each year. The flood and erosion problem of Assam is singularly different from other states. The duration of flooding and the magnitude of erosion are concerned and are probably the most acute and unique in the country [60]. The objective of the present study was analyzing the effectiveness of the existing flood control measures in Barak valley and to recommend suitable measures for mitigating the damages caused by flood. The recommendations of the report is partially implemented. The report recommended the Water Resources Department and Inland Water Transport Department use sectional profiles and flow section details for planning anti-river bank erosion measures for the construction and design of bridges across the rivers and designing sluice gate for adopting control measures. These departments are also recommended to use UH developed for watershed to generate runoff from these areas corresponding to a selected rainfall event obtaining drainage patterns, volumes of runoff generated, time to peak flow, peak flow volume etc.

Implementable recommendations:

- Use of sectional profiles and flow section details for planning anti-river bank erosion measures
- Use of UH developed for watershed

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board
- Ministry of Water Resources, River Development and Ganga Rejuvenation
- Rastriya Barh Ayog (RBA)

Study Title

Review of Studies on Urban Floods in Guwahati From Flood Knowledge to Urban Action

Implementing Institution

All India Disaster Mitigation Institute (AIDMI)

Project Location/Completion Year

Assam, 2014

Objective

The objective of the study was to find out studies on flash floods in Guwahati with specific attention to disaster and climate change risk related issues and to compile their findings and recommendations under one umbrella that exhibits short term and long term actions. However, as mandated this was not meant for academic purposes but rather for simplifying and defining unified and inclusive action points for bringing a solution to this problem.

Study Recommendation

- Regular monitoring of the wetland and hill using various modern techniques,
- Continuous environmental awareness program among local people.
- Alternative livelihood options to those depended upon the Beel.
- Proper enforcement of the policies.
- Afforestation around the barren area.
- Minimize the encroachment around the Beel and hill area. Unauthorized encroaches are to be evicted from vulnerable points for which strict legislative control will be necessary.



Analysis and Outcome

Guwahati is located at the bank of Brahmaputra as well as several of its tributaries pass through the city. There has been a rapid urban growth in Guwahati, which have degenerated the natural ecology and environment of the city. The unplanned growth and encroachment have led the wetlands under threat. The city is very much prone to floods and landslides. The objective of the current study was to identify studies done so far on flash floods in Guwahati with specific attention to disaster and climate change risk-related issues, a compilation of all the findings and recommendations. Such kinds of study are very useful in investigating the whole study and preparing an up-to-date report so that the lack could be found to mitigate the target [64]. The report recommended a regular monitoring of wetlands using modern techniques, creation of environmental awareness, suggesting alternate livelihood options, proper enforcement of the politics, afforestation, and minimization of encroachment. The analysis of the report corroborated that the recommendations of the study were considered seriously and implemented well. But such kind of study should go continuously for mitigating future flood disasters [66].

Implementable recommendations:

- Regular monitoring of the wetland and hill using various modern techniques,
- Creating environmental awareness program
- Suggesting alternative livelihood options
- Proper enforcement of the policies.
- Afforestation
- Minimize the encroachment around the Beel and hill area.

Agencies responsible for implementation:

- Ministry of Water Resources, River Development and Ganga Rejuvenation
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Assam State Disaster Management Authority

Study Title

Risk Factors for Urban Flooding in Guwahati

Implementing Institution

Center on Globalization
and Sustainable Development (CGSD) at
the Earth Institute of Columbia University

Project Location/Completion Year

Assam, 2014

Objective

To analyze urban flooding in Guwahati

Study Recommendation

- Standard Operating Procedures (SOPs) need to be followed, for the work of agencies as well as for coordinating inter-agency efforts
- It also proposes allocating less than the amount recommended for transportation and communications, instead allocating much more land to open spaces and recreation

Analysis and Outcome

The drainage system of the Guwahati is devoid of having potential to handle the extra volume of water. The unplanned development and encroachment has increased the surface run-off, decreased the absorptive capacity of wetlands and other natural water bodies. The secondary and tertiary drains have no capacity to store storm water and get filled with silt quickly brought from the hills, exacerbated by landslides that block the flow. Such happenings increase the risk of devastating floods in urban Guwahati. The current study was aimed at analyzing the urban flooding in Guwahati. This kind of study is very useful in planning to mitigate the impact of floods in urban areas [65]. The report of the recent study did not suggest the desired recommendations and were partially implemented too. The possible recommendations might be focusing on the proper management of secondary and tertiary channels for reducing the risk of flood. The analysis of the report analyzed that urban flooding risk factors were interconnected and reinforcing, more so than generally acknowledged.

Implementable recommendations:

- Management of secondary and tertiary channels of river
- Regular monitoring of the wetland and hill using various modern techniques,
- Proper enforcement of the policies.

Agencies responsible for implementation:

- Ministry of Water Resources, River Development and Ganga Rejuvenation
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Assam State Disaster Management Authority



Study Title

A Final Report on Remote Sensing Interpretations of Bhramaputra Basin With Special Emphasis on Flood Control on 1:50,000 Scale Around Dhemaji District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2013

Objective

Remote sensing interpretations of Bhramaputra basin with special emphasis on flood control on 1:50,000 scale around Dhemaji District, Assam

Study Recommendation

- Interlinking network of deep surface and subsurface canals joining rivers like Sisi and Jiyadhol may be constructed which do not meet the Brahmaputra River.
- Concrete reinforced dykes and embankments may be a good solution to prevent the flood related damage.
- Weather stations may be installed at Siji (27°44'06" N/94°42'56" E), Silapathar (27°35'47"N/94°43'23" E), Telam (27°44'06" N/94°42'56"E), Dhemaji, and Simen Chapori with routine 3 -hour interval monitoring.

Analysis and Outcome

A Geomorphological, Lineaments, and Flood Hazards mapping item with the help of Remote Sensing studies had been taken up in the Field Seasons 2010 – 2012 on 1:50,000 scale in parts of Dhemaji District of Assam. Present study in this area includes preparation of present day geomorphological map with delineation of major structural elements like faults, lineaments, etc., demarcation of the Northwestern Valley Wall, and demarcation of extents of present day flood plain area, riverine features like braided channels, point bars, etc. in the Brahmaputra River Basin and its tributaries. Such kind of study is very useful in predicting the potential of flood and its impact on nearby areas [75]. The study recommended to build interlinking network of canals joining rivers like Sisi and Jiyadhol. The analysis of the report revealed that the recommendations were essential and considered seriously. It was found that the recommendations of the study were implemented well [75].

Implementable recommendations:

- Construction of interlinking deep surface and sub-surface canals joining important rivers
- Installation of weather stations at selected places
- Construction of concrete reinforced embankments
- Construction of series of check dams and flood detention reservoirs
- Implementation of Early Flood Warning System in the entire Dhemaji District, and making the local people aware of the things to do and not to do during flood.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- India Meteorological Department
- Ministry of Water Resources, River Development and Ganga Rejuvenation

Study Title

Climate Disaster Risk Tools in the Context of Urbanization in Guwahati

Implementing Institution

Center on Globalization
and Sustainable Development (CGSD) at
the Earth Institute of Columbia University

Project Location/Completion Year

Assam, 2013

Objective

To provide instructions on how to use the tool database to understand the landscape of available tools with a focus on identifying tools that are appropriate to the user's needs

Study Recommendation

Recommendation has not been outlined in the report.

Analysis and Outcome

The average of at least 30 years of weather conditions is known as climate and the long term shift in weather pattern is called climate change. The changing climate has increased the risk of disaster such as floods, drought, global hunger, etc. Therefore, it has become very urgent to identify and implement the tool helpful in the risk of climate disaster. The objective of the current study was to provide the instruction on using the tool database to understand the landscape of available tools with a focus on identifying tools appropriate to the need of the user. In the present study, several valuable components of a relevant tools were identified. Such kinds of studies are useful in mitigating the climate change smartly. The report recommended to undertake the development of a suite of tools that could be used in conjunction with existing tools which are more appropriate to the climate related disaster risks of Guwahati. The analysis of the report identified that the recommendations of the report were very genuine and could help in mitigating the climate disaster [76]. The analysis also revealed that the recommendations were implemented completely.

Implementable recommendations:

- Development of a suite of tools

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- India Meteorological Department
- Geological Survey of India
- Ministry of Water Resources, River Development and Ganga Rejuvenation



Study Title

Flood Damage Mitigation: Report1 & Report 2

Implementing Institution

National Institute of Technology, Silchar

Project Location/Completion Year

Assam, 2013

Objective

- Assessment of existing flow capacity for different channels in the river system.
- Assessment of effectiveness of existing embankments in the study area
- Improvement works for lateral channels and natural reservoirs
- Investigation on sediment load in the river system and erosion potential for different sub catchments.
- Evaluation of impacts of flows from upstream catchments on downstream flood flows
- Development of an improved flood forecasting tool for the study area
- incorporating flow contribution from gauged and ungauged catchments
- Evaluation of effects of climate change on flood flows in the river system.

Study Recommendation

- River Kushiara: - Suitable anti erosion measures may be under taken to protect these places from erosions. - An additional sluice gate preferably in areas near Chanbazar may help much in regulating the accumulated water as well as in protecting the greater Karimganj town area from drainage congestion.
- River Longai: - Raising and strengthening existing embankment - To reduce flood related damages and water logging in Nilambazar and Nilambazar-Krishnanagar area in southern part of Karimganj District additional sluice gates are required to regulate the flows. - One number of sluice gate over Churia Jhumjhumi Channel near village Muraure in Karimganj district needs to be modernized and reconstructed for proper functioning.
- Hailakandi District: - Improvement in the functioning of sluice gates at Pola Channel, Hatia Diversion and Lalatol sluice. - Raising and Strengthening of Existing embankments along river katakhal. - Clearing of the blockages in Jita Nadi.
- Cachar District: - Construction of sluice gate at Kandhigram area along left bank of river Barak on the dyke from Badarpur to Bhanga is required to improve drainage congestion. - Raising and strengthening of embankment along Sonai River.

Analysis and Outcome

The Barak river system is the second largest system in the North Eastern region which drains 26,193 Sq. Km in India with approximately 6562 Sq. Km from the state of Assam. It receives huge number of minor tributaries and 20 major tributaries out of which 12 are wholly in India. The major objective of the current project was the study of effectiveness of the existing flood control measures in Barak valley. The recommendation of suitable measures for mitigating flood damages was also an important objective of this study. Such kind of study is useful in investigating the capacity of current measures of flood control [72]. The analysis of the report revealed that it recommended to take a suitable antierosion measures at River Kushiyara for protecting from erosions. Another recommendation was to set an additional sluice gate in areas near Chanbazar for regulating the accumulated water as well as in protecting the greater Karimganj town area from drainage congestion, raising and strengthening of the existing embankment at river Longai, etc. The analysis of the report concluded that the recommendations made were very important which can play an important role in mitigating floods. It was analyzed that all the recommendations were implemented well.

Implementable recommendations:

- Raising and strengthening of the existing embankment at river Longai, katakhal Sonai River
- Construction of sluice gate at Chanbazar, Churia Jhumjhum Channel near village Muraure in Karimganj district, Pola Channel, Hatia Diversion and Lalatol, Kandhigram area
- Clearing of blockage at Jita river

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Ministry of Jal shakti
- Ministry of Water Resources, River Development and Ganga Rejuvenation



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 83 H/9 and 83 H/10 Falling in Tamenglong and Noney Districts of Manipur

Implementing Institution

Geological Survey of India, State unit:
Manipur – Nagaland

Project Location/Completion Year

Manipur, 2019

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs,
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input thematic maps
- To prepare landslide susceptibility map using Multi-class index overlay method in a GIS platform.

Study Recommendation

Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Surma and Barail country rocks since it has been established that the response of the overburden material on hillslopes to landsliding is largely or directly controlled by the underlying lithology

Analysis and Outcome

The macro scale mapping (1:50,000) in Tamenglong and Noney districts of Manipur was done to prepare landslide susceptibility map. The major objective of the study was the preparation of landslide inventory database using high resolution remote sensing data and field inputs. The current study is useful in combating the hazard like landslide and mitigating its impact [86]. The report of the study recommended that the expansion of township, development of infrastructure and future developmental planning to be carried out in the designated low susceptibility slope, especially in those hillslopes underlain by Surma and Barail country. It has been an established fact that the response of the overburdened material on hillslopes to landsliding is directly controlled by the underlying lithology. Therefore, the mapping and detailed study of underlying rocks is very important to prepare the landslide inventory database. The analysis of the report revealed that the recommendations made here were partially implemented.

Implementable recommendations:

- The developmental planning should be carried out in low susceptibility slope.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Society of India (GSI)

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 83H/15, 83L/03 and L/07 Falling in Chandel, Tengnoupal and Thoubal Districts of Manipur

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2019

Objective

- Preparation of landslide inventory database using high resolution remote sensing data, archival information and field inputs,
- Preparation of spatial database for geofactors of landslides
- Categorization of the hillslope in terms of landslide susceptibility.

Study Recommendation

- The area near Tengnoupal town, Tengnoupal-Wamko section, Tengnoupal-Sita fall under high susceptible zone. These areas consist of highly jointed rock, steep slope, consequent slope that leads to the occurrence of number of slides.
- Site-specific study may be conducted to landslide (LS-31) near Angbreshu village which is a natural slide. That will provide a fair idea about the cause and mitigation measures of many slides in the area. That way it will help in taking preventive measures in future

Analysis and Outcome

The macro-scale mapping (1:50,000) in Chandel, Tengnoupal and Thoubal districts of Manipur was done to prepare landslide inventory database using high resolution various remote sensing data, archival information and field input. This study was intended to prepare landslide susceptibility maps which could help the future developmental activities in low susceptibility slopes. The preparation of spatial database for geofactors of landslide and its categorization of the hillslopes in the terms of landslide susceptibility were also its major objectives. Such kind of study is useful in combating the landslide hazards [85]. The report of the study recommended the areas of Tengnoupal town, Tengnoupal-Wamko and, Tengnoupal-Sita as high susceptible zone. It recommended to conduct the site specific study to landslide (LS-31) to investigate about the cause and mitigation measures of many slides in the area. The analysis of the report concluded that the recommendations of the study were partially implemented

Implementable recommendations:

- Categorization of Tengnoupal town, Tengnoupal-Wamko section under high susceptible zone –
- Conduct the site specific study to landslide (LS-31)

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Society of India



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83L/05, L/06 and L/10 Falling in Imphal East, Ukhrul, Kamjong and Kangpokpi Districts of Manipur

Implementing Institution

Geological Survey of India, State unit:
Manipur – Nagaland

Project Location/Completion Year

Manipur, 2019

Objective

- Prepare landslide inventory database using high resolution remote sensing data and field inputs,
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input maps,
- To prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Lower Barail country rocks, since it has been established that the response of the overburden material on hillslopes to landsliding is largely or directly controlled by the underlying lithology.

Analysis and Outcome

The macro-scale mapping (1:50,000) in parts of toposheets Nos. 83L/05, L/06 and L/10 falling in Imphal East, Ukhrul, Kamjong and Kangpokpi districts Manipur was done to prepare landslide inventory database using high resolution various remote sensing data. This study was envisioned to prepare toposheet-wise 1:50,000 scale spatial database for investigating all the geofactors of landslides. Such kind of study is very useful in forecasting and combating the landslide [86]. The report of the study recommended to use low susceptibility slope for the expansion of township, development of infrastructure and future developmental planning. It has been a established fact that the response of the overburdened material on hillslopes to landsliding is directly controlled by the underlying lithology. Therefore, the report recommended the mapping and detailed study of underlying rocks for preparing the landslide inventory database. The analysis of the report revealed that the recommendations made here were partially implemented and more studies has to be done.

Implementable recommendations:

- The developmental planning should be carried out in low susceptibility slope.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Society of India (GSI)

Study Title

Seismic Microzonation of Imphal City, Manipur

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2019

Objective

To delineation different seismic hazard levels by considering different influencing parameters within the Imphal master plan area. The item was formulated for two years duration which was initiated during FS: 2017-18 and continued up to March, 2019. In order to achieve the desired objectives, the geological component was taken up by the Earthquake Geology Division, the geophysical component comprising noise and resistivity survey was taken up by the Geophysics Division and the Standard Penetration Test was carried out by the outsourced driller.

Study Recommendation

The present study has been carried out at Level B stage i.e., 1:25000 scale as per the GSI guidelines. However, Level C microzonation would help in providing site-specific recommendations for the identified very high and high hazard zones. The present work primarily aims to classify the study area into high, medium and low hazard zones based on predictive parameters. It should be noted that the term high, medium and low hazard are used relative to each other and not be judged in its absolute sense. It should be borne in mind that the whole of the study area falls in the Seismic zone V (highest seismic vulnerability zone) of the BIS classification (BIS 2000).

Analysis and Outcome

The process of subdividing an earthquake prone area into different zones with respect to some geological and geophysical characteristics of the sites such as ground shaking, liquefaction susceptibility, landslide and rock fall hazard, is known as Seismic microzonation. It helps in creating a basis for the site-specific Microzonation. The objective of the current study was delineation of different seismic levels by considering different influencing parameters within the Imphal master plan area. Such studies are useful in adapting safety measures against the earthquake^[87]. The report of the study recommended that the level C microzonation would help in providing site-specific suggestions for the identified high hazard zone. It recommended that the whole study area fall in the seismic zone V of the BIS classification. It was identified from the report that the recommendations of the study were partially implemented.

Implementable recommendations:

- Level C microzonation would help in providing site-specific suggestions for the identified high hazard zone

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Society of India (GSI)



Study Title

Petrological and Petrochemical Characterization of the Volcanics and Volcaniclastics As Well as the Mafic Intrusives Within Shillong Group Rocks of East-Central Meghalaya and Adjoining Areas of Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2019

Objective

- Facies classification of the volcanics and volcaniclastics of Shillong Group of rocks.
- Establishing a tectono-stratigraphic model of evolution of Shillong basin based on petrological, petrochemical and geochronological studies of the volcanic and intrusive rocks.

Study Recommendation

- Mapping of the aerial extension of the intrusive bodies is beyond the scope of the present investigation. In some part, the Khasi meta basics show sulphide mineralization along with chalcopyrite and bornite. So, more detailed work can be taken up to map the aerial extension of these mafic intrusives with a view to look for the PGE potential.
- The younger intrusive related to Cretaceous volcanism and magmatism is intrusive to the SG as well as basement gneissic complex. More petrographic and geochemical studies are needed to characterize these younger mafic intrusive phase.
- The tectonic setting of the Shillong Basin needs further studies in relation to the MGC. -Presence of Ba more than 7.8 wt% in the meta-tuff exposed along the NEHU bypass need further study for possibility of barite deposits. It may be an erroneous value. If not, it can be investigated for its extensional area.

Analysis and Outcome

The Shillong Group of rocks lies unconformably over the Archaean gneissic complex and is represented by the Paleo-proterozoic meta-sedimentary sequence of Tyrsad Formation and Meso-proterozoic arenaceous Barapani Formation [102]. The study was aimed at classifying the volcanic and volcanoclastic of Shilong group. The establishment of tectonostratigraphic model of Shilong evolution was also targeted. The report recommended that as per the objectives of this study, the mapping of the aerial extension of the intrusive bodies was not required. Further, it was recommended to have a detailed work of mapping the aerial extension of mafic intrusives, etc. The analysis of the report identified that the recommendations given by the report were very important [103]. These studies will help in categorizing volcanics and volcanoclastic kinds of rocks present in Shilong group. The analysis of the report found that all the recommendations were partially implemented and are yet to be implemented because such a study needed another project to work on the recommendations.

Implementable recommendations:

- Detailed work of mapping the aerial extension of mafic intrusives
- Detailed petrographic and geochemical studies for characterizing younger intrusive mafic
- Further study to investigate possibility of barite deposits in Shillong Basin

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Final Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets 78 O/04, O/08, O/11, O/12 & O/16, Parts of East Khasi Hills, South West Khasi Hills & South Garo Hills Districts, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs.
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input thematic maps.
- To prepare landslide susceptibility map using Multi-class index overlay method in a GIS platform.

Study Recommendation

- The susceptibility map is actually meant for regional application because the information is shown on scale 1:50,000. Areas falling in high susceptibility zone should be given due attention through large scale slope stability studies while executing any civil constructions.
- The 80.47% of the area falls in low susceptible zone. The near-flat, gentle to lowly undulating slopes in the classified low susceptible zone may be utilized for major developmental work with necessary precautions.
- Few recurring and conspicuous landslide are observed which recommended for the continuous monitoring and detailed site specific study such as Balat landslide, Borsora landslide, Arwa landslide.

Analysis and Outcome

The macro scale mapping (1:50,000) in Karbi Anglong and Nagaon districts of Assam was done to prepare landslide inventory database using various remote sensing data and field input. The objective of the present study was preparing the landslide inventory database with the help of high resolution remote sensing data. In addition, the preparation of spatial database for geofactor of landslide was also its objective. The present study is essential for identifying the landslide prone areas and mitigating its disastrous impact [115]. The analysis of the report identified few recommendations by this report. The first recommendation was giving attention to those areas which comes under high susceptibility zone. About 80.47% of the areas come under low susceptibility zone which might be utilized for the major developmental projects. The recurring and conspicuous landslides were recommended for the detailed site-specific study. The analysis of the project identified that the recommendations made by this study was utilized in the developmental activities [116]. Hence it is obvious that the recommendations were implemented well.

Implementable recommendations:

- The areas which comes under high susceptibility zone should be given attention
- Low susceptibility zone should be utilized for developmental projects
- Detailed site specific studies for recurring and conspicuous landslide.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Petrology and Geochemistry of the Felsic Volcanic Rocks of Shillong Group: Their Stratigraphic and Magmato-Tectonic Evolution With Respect to the Shillong Sedimentary Basin

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

The objectives of the study of felsic volcanic associated with Shillong group is to understand their genesis, stratigraphic status and tectonic evolution with respect to the Shillong Basin.

Study Recommendation

- The middle argillaceous unit needs to be mapped in detail to know the extent of the felsic volcanic to get a clear picture of its aerial extension.
- Autoclastic Nongkha conglomerate need to be studied further for its volcanic input as the matrix seems to be volcanic origin.
- The associated foliated Khasi Metadolerite/Metagabbro needs further study, as in some part it occurs as sills in concordant with the bedding. Probability of presence of volcanic facies of these rocks cannot be ruled out.
- These may be the basic volcanic associated with the initial rifting stage of Shillong Basin.
- More geochronological studies are required to resolve the age of the Shillong Group of rock and the associated meta volcanic rock.

Analysis and Outcome

The objective of the current study was to study petrology and geochemistry of felsic volcanic rocks which were associated with Shillong group for investigating their origin and stratigraphic status and tectonic evolution regarding Shillong Basin. Such study helps in understanding the basics geochemistry and rock pattern of the given area ^[123]. The report of the study recommended the mapping of middle argillaceous unit in detail. It also recommended to study the associated foliated Khasi Metadolerite/metagabbro. In addition, it also recommended the geochronological studies for resolving the age of Shillong Basin. The analysis of the report revealed that the recommendations given for the study were very essential. All the recommendations were partially implemented.

Implementable recommendations:

- Mapping of middle argillaceous unit in detail
- Studying the associated foliated Khasi Metadolerite/metagabbro
- Geochronological studies for resolving the age of Shillong Basin

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets 83 C/4, 83 C/7 & 83 C/8, East Jaintia Hills, West Jaintia Hills & East Khasi Hills Districts, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2017

Objective

To prepare landslide susceptibility map using heuristic method and multi-class index overlay technique on GIS platform and classify the area into varying degree of landslide prone zones.

Study Recommendation

- Under such circumstances, any attempt to raise civil structures of importance on the slopes must consider the site specific suitability and criticality of the slope.
- It is recommended that the susceptibility map showing not only the potential landslide initiation areas but adjacent upslope or downslope should be further examined. Areas falling in high susceptibility zone should be given due attention while executing any civil constructions.
- Coal mining and limestone quarrying have been observed particularly in parts of Toposheet 83 C/7 and northern part of 83 C/8. Hence, it is recommended that efficient attempts be made to stabilize the slope during and after the excavation. Excavated material should be disposed of in suitable locations and any precariously hanging boulders and loose debris should be removed to reduce instability.
- A few stretch of the NH identified as moderate to high susceptible primarily the assorted debris that readily moves down towards the road bench should be dressed and removed with adequate number of culverts to drain of the debris, etc.
- Given the dynamic nature of landuse pattern of the people and their influence on slope stability and also the hazard posed by slope failures, it is only fair that awareness and contact programme between the masses and stake holders of the government are taken up from time to time to help disseminate knowledge about risk, mitigation and remedial measures of landslides.



Analysis and Outcome

The aim of the present study was the preparation of landslide susceptibility map using the heuristic method and multi-class index overlay technique on GIS platform and classify the area into varying degree of landslide prone zones. The current study is very useful for suggesting safety measures and mitigating the impact of landslide. It is also useful in identifying the regions of potential landslide [129]. The analysis of the report identified that the recommendations of the report were considerable and should be implemented to achieve the aim. It recommended that the susceptibility map which corroborates the initiation areas of potential landslide and adjacent upslope & downslope should be examined thoroughly. The high susceptibility zones should be given attention while construction of buildings or any infrastructures. It is recommended to stabilize the slope of these areas during and after excavating. Moreover, the excavated materials should be managed properly. It also recommended to create awareness of the landslides risk, mitigation, and remedial measures. The analysis of the report revealed that the recommendations were taken on priority and were implemented completely. Presently, no recommendations were left to be implemented.

Implementable recommendations:

- Examining thoroughly the landslide susceptible area as well as upslope and downslope
- Stabilizing the area during and after excavation

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Multi Hazard Risk and Vulnerability Assessment (HRVA) Report and Risk Atlas of Shillong City (Meghalaya)

Implementing Institution

Risk Modeling and Insurance

Project Location/Completion Year

Meghalaya, 2017

Objective

- To assesses hazard risks with a focus on climate-related hazards and how they are likely to be impacted by climate change.
- To integrate Disaster Risk Reduction initiatives into city development, including strengthening the institutional capacity for DRR activities and risk resilient urban planning.
- To investigate if the severity of thunderstorm and associated gale force winds in and around Shillong city could increase in future due to climate change induced rise in surface air temperatures.
- To demarcate the flood-prone area (extent), and assess its intensity and magnitude. Flood-prone areas are those areas subjected to inundation at a regular frequency.

Study Recommendation

- Decongestion of city and strict regulation of new construction in the high density vulnerable areas.
- Detailed vulnerability assessment of lifeline facilities, including hospitals and schools and other essential facilities and retrofitting, if required.
- Review development zone defined in Shillong urban master plan in the light of hazard risk maps generated.
- Construction of roads needs to consider landslide hazard map and slope of the area and provide proper drainage for easy water runoff
- Local level solid waste management strategies
- Update building bylaws and development control regulations to incorporate CC and hazard risks
- Develop effective enforcement mechanisms for building bylaws and development control regulations
- Details road and traffic survey to develop location specific solution to develop a good city road development plan
- Procurement of Specialized Equipments for Fire and Emergency Services

Analysis and Outcome

Shillong is very prone to thunderstorms and other natural hazards. This study aimed at investigating the severity of thunderstorms, demarcating the flood-prone areas and their magnitude. Such kind of study is very useful in early warning and mitigating the disastrous impact. The study recommended several points which were essential and very feasible for meeting the objectives. The analysis revealed that the recommendations were very important and implemented well ^[136].

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- National Disaster Management Authority



Study Title

Rainfall Induced Hazards Analysis of Mizoram

Implementing Institution

Mizoram Science, Technology and Innovation Council, MISTIC

Project Location/Completion Year

Mizoram, 2020

Objective

Identify various natural hazards induced by rainfall which can affect the state of Mizoram.

Study Recommendation

The study recommends for a strong adherence to "The Aizawl Municipal Corporation Site Development and Slope Modification Regulations, 2017" to reduce/mitigate hazards especially landslides which in the case of Mizoram are basically anthropogenically triggered.

Analysis and Outcome

In the present study, a relationship has been shown between hazards (landslides, cyclones and hailstorms) with rainfall within the state of Mizoram. Analysis of such recorded data reveals that most of the occurrences and the number of villages being affected increases with heavy rainfall events. Mizoram, especially the capital city of Aizawl has experienced numerous landslides, which have all too often caused loss of life and the destruction of homes, community buildings, and important infrastructure. Anthropogenic and developmental activities such as slope cutting, filling, and disposing of sewerage and drainage onto slopes in a poorly controlled manner plays a great role in triggering landslides. As such proper implementation and enforcement of "The Aizawl Municipal Corporation Site Development and Slope Modification Regulations, 2017", a very crucial initiatives taken up by the Aizawl Municipal Corporation is the need of the hour to reduce/mitigate hazards especially landslides which in the case of Mizoram are basically anthropogenically triggered. The recommendation of the study is partially implemented.

Study Title

A Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 84A/12 & 84A/16, Lunglei and Serchhip Districts, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2019

Objective

- Prepare a landslide inventory database using high resolution remote sensing data (Google earth and/or other satellite imagery) with field inputs.
- Prepare Toposheet-wise 1: 50,000 scale spatial database for geofactors of landslides for use as input thematic maps and ultimately
- Prepare a seamless landslide susceptibility map using multi-class index overlay method using a GIS platform.

Study Recommendation

- During road construction or road widening activities, mitigation measures such as optimal angle of slope cutting and construction of proper drainage system should be practised.
- Vulnerable drains and supply tanks near road and settlement areas should be concrete lined to minimize the risk.
- In areas where a number of gullies and streams cut the slopes, heavy monsoonal rains cause the streams to swell resulting in vigorous erosion and failure along its path. In such cases, indigenous materials and methods can be utilised viz. bamboo fences, sack/drum piling, log/bamboo support, etc.

Analysis and Outcome

The present study was carried on a scale of 1:50000 in Sol Toposheet nos. 84A/12 & A/16 covering 1429 sq. km. in parts of Lunglei and Serchhip districts of Mizoram. A total 407 landslides were mapped for landslide inventory. In the current study area, the sections along the rivers Tuipui, Tuichang, Delui and Phairuang are part of the low susceptible zone. However, the NS trending ridges and steeper valleys near the river valley are within the moderate to high susceptible zone. Most part of the high susceptible zone fall in the forest areas where roads and settlement are absent and therefore poses less risk in case of an event.

The relationship of geological units present in the study area with the occurrence of landslide also shows interesting ratios. It is iterated that landslides are caused by a combination of factors and the dynamics and conditions in a particular area are to be considered before any conclusion is made. This result shows that more detailed landslide studies are required to understand the dynamics of landslides particularly in this kind of terrain to bring about terrain specific and appropriate economically viable mitigation measures. The recommendation of the study is fully implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Transport Department
- State Disaster Management Authority



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets No. 84B/14 and 84B/15, in Lunglei, Lawngtlai and Saiha Districts, Mizoram

Implementing Institution

Geological Survey of India, State Unit:
Tripura & Mizoram

Project Location/Completion Year

Mizoram, 2019

Objective

- Preparation of landslide inventory database using high resolution remote sensing data, archival information and field inputs
- Prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input thematic maps
- Prepare landslide susceptibility map using Multi-class index overlay method in a GIS platform.

Study Recommendation

The susceptibility map is actually meant for regional application because the information is shown on scale 1:50,000 and can meaningfully serve as a contributing parameter for landslide hazard and risk evaluation indicating the vulnerability and the elements at risk. Therefore, it is recommended that a detailed site-specific study may be duly conducted before planning and execution of the civil construction works. The areas especially falling in high susceptibility zone should be given due attention while executing any civil constructions

Analysis and Outcome

The study carried out Landslide Susceptibility Mapping in parts of Lunglei, Lawngtlai, and Saiha districts of Mizoram and falling in parts of Survey of India Toposheet Nos. 84B/14 and 84B/15. Landslides inventory map was validated for accessible landslides and 42-parametric datasheet was prepared for 118 numbers of landslides. Of them, 81% of the slides are debris slide and the rest are rock slide, fall and subsidence. Most of these slides are located within a distance of 50m on either side of the road and probably might have resulted due to removal of crown/toe during the cutting of hill slope for road construction. Landslides caused under natural conditions vary in sizes and constitute about 49% of the inventory.

The susceptibility map produced will be useful for future planning and developmental activities (like creation of new projects) in the classified susceptibility zones and, identification and delineation of target areas for meso-scale (1:5,000/10,000) or detailed site-specific studies. The landslide inventory database with the susceptibility map can meaningfully serve as a contributing parameter for the geo-hazard assessment and evaluation of the area. The recommendation of the study is fully implemented.

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets No. 84E/04, 84F/01 and 84F/02, Serchhip, Lunglei and Saiha Districts, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2019

Objective

- Creation of dynamic National Landslide Susceptibility Geodatabase for India
- Preparation of GIS based seamless Landslide Susceptibility Maps of India on 1:50,000 scale
- Identification of landslide susceptible areas of the whole country on a scale of 1:50,000.

Study Recommendation

- The susceptibility map is actually meant for regional application because the information is shown on scale 1:50,000 and can meaningfully serve as a contributing parameter for landslide hazard and risk evaluation indicating the vulnerability and the elements at risk.
- The assessment of the landslide susceptibility is extremely important for such high vulnerable areas because it gives basic construction standards for new roads or buildings, helps to assess the impact of future landslides and can also be used to locate key facilities like hospitals, fire stations, etc.
- Conclusions derived from the generated LSM indicate that majority of the road corridor falls in the classified high susceptibility zone. Field studies have also shown that significant stretches of the road corridor are severely affected by very large landslides and prominent subsidence zones.

Analysis and Outcome

The study carried out a Landslide Susceptibility Mapping on Macro Scale (1:50,000) in parts of SOI Toposheet nos. 84E/04, 84F/01 and 84F/02 covering an area of 1356sq.km in parts of Serchhip, Lunglei and Saiha districts, Mizoram. A total of 81 landslides have been considered for study both from multi-temporal Google Earth imagery data and from the field investigations for the entire study area. 20 landslide inventories as per 42-point-geo-parametric data sheet have been documented during field traverses which includes 16 debris slides, 3 rock slides; and 1 rock falls respectively. The argillaceous dominant rock account for 83.94% (approx.) and the arenaceous dominant rock account for 16.05% of the total landslide distribution in the area. Most of the landslides are shallow translational failures with depth of slip plane less than 5m.

Even though rocky slopes (Phwangpui/Blue Mountain) falls in the low susceptible zone in the LSM but occasional rock fall may not be ruled out as evident from the presence of already fallen boulders along the road and even in some villages during the fieldwork. Although it is expected that land sliding will occur more frequently in the most susceptible areas, however, in the susceptibility analysis, no time frame and magnitude of event are explicitly taken into account.

Agencies responsible for implementation:

- Geological Survey of India
- State Road Transport Department
- State Urban Development Agency



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 84E/01, 84E/05, 83H/04 & 83H/08, Aizawl and Champhai Districts, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2018

Objective

- Prepare a landslide inventory database using high resolution remote sensing data with field inputs;
- Prepare Toposheet-wise 1: 50,000 scale spatial database for geofactors of landslides to be used as input thematic maps and categorisation of the hillslope in terms of landslide susceptibility map using weighted multi-class index overlay method in GIS platform.

Study Recommendation

In the study, along with long term remedial measures, recommendations which have more significance locally and practically viable are suggested for landslides collected during the field work.

- During road construction or road widening activities, mitigation measures such as optimal angle of slope cutting and construction of proper drainage system should be practised.
- Vulnerable drains and supply tanks near road and settlement areas should be concrete lined to minimize the risk.
- To control erosion due to monsoon rain, some indigenous materials and methods can be utilised viz. bamboo fences, sack/drum piling, log/bamboo support, etc. For temporary economic remedial measures, small areas of exposed cut slopes can be protected by covering with tarpaulin during heavy rains.
- For long term measures such as plantation of locally available varieties such as bamboo grass, vetiver grass, or such other plants with horizontally spreading roots are recommended for landslide prone area.
- Along the roads, channelling and lining of drainages are important to protect both the upslope and downslope areas.
- Slope moderation by removal or by benching where the slope is steep.
- Removal of locally jointed rock fragments and overhanging rock blocks.

Analysis and Outcome

The study carried out a Landslide susceptibility mapping of 1357 sq. km. was carried out on a scale of 1:50000 in parts of Sol Toposheet nos. 84E/01, 84E/05, 83H/04 & 83H/08 in Aizawl and Champhai districts of Mizoram. Ngopa, Suangpuilawn, Kawlbem, Mimbung and Phuaibuang are some of the important towns and villages. A total of 364 nos. of landslide inventory were recorded through remote sensing technique using Google Earth imagery and field work. Out of which, 159 nos. of landslide inventory were field validated and documented in 42-point format with 91 debris slide, 60 rock slide, 4 soil slide and 2 debris flow and 01 each of rock fall and subsidence.

About 24.4% (331.05 km² area) of the macro scale susceptibility map is under high susceptibility class. Moderate susceptible zone covers around 29.24% (396.7 km² area) while 46.3% (~629.1 sq. km.) of the total area lie in the low susceptible class in the of Survey of India Toposheet nos. 84E/01, 84E/05, 83H/04 & 83H/08 of Aizawl and Champhai districts of Mizoram. The recommendation of the study is fully implemented.

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets No. 84E/02 and 84E/06, Aizawl and Champhai Districts, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2018

Objective

- Categorization of the hillslope in terms of landslide susceptibility.
- Preparation of landslide inventory database.
- Preparation of spatial database for geofactors of landslides respectively.

Study Recommendation

- Detailed site-specific study may be duly conducted before planning and execution of the civil construction works.
- Several road sections in susceptible zones require planning, and may be implemented with remedial measures after proper understanding the properties of the slope materials and the hydrological condition in the area.
- Detailed study, including the geotechnical aspects of the slope forming material and its underlying bedrock as well as the hydrological conditions are highly recommended prior to the execution of any future developmental activity over the categorized high susceptible hillslopes. Detailed geological studies along the identified high susceptible stretches of the road, planned excavation and controlled dumping, etc., will go a long way in maintaining the stability of such identified slopes.
- Increasing awareness amongst people through Community Based Disaster Management Programme (CBDMP) and villages or communities located in and around high hazard areas should be given priority in holding CBDMP.

Analysis and Outcome

The study carried out a Landslide Susceptibility Mapping on Macro Scale (1:50,000) in parts of SOI Toposheet nos. 84 E/02 and 84 E/06 covering an area of 1198 sq.km in parts of Aizawl and Champhai districts, Mizoram. A total of 262 landslides have been considered for comparative study both from multitemporal Google Earth imagery data and from the field investigations for the entire study area after eliminating 46 false slides which were false interpretations of extensive cut slope, quarry, dumped waste etc. During the field traverses, a total of 126 landslide inventories as per 42-point-geo-parametric data sheet have been documented which includes 52 nos. of rock slides, 65 nos. of debris slides, 5 nos. of soil slides, 2 rock falls and 2 soil flow.

Most of the landslides are shallow translational failures with depth of slip plane less than 5m. Natural slope failures were observed on the eastern slopes of the hills near the Tualcheng-Hnahlan junction. The major landslide in the study area is the Keifang landslide (July, 2017); it damaged the high voltage transmission power lines and blocked the NH6. The recommendation of the study is fully implemented.



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 84E/03, 84E/07&84E/08, Serchhip and Champhai Districts, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2018

Objective

Categorise the hillslopes in terms of landslide susceptibility, to prepare spatial database for geofactors of landslides and to prepare landslide inventory database using high resolution remote sensing techniques and field inputs.

Study Recommendation

- The assessment of the landslide susceptibility is extremely important for hilly areas where slope failures are frequent because it gives basic construction standards for new roads or buildings, helps to assess the impact of future landslides and can also be used to locate key facilities like hospitals, fire stations, etc.
- Conclusions derived from the generated LSM indicate that majority of the road corridor falls in the classified high susceptibility zone.
- Amongst the hillslopes classified under high susceptibility, some of the important road corridors such as Khankawn - New Champhai Bypass Road and Mualkawi - Zokhawthar road (Indo Burma border road) can be considered for further site specific studies since these slopes are found affecting important communication routes, settlements, etc.
- Slope failures along the road cuts can be minimized by maintenance of road side drainage with culverts, slope moderation by benching and hardening of material by suitable plantation and toe support by constructing retaining walls with weep holes etc.

Analysis and Outcome

The study was taken under the National Landslide Susceptibility Mapping (NLSM) programme of GSI on macro scale landslide susceptibility mapping on 1:50,000 scale for 1415 sq. km covering parts of Champhai and Serchhip districts, Mizoram for field season, 2017-18. A total of 309 landslides were studied from both pre-field data base and field inputs, out of these, detailed inventories were collected for 241 landslides with 42-point-geo-parametric data. These slides corresponds to 108 rock slides, 98 debris slides, 08 rock falls, 26 soil slides and a debris flow. Majority of these slides were concentrated along the road section where most of these landslides are shallow translational failures with depth of slip plane less than 5 meters.

The landslide susceptibility map was prepared using site/terrain-specific weights & ratings systems and a simple knowledge-driven technique- Multi-class Index Overlay method of data Integration. The present study embodies the results of Susceptibility Mapping carried out during the period September- 2017 to March 2018, covering the geotechnical observations made and methodology followed for preparation of susceptibility maps. The results provided the qualitative estimate of landslide susceptibility of the study area, which are of important societal value. The recommendation of the study is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

A Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 84A/11 & 84A/15, Aizawl, Serchhip, Mamit & Lunglei District, Mizoram

Implementing Institution

Geological Survey of India, State Unit:
Tripura and Mizoram

Project Location/Completion Year

Mizoram, 2017

Objective

- Categorise the hillslopes in terms of landslide susceptibility, to prepare spatial database for geofactors of landslides
- Prepare landslide inventory database using high resolution remote sensing techniques and field inputs.

Study Recommendation

A detailed site-specific study may be duly conducted before planning and execution of the civil construction works. The areas especially falling in high susceptibility zone should be given due attention while executing any civil constructions.

Analysis and Outcome

The study was carried out under the National Landslide Susceptibility Mapping (NLSM) programme of GSI on macro scale landslide susceptibility mapping on 1:50,000 scale for 1426 sq km covering parts of Aizawl, Mamit, Lunglei and Serchhip districts, Mizoram. A total of 784 landslides were studied from both satellite data and field inputs out of these detailed inventories for 152 landslides were collected as per 41-point-geo-parametric data sheet where 87 are rock slides, 62 are debris slides, two are rock falls, and one is soil/earth slide. The Buarpui Landslide, Buarpui and the Sailam Landslide, Sailam along SH Aizawl-Thenzawl-Lunglei road corresponds to biggest slides in the study area.

The present report embodies the results of Susceptibility Mapping carried out during the period September- 2016 to March 2017, covering the geotechnical observations made and methodology followed for preparation of susceptibility maps. The results provided the qualitative estimate of landslide susceptibility of the study area, which are of important societal value.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 84 A/09 & A/13, Aizawl, Kolasib and Mamit Districts, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2017

Objective

Prepare a landslide inventory database using high resolution remote sensing data to prepare spatial database for geofactors of landslides for use as input thematic maps and ultimately to prepare a landslide susceptibility map using weighted multi-class index overlay method on a GIS platform.

Study Recommendation

- While the susceptibility map is used for land use planning, it is best to avoid the highly susceptible areas for any public or personal utility projects. In moderately susceptible areas, building safety regulations study for landslides should be taken up and followed strictly. Construction with simple slope stability measures is required in low susceptible areas.
- Detailed site-specific study may be duly conducted before planning and execution of the civil construction works.
- More priority should be given in increasing awareness amongst people through Community Based Disaster Management Programme (CBDMP). The awareness should include information about the potential danger, its identification and its communication; the physical significance of hazard and inherent uncertainties; ways to reduce landslide risk and the available local mitigation options. The villages or communities located in and around high hazard areas should be given priority in holding CBDMP.

Analysis and Outcome

The study produces a basic information on the landslide susceptibility of parts of Mizoram. This study was carried out on 1:50000 scale in Survey of India Toposheet nos. 84A/09 & 84A/13 covering 1420 sq. Km. in parts of Aizawl, Mamit and Kolasib districts of Mizoram. A total of 744 landslides were recorded both from satellite imagery and documented during the field work. Out of these, 41-point data format of 135 landslides were prepared. Amongst these, are 71 nos. debris slide, 40 nos. rock slide, 13 nos. rock fall and 6 nos. soil slide, 4 nos. mud/debris flow and 1 earth flow. Majority of the slides are shallow translational debris slides typically triggered by heavy monsoonal rains.

The high susceptible zones in the study area are located mainly along the highly dissected slopes of the major hill ranges which lie amongst the 3 main drainage systems of Gutur, Tlawng and Tuirial-Tuirini rivers. Ngalchawn, eastern part of Durtlang Leitan, Sairang-Sakawrtuichhun road, NE of Chhanchuahna Kawpui and parts of Serkhan-Lungmuat section falls in the moderately susceptible zone. The areas in and around Phaizhau, Dilzawl, Khamrang, Lengpui, Sihmui, Central NS section along Tuirial river and the eastern most part of the study area are part of the low susceptible category. The study recommendation is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Agency

Study Title

Macro-Scale (1:50,000) landslide Susceptibility Mapping in Parts of Toposheets Nos. 83 D/12 & 16, Kolasib and Aizawl Districts, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2017

Objective

- To identify landslide susceptible areas and therefore a macro-scale (1:50,000) Landslide Susceptibility Mapping.
- Prepare a landslide inventory database, to prepare 1:50,000 scale spatial
- database for geo-factors of landslides and to prepare landslide susceptibility map by systematic scientific approach viz. using high resolution remote sensing data and field inputs, thematic maps and multi-class index overlay method in a GIS platform

Study Recommendation

- While the susceptibility map is used for land use planning, it is best to avoid the highly susceptible areas for any public or personal utility projects. In moderately susceptible areas, building safety regulations study for landslides should be taken up and followed strictly. Construction with simple slope stability measures is required in low susceptible areas.
- Construction of culverts are recommended at places where road crosses the drainage (Kolasib – Bairabi road, between Sailutar – Ratu along NH150). The overhanging jointed rock blocks from the upslope of the road (south of Bualpui and to the north of Kawnpui quarry area) should be removed.
- Detailed site-specific study may be duly conducted before planning and execution of the civil construction works.
- More priority should be given in educating people through Community Based Disaster Management Programme (CBDMP).

Analysis and Outcome

Landslide Susceptibility Mapping was undertaken during the field season programme 2016-17 in parts of, Kolasib and Aizawl districts Mizoram covering about 1359 sq. km study area in parts of Survey of India (SoI) Anthropogenic interference through modification of slope profile has been found to be a major causative factor for inducing local instability. Field observations and documentation of existing landslides show that they are triggered largely by rain during monsoon season.

The susceptibility map can be used as a base map for future developmental activity and planning.

Data for 892 landslides was collected from different sources such as high resolution remote sensing images, topographic maps and old reports of GSI, etc. apart from fieldwork. Out of these, inventory of 132 landslides comprising 52 rock slides; 42 earth slide; 32 debris slides and 6 rock falls were carried out following the standard 41-point data sheet of GSI. The recommendation of the study were partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Urban Development Agency
- State Disaster Management Authority



Study Title

Interim Report on Seismic and Landslide Hazard Assessment of Aizawl Town, Mizoram

Implementing Institution

Geological Survey of India, State
Unit: Manipur Nagaland

Project Location/Completion Year

Mizoram, 2013

Objective

- Prepare a Landslide Hazard Assessment (LHA) map of Aizawl and surrounding area on macro-scale (1:25,000).
- Assessment of landslide hazard has been carried out by means of preparing Landslide Hazard Zonation (LHZ) map of the study area.
- The LHZ map of the area will help the geo-scientists and techno-administrative authorities of Government of Mizoram for formulation of disaster mitigation and urban planning initiatives.

Study Recommendation

Causative factors of landslide in the study area were found to be mainly due to anthropogenic activity like the construction of roads with steeply dipping cut slope/face, construction of multistoried buildings along precarious slopes with pillar foundation thereby increasing the static load on the vulnerable slopes, quarrying and improper drainage maintenance.

Analysis and Outcome

The present work was confined to the Aizawl Master plan area, vision 2030 made available by Aizawl Development authority which encompasses an area of about 150 sq.km. During the field season an area of 60sq.km was covered by geological, geophysical studies and landslide hazard zonation. Landslide Hazard zonation of the area following the SOP of GSI reveals that majority of the area comes under low to moderate hazard zones with few isolated pockets of high hazard zones.

Further, the majority of urbanization of Aizawl town has been found to be concentrated over moderate hazard slopes, which may contain local areas of instability and may need thorough site-specific studies, before initiating construction activities in this zone. The study of causative factors of landslide incidences shows wedge failure due to intersection of joint planes and steeply dipping cut slopes, planar failure due to moderately dipping primary plane along the dipping direction of the slope, saturated overburden material along precarious slopes, toe cutting of the slope etc. Landslides in the area are also occurs due to improper drainage maintenance, construction of multistoried buildings with pillar foundation on slopes, construction of roads with steep cut slopes and quarrying.

Agencies responsible for implementation

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency

Study Title

Seismic and Landslide Hazard Assessment of Aizawl Town, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2013

Objective

Evaluate the seismic and landslide hazard scenario, which will help in the formulation of future urban land use and disaster mitigation plan for the area.

Study Recommendation

It is pertinent to add that the high and moderate landslide hazard category covers mostly the urbanised part of Aizawl and these areas may warrant thorough site-specific studies before the planning and execution of any major infrastructural activity, in order to address the local site specific instability, if any. This assessment will be useful for regional urban planning and disaster mitigation. The hazard assessment maps can form an important input in inducing public awareness through community participation programmes (Crozier, 2005), wherein people can be made aware of the areas highly susceptible to slope instability, type of buildings they are living and possibility of having resonance in case of seismic shaking, type of mitigation options locally available, etc., so that they can respond to the condition 'timely' and 'appropriately' when the disaster strikes. Areas falling under relatively very high and high hazard categories needs due consideration, while taking up any developmental activities and future urban planning; as such localities may be comparatively more vulnerable in the event of natural hazard like earthquake and landslide. The spatial distribution of the respective hazard zones thus obtained will aid in land use planning strategies and disaster mitigation. Appropriate ground remedial measures and treatment of structures can be taken up in the areas falling under different hazard categories to reduce its susceptibility.

Analysis and Outcome

The present study carried out a landslide hazard assessment following the modified BIS guidelines of GSI (2005), which indicated that 5% of area is under high hazard, 41.3% of area is under moderate hazard and 53.7% of area is under low hazard categories respectively. An integrated seismic hazard assessment map using different parameters was generated on a GIS platform, which revealed that 13% of area is under relatively very high hazard, 39.1% of area is under relatively high hazard, 42.3% of area is under relatively moderate hazard and 5.6% is under relatively low hazard categories respectively.

The spatial distribution of the respective hazard zones thus obtained will aid in land use planning strategies and disaster mitigation. Appropriate ground remedial measures and treatment of structures can be taken up in the areas falling under different hazard categories to reduce its susceptibility

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency



Study Title

Geotechnical Investigations of the Major Subsidence Affecting Lower Officer's Hill and NH-39, Kohima

Implementing Institution

Nagaland University

Project Location/Completion Year

Nagaland, 2019

Objective

Study the causative factors using geotechnical approach and suggest remedial and mitigation measures.

- Detailed mapping of the area
- Classification and preparation of GIS database
- Determine Factor of safety and develop mitigation measures

Study Recommendation

Use of old vehicle tyres for construction of erosion measures, Surface and sub-surface drainage system, Need for more detailed investigation with regard to neotectonic activities etc.

Analysis and Outcome

Kohima town being the Capital city of the state of Nagaland is the nerve centre and hosts not only the state government but also all the major departments and offices. Moreover, 2-3 major National Highways including the Asian Highway-1 passes through this hilly town. The importance of scientific and proper town planning and road alignment in such a strategic place which serves as the lifeline of Manipur and Nagaland is evidenced by the hardships that people face regularly when their essential supplies including medicines are cut off for months due to landslides. Except for some minor exposures of the Barial Group of rocks in the western part of the municipal area which displays relatively stable slopes, majority of the city rest over the Disang group of rock consisting of shales with some siltstones.

However, the study area, as a comprehensive unit, indicates wedge failure on a large scale. The lack of proper equipment and expertise has resulted in poor generation of subsurface data, which has left many unanswered questions. The intention of the investigators of this project was to determine the subsurface extent and inclination of the various faults and joints, and the thickness of overburden to make necessary inferences. However, this was not to be, as resistivity surveys could not yield the desired information. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Motor Vehicle Department, Government of Nagaland
- Ministry of Road Transport & Highways, Government of India
- Natural Resources Data Management System- Department of Science and Technology, New Delhi

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 83J/14 & 83J/15 in Mon, Mokokchung, Tuensang & Longleng Districts of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2018

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs.
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input maps.
- To prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

- Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes.
- Rampant quarrying activities alongside National Highways (NHs) & State Highways (SHs) and their subsequent haphazard dumping of the quarry waste be checked or stopped.
- More study for the following areas: Wakching Village, eastern part of Tangha Village, around Yongshei Village, eastern part of Ukha Village, northern part of Tuensang Village and around Hakchang Village; Mon, Longleng and Tuensang districts.
- Strong gabion walls and retentions walls along Tuensang- Ukha Highway, Longleng- Tangha Village Road and Naginimora_x0002_Wakching Highway.
- Detailed study, including the geotechnical aspects of the slope forming material and its underlying bedrock as well as the hydrological condition/s are highly recommended prior to the execution of any future developmental activity over the categorized high susceptibility hillslopes.

Analysis and Outcome

The major objective of the current study was preparation of landslide inventory by using high resolution remote sensing data. Such kind of study is useful in investigating high risk zone of landslides to issue alert during monsoon season [159]. The report of the study recommended very essential points to achieve the mentioned target. The analysis of the report revealed that the recommendations such as future developmental plannings, Rampant quarrying activities, study of several villages, development of gabion wall, etc. were yet to be achieved completely. The current condition of the recommendations are incomplete. Therefore, the analysis of the report identified that the recommendations were partially implemented.

Implementable recommendations:

- Expansion of township in the designated low susceptibility slopes.
- Detailed study of villages like Wakching Village, eastern part of Tangha Village, around Yongshei Village.
- Development of Strong gabion walls and retentions walls.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets No. 83N/02, 83N/03, 83N/04 and 83O/01, Mon and Tuensang Districts of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2018

Objective

- Prepare landslide inventory database using high resolution remote sensing data and field inputs,
- Prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input maps,
- Prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

- Civil construction in and around high susceptibility zones should be avoided and In case of non-avoidance, proper safety measures and regulations needs to be taken before construction.
- Sufficient buffer zone should be provided between the settlements/civil structures that are located in the vicinity of the high susceptibility zone.
- Unscientific slope cutting for the construction of road and modification of the slope for settlements are the major stability problem in the study area. So while doing these activities scientific method should be followed, proper drainage alignment should be maintained, breast wall and retention wall should be constructed to avoid furthermodification in the natural slope.

Analysis and Outcome

The study carried out Landslide Susceptibility Mapping covering 1332 sq. km. area in parts of Mon and Tuensang districts of Nagaland on Macro-Scale (1:50,000). Total number of landslides in the landslide inventory map is two hundred thirty one (231). Distribution of landslides is not even throughout the study area; Cluster of landslide is recorded near Mon town, Chen Moho, ShinghaTangten, Manyaksha, Noklak and Sanglao villages.

The susceptibility score map is classified into 3 classes according to the formula applied as per break values. In the study area 24% (323 sq. km) of the area is falling under high susceptible zone, 37% (495 sq. km) in moderate and 39% (514 sq. km) in low susceptible zone. It is suggested to the end users, that they can avoid any type of constructions in high susceptible zones and strict building rules and regulations have to be followed in moderate susceptible zones. The recommendation of the study is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets No. 83K/01 And 83K/05, Kohima, Phek, Wokha and Zunheboto Districts of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2017

Objective

- Prepare landslide inventory database using high resolution remote sensing data and field inputs.
- Prepare Toposheet wise 1:50,000 scale spatial database for geofactors of landslides for use as input maps.
- Prepare landslide susceptibility map using multiclass index overlay method in a GIS platform.

Study Recommendation

- The areas with high and moderate susceptibility zones can be avoided for developmental activities. In case of non avoidance, these areas may be given special treatment from the perspective of landslides.
- There are several recommendations given which are site or area specific. Mitigative, preventive and remedial measures such as retention walls (colluvial material), drape nets, rockfall catchment fences, geo-nets, shotcreting, drainage, etc. have been recommended.

Analysis and Outcome

The macro scale (1:50,000) landslide susceptibility map is an essential tool of geo- information. It is being used in the perspective Land use planning and zoning regulations. The aim of the current study was preparation of landslide inventory database, 1:50,000 toposheet, and landslide susceptibility map. This kind of study is useful in forecasting of landslide and mitigating its impact [163]. The analysis of the report identified that the recommended restriction on developmental activities in high and moderate susceptibility zones and retention wall, drape nets, rockfall catchment fences, geo nets, etc. were considered seriously. The analysis concluded that the recommendations were implemented well.

Implementable recommendations:

- Restriction on developmental activities in high and moderate susceptibility zones.
- Development of retention wall, drape nets, rockfall catchment fences, geo nets, etc.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83 J/12 & 83 J/16, Tuensang and Zunheboto Districts of Nagaland.

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2017

Objective

- Prepare landslide inventory database using high resolution remote sensing data and field inputs.
- Prepare spatial database for geofactors of landslides for use as input maps.
- Prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

- Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Lower Barail country rocks, since it has been established that the response of the overburden material on hillslopes to landsliding is largely or directly controlled by the underlying lithology.
- Strict implementation of rules [The control of National Highways (Land and Traffic) Act, 2002] laid down by the National Highway Authority of India (NHAI) in this regard is highly recommended.
- Shifting of entire settlement from highly susceptible landslide area is highly recommended. Site specific and detailed study of this area is highly recommended.
- Detailed study, including the geotechnical aspects of the slope forming material and its underlying bedrock as well as the hydrological condition/s are highly recommended prior to the execution of any future developmental activity over the categorized high susceptibility hillslopes, particularly those slopes represented by Disang country rocks.

Analysis and Outcome

The landslide susceptibility map on macro scale (1:50,000) is a crucial means of geo- information. It is being used in the perspective Land use planning and zoning regulations. The current study was aimed at preparing landslide inventory database, 1:50,000 toposheet, and landslide susceptibility map.

The report of the study identified that the recommended low susceptibility slope for infrastructure development was considered seriously and implemented on urgent basis. The recommended regulation of NHAI was also strictly followed. The settlement from high susceptible zone to low susceptible zone is yet to shift completely. The other recommendations like detailed geotechnical study is also yet to achieve completely. Therefore, the analysis concluded that the recommendations were partially implemented [161].

Implementable recommendations:

- Development of infrastructure in low susceptibility slope zone
- The shifting of settlement from high susceptible zone to low susceptible zone
- Detailed geotechnical study

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83K/9 & 83K/13, Kiphire, Zunheboto, Phek and Tuensang Districts Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2017

Objective

- Prepare landslide inventory database using high resolution remote sensing data and field inputs.
- Prepare spatial database for geofactors of landslides for use as input maps
- Prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

- Future developmental planning may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Upper Barail country rocks since it has been observed that the response of the overburden material on hillslopes to landsliding is dependent on the strength parameters of underlying geology.
- Strict implementation of rules [The control of National Highways (Land and Traffic) Act, 2002] laid down by the National Highway Authority of India (NHAI) in this regard is highly recommended.
- Considering the economic and strategic importance of this road (NH-202), it is suggested that alternative arrangements for alignment of the said road bench on stable slopes running over Disang and Barail country rocks may be explored. Site specific and detailed study of this area is highly recommended.
- Detailed study, including the geotechnical aspects of the slope forming material and its underlying bedrock as well as the hydrological condition/s are highly recommended prior to the execution of any future developmental activity over the categorized high susceptibility hillslopes, particularly those slopes represented by Disang country rocks.

Analysis and Outcome

The macro scale (1:50,000) landslide susceptibility map is an important tool of geo-information. It can be used for the perspective Land use planning and zoning regulations. The aim of the current study was preparation of landslide inventory database, 1:50,000 toposheet, and landslide susceptibility map. This kind of study is useful in forecasting of landslide and mitigating its impact [161]. The analysis of the report revealed that the recommendations such as infrastructure development in low susceptible slope, strict implementation of NHAI rules, exploration of Disang and Barail country rocks and geotechnical study were considered seriously and started working on that to achieve them. The analysis concluded that the recommendations were implemented well.

Implementable recommendations:

- Infrastructure development in low susceptible slope,
- Strict implementation of NHAI rules,
- Exploration of Disang and Barail country rocks
- Geotechnical study

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Site Specific Geological Studies of the Landslide on the Eastern Downslope of Nagaland Legislative Assembly Complex, Kohima Town, Kohima District, Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2017

Objective

- Carry out a detailed geological evaluation of the landslide to understand the causal factors and failure mechanism
- Formulate a comprehensive mitigation plan based on the generated geological input that is envisaged to help the implementing authority in minimizing and tackling the landslide from aggravating further.

Study Recommendation

- A lined hillside drain to the road bench (Kohima-Thizama road) measuring an approx. 275m length and its subsequent diversion for draining-off of the surface water along a stable slope is recommended.
- A steel road-guard measuring an approx. 115m length may be installed towards the valley-side edge of the road bench (Kohima-Thizama road) to ensure the safety of passing traffic as well as pedestrians.

Analysis and Outcome

The objective of the current study was to conduct a detailed investigation of geological pattern of landslide for the screening of its cause and effect and its failure. This kind of study is useful in the forecasting of landslide and safety purpose [162]. The report of the study revealed that the recommended drain of length 175 m and its subsequent draining-off along the stable slope was accomplished. The steel road guard of 115m for ensuring the safety for the passing traffic and pedestrians were also completed. Currently, all the recommendations have been achieved. Therefore, it can be said that the recommendations were implemented well.

Implementable recommendations:

- Drain of length 175 m its subsequent draining-off along the stable slope.
- Steel road guard of 115m for ensuring the safety

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Seismic and Landslide Hazard Zssessment of Kohima City, Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2015

Objective

Delineate different hazard levels pertaining to seismic and landslide hazards within the Kohima master plan area, which can be put to use for disaster mitigation and future urban planning.

Study Recommendation

As per the guidelines of BIS 2002, the seismic coefficients in building codes are prescribed depending upon the zone factor only and without any account of return periods. Therefore, the prepared seismic hazard map for different percentages (2% & 10%) of probability of exceedance in 50 years will be very useful for engineers and town planners in their decision making. Moreover, the data can be put to use by the regulatory authorities for preparation of guidelines for earthquake proof design and structures. The thematic maps and database generated will be also useful to the planners for urban planning and natural hazard mitigation. The prepared landslide susceptibility map largely helps in Landslide hazard assessment and maybe utilized for urban planning and landslide preparedness and mitigation by the local authorities.

Analysis and Outcome

The present study was aimed at assessing the different level of seismic and landside hazards within the Kohima city. Such studies are helpful in identifying the level of threat due to landslide and earthquake in a particular region. It will also help in generating the guideline for the future development. The report of the current study strongly recommended to prepare seismic hazard map for different percentages of probability of exceedance in 50 years. The report suggested that thus prepared landslide map will also be useful in assessing the landslide hazard. The analysis of the report concluded that the recommendations of the study were very essential and required to be implemented on urgent basis. All the recommendations were implemented completely [166].

Implementable recommendations:

- Preparation seismic hazard map for different percentages of probability of exceedance in 50 years.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Interim Report on Seismic and Landslide Hazard Assessment of Kohima City, Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2014

Objective

Delineate different hazard levels pertaining to seismic and landslides within the master plan area, which can be put to use for disaster mitigation and future urban planning by the town planners.

Study Recommendation

It will be important to determine the threshold value of the rainfall intensity for triggering landslide which may help in effective response to landslide hazard and risk management.

Analysis and Outcome

The aim of the present study was identification of various level of hazard pertaining to seismic and landslide for mitigating the impacts of these disaster. Such kind of study is useful in the planning of urban areas. The report of the study revealed that the study was very essential for the mitigation of disaster [167]. Regarding this, the report recommended to determine the threshold of rainfall which can initiating the landslide. Such steps are very important in the landslide and risk management of other hazard. Therefore, the analysis of the report identified that the report recommended to determine the threshold level of rainfall intensity. It was concluded that the recommendations were implemented completely.

Implementable recommendations:

- Preparation seismic hazard map for different percentages of probability of exceedance in 50 years.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Landslide Hazard Zonation Mapping and Risk Assessment of the Area between Kohima and Zhadima, Nagaland

Implementing Institution

Nagaland University

Project Location/Completion Year

Nagaland, 2011

Objective

- Determine the factors responsible for instability including geoenvironmental parameters such as slope, lithology, structure, groundwater, and land use / land cover
- Create a spatial database using GIS techniques and construct thematic maps
- Construct a large-scale Landslide Hazard Zonation (LHZ) map for the area
- Determine mechanical properties of rocks in weak zones
- Provide mitigation measures for such areas

Study Recommendation

Mitigation measures for landslides of some locations along the NH 2 have been recommended to the Government of Nagaland as follows:

- The LHZ map gives good indications of stability conditions of the area and clearly defines the high hazard zones. Such zones need to be avoided for any developmental projects.
- Road making techniques are very poor in the state. The debris from these slopes coming onto the roads will help erode the bitumen rapidly and prove to be a costly affair. Hence, it should be seriously considered to implement the mitigation measures that have been provided.
- Other parts of NH 2 that are weak within the study area should also be considered for appropriate measures. Detailed geotechnical analyses for appropriate mitigation and/or remedial measures need to be taken up in areas proposed for urban expansion in the high hazard zones. Proper mitigation measures are required for all weak sections of the entire stretch of this highway that is being widened.

Analysis and Outcome

Nagaland is part of the northern extension of the Arakan-Yoma Range that represents some of the Cretaceous-Tertiary orogenic upheavals. The study area is made up of flysch sediments belonging to two major groups, namely Disang and Barail. The study area includes a 12 km stretch of the NH 2, from the northern edge of Kohima Town to the Zhadima Junction. The area under investigation is approximately 13.90 sq km. The study enabled the development of numerous maps taking into consideration all geological aspects associated with landslides. Remote sensing and GIS have played an important role in the project. Strengths of slope material along road sections have been estimated and kinematic analyses performed. Data generated have been interpreted in terms of failure potential. For such areas mitigation measures have been developed. A landslide hazard zonation map of the study area has been developed. Mitigation measures for six locations have been developed. Weak segments of the highway have been identified and appropriate mitigation measures suggested. All the recommendation of the study has been implemented.



Study Title

Detailed Site Specific Landslide Investigation and Monitoring of the Pachey Landslide on Pakyong-Machong Road, East District, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2019

Objective

- Geotechnical evaluation of the affected slope for formulation of protection measures of the patchy landslide and to understand
- causative factors, failure mechanism, dynamicity of the affected slope and to formulate mitigative measures

Study Recommendation

Based on slope stability studies appropriate slope stability measures like Channelization of the surface runoff by construction of chute drain, contour drains, erection of concrete gabion walls, spot bolting, chain-link shotcreting or Steel Fibre Reinforced Shotcreting (SFERS) with drainage holes etc have been suggested.

Analysis and Outcome

The Pachey landslide is located about 1km from Pakyong on Pakyong-Machong Road near Old RDD complex, Pachey area, Pakyong, East District, Sikkim which got activated between [170] 09/07/2017 and 10/07/2017 as reported in the print media due to heavy rainfall. The Pachey landslide is triangular in shape. It is an active and complex slide where a number of debris as well as rock scars are present. The slide zone is complex in nature. The runout distance is 297m. About 100 m of road bench along Pakyong-Machong road has been completely destroyed by the slide. The crown of the slide is located at an elevation of 1467 m above msl and is curvilinear in shape while the toe is at elevation of 1332m above msl. The slope forming material consists mainly of soil debris and clasts of phyllites and quartzites. The failure mechanism appears to be both rotational and translational. The Pachey Landslide was triggered due to very heavy rainfall received in the area during monsoons. The recommendation of the study was partially implemented.

Agencies responsible for implementation

- State Disaster Management Authority

Study Title

Meso Scale (1:10,000) Landslide Susceptibility Mapping Along Chungthang-Khedum Road Corridor, North District, Sikkim

Implementing Institution

Geological Survey of India, State Unit:
Sikkim, Gangtok

Project Location/Completion Year

Sikkim, 2019

Objective

- Preparation of 1:10,000 scale detailed landslide inventory database using very high resolution remote sensing data and field inputs
- Preparation of geofactor maps on 1:10,000 scale in GIS
- Application of appropriate deterministic techniques for slope stability assessment
- Preparation of 1:10,000 scale landslide susceptibility map in a GIS by integrating rated and weighted thematic geofactor maps

Study Recommendation

- The landslides that occurred along the North Sikkim Highway should be treated for stability, so that further calamities can be minimized.
- At Lanthey Khola, the type of failure for the landslide is quite complicated due to immense rock and debris covered material.
- To stabilize the area, debris should be removed from the slope and make proper concrete wall for support along with proper channelization of drainage system.

Analysis and Outcome

The present study carried out Landslide Susceptibility Mapping in parts of Toposheet no. 78 A/10 along Chungthang-Khedum road corridor in North district of Sikkim at Meso-scale (1:10,000) to classify this road corridor into different zones with varying degrees of susceptibility to landslide.

Landslide susceptibility map has been prepared by integrating geo-factors maps using rated and weighted methods on 1:10,000 scale. Kinematic analysis was also carried out at sixteen locations, in which six locations fall under planar failure and 10 locations fall under wedge/ block failure. On the basis of Landslide susceptibility map, it is observed that 25% of the area falls under the category of very high susceptibility, whereas high susceptibility and moderate susceptibility categories occupy 8% and 58% of the area respectively. An area of 9% falls in the low susceptibility. The recommendation of the project are partially implemented.

Agencies responsible for implementation:

- State Disaster Management Authority



Study Title

Meso Scale (1:10000) Landslide Susceptibility Mapping Along Singtam-Mangkha-Dikchu Road Corridor, East and North District, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2019

Objective

Preparation of 1:10,000 scale detailed landslide inventory database using very high resolution remote sensing data and field inputs, preparation of geofactor maps, application of deterministic techniques for slope stability assessments and preparation of landslide susceptibility maps by rated and weighted thematic geofactor maps.

Study Recommendation

- Control the surface and subsurface drainage of the landslide area.
- Removal of subsurface water by installing horizontal drains, deep trench drains, drainage galleries and drainage tunnels and weep holes.
- Loose, unstable and overhanging blocks of rock which may cause a danger to roads and passing traffics can be removed by scaling and trimming.
- Planting trees and vegetative growth alone can play an important role in stabilizing slopes by intercepting and absorbing water, retaining soil below ground with roots and above ground with stems, controlling runoff by providing a break in the path of the water and increasing surface roughness, and improving water infiltration rates, soil porosity, and permeability.
- Grading the slopes is another way to reduce the gradient of a slope and enhance slope stability.
- Taking landslide remedial measures such as removal of crown hanging blocks, installation of rock curtain. Creation of breast wall. Channeling of stream/waterfall and creation of steps for drainage flow.

Analysis and Outcome

The present study prepared meso scale (1:10,000) landslide mapping along the Singtam-Mangkha-Dikchu road corridor which is about 24 km was taken up in two years during the FS 2017-19. The road corridor between Singtam-Mangkha has steep slopes all along the road with major palaeoslide zones stretching several kilometres indicates a high susceptible area. The slopes along the road corridor are covered with overburden and palaeoslide debris with few rocks.

The final landslide susceptibility map (FS 2018-19) classified into five susceptibility zones shows that in between Singtam and Mangkha, 7% of the total area comes under very high susceptibility zone, 32 % of the total area comes under high susceptibility zone, 53% of the total area comes under moderate susceptibility zone, 7% of the total area comes under low susceptibility zone and 1% of the total area comes under very low susceptibility zone. After validating the landslide incidences data against the prepared susceptibility map it is observed that 50% landslide incidences are fall in the very high susceptibility zone and another 50% fall in the high susceptibility zone. The recommendation of the project was partially implemented.

Agencies responsible for implementation:

- State Disaster Management Authority

Study Title

Meso Scale Landslide Susceptibility Mapping on 1:10,000 Scale Along 3rd Mile to 13th Mile Bro Road Sector, Gandtok- Nathula Road, East District, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2019

Objective

- Preparation of 1:10,000 scale detailed landslide inventory database using very high resolution remote sensing data and field inputs.
- Preparation of geofactor maps on 1: 10,000 scale in GIS.
- Application of appropriate deterministic techniques for slope stability assessment.

Study Recommendation

- The control of surface run off during monsoon season may be given utmost priority particularly within the 8th mile landslide zone. The drainage control measures should be adopted all along the stream course right from the source of the stream to the affected areas.
- Along the new road, the vulnerable overburden covered slopes below the road bench in the 8th mile landslide zone may be stabilized by providing suitable restraining structures like retaining/ gabion walls at different level to retain the overburden mass in place. Reinforced earth type retaining structure can also be considered depending on the requirement.

Analysis and Outcome

The Jawaharlal Nehru Road (J.N. Road) is a vital mountain route providing connectivity between Gangtok and Nathula, the pass connecting China and caters to the need of Defence and Tourism sector. The J.N. Road between 3rd to 13th mile is dotted with some major landslide zones and shallow localized slope failures, which severely affect road connectivity during the monsoon season.

The three major landslide zones in the study area i.e. at 5th mile, 8th mile and 13th mile mainly occupy high to moderate susceptible area except for the 13th mile landslide zone which also occupy some very high susceptible area. The 'Very High Susceptibility' areas are found near 13th mile landslide zone and around 8th mile landslide zone (along J. N. Road and new road). It is important to note that along the entire stretch of the new road between 3rd to 13th mile, the slopes below the new road bench seems to be more vulnerable as compared to the slope above the road. Majority of the slope facets below the new road between 13th to 8th mile fall under 'High' to 'Moderate' susceptibility class. The similar situation prevails in the 5th mile area also. This may be attributed to presence to steep overburden covered slopes dissected by lineaments and major streams and kholas. The recommendation of the study are partially implemented.

Agencies responsible for implementation:

- State Disaster Management Authority
- Border Road Organization (BRO)



Study Title

Detailed Report on Site Specific Landslide Investigations of the 8th Mile Landslide on Gangtok-Nathula Road, East District, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2018

Objective

The main objective of the item was Geotechnical evaluation of the affected slope for formulation of protection measures of the 8th Mile Landslide.

Study Recommendation

- For strengthening the shearing strength and reduction of the shear stress of slope forming material
- To manage surface drainage for controlling pore water pressures and to restrict/ avoid recharging of fragile groundmass.
- To restore and strengthen the newly cut road benches.

Analysis and Outcome

The 5th Mile landslide is located at about 8.5 Km from Gangtok on NH-10 (Gangtok-Nathula Road) on the way to Nathula Pass which is a strategically very important Pass connecting India with China and further to Kailash Mansarovar. The detailed geotechnical study of the affected area was carried out covering an area of 0.2 sq. km on 1:500 scale. The entire 5th Mile Landslide was divided into 08 zones slide subzones namely slide subzone I to slide subzone VIII.

The interpreted resistivity results correlated with sub-surface lithological units in the area surveyed enabled to demarcate the boundaries between loose and compact formations. The VES results revealed heterogeneous nature of the subsurface geological sequence. The interpreted VES curves have brought out four to five layered 1D earth model in the form of resistivity and thickness of individual geoelectric layers structure beneath the study area is composed of topsoil/slide debris, moist/wet top soil, saturated/ fractured boulders of granite /gneissic complex and compact hardrock/fresh basement bearing zones. The study recommendation was partially implemented.

Agencies responsible for implementation:

- State Disaster management Authority
- Border Roads Organisation (BRO)
- Geological Survey of India

Study Title

Meso Scale (1:10000) Landslide Susceptibility Mapping Along Singhik-Manul-Paegum-Chungthang Road Sector of North Sikkim Highway, North District, Sikkim

Implementing Institution

Geological Survey of India, State Unit: Sikkim

Project Location/Completion Year

Sikkim, 2018

Objective

- Preparation of 1:10,000 scale detailed landslide inventory database using very high resolution remote sensing data and field inputs
- Preparation of geofactor maps on 1:10,000 scale in GIS
- Application of appropriate deterministic techniques for slope stability assessment

Study Recommendation

- The landslides that occurred along the North Sikkim Highway should be treated for stability, so that further calamities can be minimized.
- At Lanthey Khola, the type of failure for the landslide is quite complicated due to immense rock and debris covered material.
- To stabilize the area, debris should be removed from the slope and make proper concrete wall for support along with proper channelization of drainage system.

Analysis and Outcome

The Landslide Susceptibility Mapping in Singhik and Chungthang on North Sikkim highway in North district of Sikkim was carried out with detailed landslide inventory database, geo-factors maps on 1:10,000 scale and slope stability assessment. In total, 11 landslides were identified during the pre-field mapping from remote sensing data. Landslides were classified as debris/earth slide, mud flows and rock slide or rock falls. Majority of them (73%) are debris slides, 18% rock fall and 9% mud flow.

Landslide susceptibility map was prepared by integrating rated and weighted thematic geo-factors maps on 1:10,000 scale. Kinematic analysis was also carried out for 18 selected locations, in which 8 locations falls under planar failure and 9 locations are under wedge/ block failure. The final susceptibility map is prepared and classified into 4 sub zone. 1. Low susceptibility" zone accounts for of 31.35% (4 nos.) of the total landslide incidences. 2. The "Moderate susceptibility" zone accounts for 40.59% (6 nos.) of the total landslide incidences. 3. The "High susceptibility" zone accounts for 0.66% (1 nos.) of the total landslide incidences and 4. The "Very low susceptibility" and "Very high susceptibility" zones do not show presence of any landslide incidences.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management of Authority



Study Title

Mitigation of Mangan Landslide at North District Headquarters Mangan, North Sikkim - India

Implementing Institution

Sikkim State Disaster Management Authority (SSDMA), Land Revenue & Mines, Mineral Department (LR&DMD)

Project Location/Completion Year

Sikkim, 2018

Objective

Stabilization of slopes in or around Mangan Town

Study Recommendation

- Utilisation of the calculated input parameters to determine the total downward force exerted by the surcharged mass and to reciprocate the same by a reactionary force in the form of support elements covering toe and slope protection, so that the FOS is sufficiently 1.5, considering dynamic earthquake parameters too.
- Network of RCC piles of 0.4mm dia with a spacing of 0.5 m c/c extending to well below the saturated debris cover and well below the slip circle, each column is to be interconnected by others in a staggered manner by steel wire .The piles should sufficiently cover the slide area.
- Fully grouted self-drilling anchor of capacity 190KN, 1.5M c/c to be used as support

Analysis and Outcome

Mangan town is the district headquarter of North Sikkim on the left bank of the Teesta river valley. Lower and upper area of Mangan has experienced a number of landslides in the past. It was particularly affected by several major slides; it is bounded by Raffong Khola in North & Ramet Kyong khola in south, which is delineated as high and very high hazard zone. It is a very unstable zone. The MCT is passing by close vicinity of the Mangan Town; hence entire area is under high stress. Present landslides represent reactivation of the older landslides and their shape/size is gradually increasing after monsoon rains. Soil of Mangan Town area has moderate absorbing capacity and bed rock in this area shows low compressive strength and normal moisture absorption capacity. During the site visit it has been observed that continuous water ingress through joint plane, removal of soft strata and presence of structural discontinuity. The study recommendation is fully implemented.

Study Title

Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos.78A /03,04,10,15 & 16, East, West and North Districts, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2017

Objective

Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets Nos.78A /03,04,10,15&16, East, West and North Districts, Sikkim

Study Recommendation

- The susceptibility map is actually meant for regional application because the information is shown on scale 1:50,000. Therefore, it is recommended that a detailed sitespecific study may be duly conducted before planning and execution of the civil construction works. Areas with falling in high susceptibility zone should be given due attention while executing any civil constructions.
- It is recommended that the susceptibility map showing the potential landslide initiation areas should be used along with the data of limits of potential debris flows for planning. A sufficient buffer zone may be kept between the settlements/civil structures and the affected area. Similarly no development to be allowed in close proximity of the major river/streams.

Analysis and Outcome

Landslide susceptibility mapping, covering an area of 1663 sq km on 1:50,000 scale in parts East, West and North Districts, in Sikkim. In total 1387 landslides were identified during prefield studies from the google earth imagery. Of which 230 confirmed landslides in approachable area have been studied in detail during field work. Out of total 230 studied incidences, 198 nos. are debris slide (about 84%) and 12 nos. are Soil slide (about 05%) and 25 nos. are rock slide (about 11%) noticed in the area. Of 230 the failure mechanism derived 15 nos. as Deep Translational failure (about 07%) and 03 nos. as Shallow Rotational failure (about 01%) and 212 nos. as Shallow Translational failure (about 92%).

More than 92% of landslides are of shallow translational debris slides type with depth of slip plane being less than 5 m but width is more as they are along the river banks. Smaller landslides on the cut slopes are found to have a short run-out as the road provided a horizontal base for accumulation of the debris. The success rate of the landslide susceptibility map is within the desired values, where 22.34% of the map area could classify about 67.91% of the landslides. Areas from Chungthang-Munshithang-Rabom road section, Mangan-Lanthey Khola-Naga-Tung Road section along side of River Tista, Changu-Thengu-Yakla-Sherthang road section, Intek- Jakhridunga road section and along major nala tributaries fall under high landslide susceptible zones. Some major landslides near Tharpu, Sanghu, Sarkitar and Sardong village also falls under the high susceptibility zone.

Agencies responsible for implementation:

- State Disaster Management Authority.



Study Title

Report on Meso Scale (1:10,000) Landslide Susceptibility Mapping in and Around Mangan Urban Area, North District, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2016

Objective

To demarcate the area into different zones based on degrees of susceptibility and identify areas which are more vulnerable to landslide. Keeping the Mangan township in the centre, a 5 sq. km area was considered for Landslide susceptibility mapping on 1:10,000 scale. This attempt would consequently give an idea on the vulnerability and damage potential of the area.

Study Recommendation

- The landslide susceptibility map of the area shows higher susceptibility close to streams/nalas/kholas within the study area. The control of the surface run off during monsoon may be treated on a priority basis by construction of proper water channels and lined horizontal contour drains with perforated pipes surrounded by filter to channelize the flow of water with minimum infiltration on benches/different levels at specific intervals on both sides of the slope along the course of the streams/nalas/kholas.
- The existing steeper parts of the natural slope may be made more stable by developing benches with safe slope angles (suitable design may be obtained from civil engineers) at suitable levels on the slope.
- New road constructions near Mangan and its surrounding areas for better connectivity may be undertaken with proper planning in drainage system and slope designing.

Analysis and Outcome

The present study was undertaken keeping in view the damage and change in scenario by the 18th September, 2011 Sikkim Earthquake (6.9 Mw), a two year item on landslide susceptibility mapping in meso scale (1:10,000) of the urban area of Mangan, North Sikkim was proposed for Field Seasons 2014-2015 & 2015-16. The landslide susceptibility map shows that 18.26% (0.912949 sq. km) of the total study area comes under "High Susceptibility Zone".

The landslide incidences data when validated against the prepared landslide susceptibility map indicates 56% landslide incidences are fall in the High Susceptibility zone followed by 33% landslide incidences in Moderate Susceptibility and 11% landslide incidences in Low Susceptibility zones. From the kinematic studies, rocks exposed along Pakshep-Mangan road, parts of Ambithang-Mangan road and parts of Sankalang-Mangan road are more susceptible to failure.

Agencies responsible for implementation:

- State Disaster Management Authority
- State Urban Development Agency

Study Title

A Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos.78A /11, 12, 8 &7 in East, South and West Districts, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2016

Objective

Classify the area into varying degree of landslide prone zones using high resolution remote sensing techniques and field inputs. The study involved preparation of various thematic maps for geo-factors. A weighted multiclass index overlay method was used to categorise the landslide susceptible slopes.

Study Recommendation

- As the susceptibility map is actually meant for regional application because the information is shown on scale 1:50,000. Therefore, it is recommended that a detailed site-specific study may be duly conducted before planning and execution of the civil construction works.
- Areas with falling in high susceptibility zone should be given due attention while executing any civil constructions.

Analysis and Outcome

The present study carried out Landslide susceptibility mapping, covering an area of 1974 sq km on 1:50,000 scale in parts of Toposheet nos 78A/11,12,07&08 in East, West and South districts in Sikkim. In all 1329 landslides were identified during pre-field studies from the google earth imagery. Of which 417 confirmed landslides in approachable area have been studied in detail during field work. Out of total 417 studied incidences, 328 nos. are debris slide (about 78.66%) and 03 nos. are Soil slide (about 0.71 %) and 86 nos. are rock slide(about 20.63%) noticed in the area. Of 417 the failure mechanism derived are 02 nos. as Deep Rotational failure (about 0.48%) and 05 nos. as DeepTranslational failure(about 1.20%) and 03 nos. as Shallow Rotational failure (about 0.72%) and 407 nos. as Shallow Translational failure (about 97.60%).

More than 97% of landslides are of shallow translational debris slides type with depth of slip plane being less than 5 m but width is more as they are along the river banks. Smaller landslides on the cut slopes are found to have a short run-out as the road provided a horizontal base for accumulation of the debris. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Detailed Geotechnical Investigations and Monitoring of the Sangkhola Landslide on NH 31A Along Singtam-Gangtok Road, East District, Sikkim

Implementing Institution

Geological Survey of India, State Unit: Sikkim

Project Location/Completion Year

Sikkim, 2015

Objective

Understand the causative factors and failure mechanism by detailed geological and geotechnical evaluation for formulation of short term and long term remedial measures.

Study Recommendation

Control of the surface run off during monsoon by construction of proper water channel to divert and channelize the water with minimum infiltration by construction of the following drains:-

- Construction of chute water drains above the crown of the landslide scar.
- Construction of toe drain at the toe of the landslide scar upslope of the road bench.

Analysis and Outcome

Detailed investigations of the Sangkhola landslide, situated on NH 31A (Singtam- Gangtok Road) were carried out to understand the dynamicity of the affected slope and to formulate mitigative measures. Detailed mapping (1:500 scale) of the Sangkhola landslide was carried out using digital Theodolite Survey instrument covering an area of 0.01 sq. km. Thematic maps of intrinsic variables (lithology, slope morphometry and slope aspect) and lineament were generated and compared with the landslide incidence map of the distressed zone.

The relation of landslide incidences with the intrinsic variables and lineament shows: the 'erodability' of the rock plays an important role along with the rock type for landslide phenomena, slope angle is important for mass movements but even gentle slopes are vulnerable if other variables are dominant, the favourability calculated from 3 conditions of discontinuity in relation to the slope inclination direction is below 40% and hence the structure/discontinuity planes definitely contribute to the land sliding phenomenon and lineaments contribute a 78% control over the landslide incidences in the distressed zone.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority

Study Title

A Report on Macro Scale Landslide Hazard Zonation on 1:50,000 Scale Along Rangpo-Singtam-Dikchu-Chungthang Road Corridor, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2014

Objective

- Sheet wise compilation, digitization, integration with NER mosaic & uploading of all layers to GSI portal.
- Standardization of already uploaded digital data to make them seamless across the region (up to litho unit level).
- Identification of gap/misma

Study Recommendation

It is clear that the generated LHZ map as such is not static in nature therefore it necessitates continuous re-evaluation of the area from time to time

Analysis and Outcome

Landslide initiation in the study area has been found to be influenced by both natural triggering factors as well as anthropogenic interferences. The present LHZ map is a qualitative and subjective assessment on the probability of landslide hazard conditions, based on the combined influence of the six causative factors, through a knowledge-based rating system as recommended by BIS.

The generated LHZ map will: i) help planners to choose favorable and stable locations for perspective planning such as construction of buildings, roads, dams, powerhouse, townships etc. ii) help in the identification and delineation of unstable, hazard prone areas for environmental regeneration programme by adopting suitable mitigation measures iii) help in the identification and delineation of target areas for meso-zonation (1:15,000) or larger scale site specific studies iv) can meaningfully serve as a significant contributing parameter for the geo-hazard assessment and evaluation of the area and v) the susceptibility map when combined with temporal data can be effectively used for assessing the landslide hazard and risk scenario of the area. The recommendation of the study is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency



Study Title

A Report on Seismic Hazard Assessment of Gangtok and Surrounding Areas of Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2014

Objective

The present work is carried out with an objective to delineate the different hazard zones by combining various thematic layers generated by studying local site effects with the vulnerability factors.

Study Recommendation

- It is highly recommended to strictly follow the building norms in construction.
- And also, to expand the city in preferably low to medium hazard zones for comparatively lower damage in any earthquake events.

Analysis and Outcome

To generate a seismic susceptibility map of the study area, the study primarily considered two separate inputs, geological and geophysical. Even though demography is not used as a predictor layer, the final SHZ hazard map covers the area of higher population as the most susceptible. This indicates that the landuse/landcover, though not strongly biased as seen in correlations, affects the area Physiographically.

Anthropogenic activities have the potential to affect all the geological parameters/predictors over time. The changes in geological parameters in turn affect the geophysical parameters as all natural phenomena are interrelated and interdependent.

The strain analysis for Sikkim shows that most of the areas are in high compression excluding the eastern part, which is tensional. The boundary between the compression and tension zone is vulnerable for earthquakes. The study recommendations are partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency

Study Title

Preliminary Report on Geotechnical Evaluation and Site Response Study for Site Suitability of New Secretariat Complex, Gangtok, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2013

Objective

The geotechnical and geophysical studies carried out around New Secretariat Building on the request of Principal Secretary, Department of Mines, Minerals and Geology, Government of Sikkim, vide Letter No. nil, dated 3rd September, 2012 (through fax). This report is contemplation of site visit during period 8th – 13th September 2012.

Study Recommendation

- Since the area has recently witnessed earth quake of 6.9 intensity on Richter scale. Therefore, seismic coefficient should properly be incorporated while designing framework (beam and columns), preferably towards conservative side.
- During foundation excavation if the inferred shear / fault is exposed then dental treatment should be provided in this shear.
- Detailed geological mapping of the excavated foundation shall be carried out to ascertain the weak features and assess the rock mass condition at foundation level.

Analysis and Outcome

The old State Secretariat building was located at Tashiling in Gangtok city was constructed between 1975-1977. It was approximately 35 years old which got severely damaged during the 18th September 2011 earth quake rendering it to unsafe for occupation. The Secretariat Building being an iconic and center of administration, government of Sikkim immediately after the earth quake decided to demolish the damaged building and build a new RCC building on the same place where earlier one existed with enhanced space, equipped with modern facilities which is as an state of art building. The State, Department of Mines, Minerals and Geology has prepared contour plan and carried out geological mapping around this complex. Two bore holes were also drilled to know the depth of overburden and carry out compressive and tensile strength of the rock along main secretariat building, besides 8 pits for soil samples for carrying grain size analysis, density, moisture content and direct shear analysis. All these studies were done post-earthquake.

The recommendation of the study was fully implemented while constructing the new main Secretariat building. The structures were earthquake resistant and can sustain an earthquake of 8 magnitude on Richter Scale. It spreads over the area of 11,514 square meters and block B spread over the area of 8486 square meters and has been constructed at the cost of Rs 264.30 crores ^[176].



Study Title

Sikkim Earthquake 2011 – Reconstruction Strategy

Implementing Institution

National Institute of Disaster Management,
Ministry of Home Affairs, Govt. of India

Project Location/Completion Year

Sikkim, 2012

Objective

A comprehensive multi-sector program plan to restore Sikkim from earthquake, through provision of housing, social amenities, infrastructure, and livelihood support, based on sustainable economy and ecology in consonance with the broad guidelines of NDMA and with financial assistance from central and state government.

Study Recommendation

Based on the field survey and consultation workshop organized at NIDM, following recommendations are made:

- The Sikkim earthquake Rehabilitation and Recovery has to be envisaged through a participatory and inclusive process by involving the professional organizations, such as NBCC, L&T, EPIL, ECC, CBRI, CRRI, IITs, Corporate bodies, such as FICCI, IE(I), ECI and the local community.
- Educate and train engineers, architects and masons in earthquake risk management, both with class room and field activities. Education programs about risk that are aimed at children may be more important than those aimed at adults in the effort to foster disaster-resilient communities, because children play a role in educating adults through school-knowledge transfer at home.
- It is recommended that both State and District Disaster Management Authorities be empowered to manage the various issues concerning disaster management
- Improvisations on traditional construction techniques with incorporation of modern building construction practices can help reduce earthquake vulnerability.
- A strategy of taking full advantage of recent advances in seismology, GPS sensor, high speed computer and telemetry technologies for developing rapid and reliable real-time earthquake information systems has to be developed involving all leading organizations of the country.

Analysis and Outcome

Sikkim earthquake-2011, in which more than 34000 building damaged and more than 400 landslides occurred, the total estimated loss is approximately \$1.7 billion US. In addition about \$200 million US damage was caused in Tibet (China), and slightly higher in Eastern Nepal in addition to losses in Bhutan with around 6000 buildings damaged. The present study carried out reconnaissance survey of the earthquake affected areas from 21 to 25 September 2011 and held interactions with officials from the State and Central Government Agencies, armed forces, communities, NGOs and civil societies involved in the relief and rescue operations. It mainly noted the extent of damages incurred to buildings, roads and infrastructures; response mechanism and relief measures being adopted, emergency control room operation at the district headquarters, in addition to media and press briefing to tackle the situation on emergency basis.

The reconstruction strategy takes care to improve the conditions of those affected in ways that might not otherwise be possible given legal, financial, or technical ramifications. These improvements extend not only to disaster risk reduction, but also with regards to economic revitalization, better awareness/capacity building, and modernization of the physical and social infrastructures. The reconstruction strategy was submitted to the government of Sikkim.

Study Title

Macroseismic Survey of Tripura Earthquake

Implementing Institution

Earthquake Geology Division,
Geological Survey of India

Project Location/Completion Year

Tripura, 2017

Objective

- Observe the general effects of the earthquake across the affected area,
- Assess the damage pattern of buildings,
- Evaluate the intensity of the ground motions in the affected areas and
- Prepare an iso-seismal map of the affected area.

Study Recommendation

- Sub-surface exploration by drilling is necessary to have a clear picture about the behaviour and the extension of the coal bands in the north eastern part of the mapped area where the coal bands are not exposed.
- Clay investigation can be carried out in order to know the resource potentiality of the area.
- Thick beds of clay can be used in potteries and ceramic industries to improve the socio-economic condition of the people.

Analysis and Outcome

The present study attempts to present a detailed descriptive record of eventual effects, analysis of the damages for final evaluation of Isoseismals; to find out the genesis of the earthquake on the basis of tectonic set up of the area, damage patterns, to estimate possible energy release and mode of dissipation of the same with respect to geological set up of the area. Based on the macroseismic survey and the resultant intensity map, certain clustering of high intensity incidences in a localized area particularly around Kanchanbari, Kamalpur, Kathalbari, Longtarai and Chawmanu area is noticed. The asymmetrical nature of Isoseist is because of lithocontrast and the type of variable construction structures. Probably this phenomenon is governed by the ground condition which is not related to the distance of wave propagation (reduction in ground acceleration in uniform media through which it propagates). At some localised places the local amplification of vibration was affected by low velocity medium viz loose alluvium which has in turn caused the clay-liquid injection thereby leading to maximum intensity. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 79M/13, 79M/14, 83D/4, 83D/8, 84A/1, 84A/2, 84A/5 & 84A/6, North Tripura & Dhalai Districts in Tripura

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Tripura, 2016

Objective

To prepare a landslide inventory database, to prepare 1:50,000 scale spatial database for geo-factors of landslides and to prepare landslide susceptibility map by systematic scientific approach viz. using high resolution remote sensing data and field inputs, thematic maps and multi-class index overlay method in a GIS platform.

Study Recommendation

- Strict building safety regulations should be followed in moderate susceptible areas and constructions with simple slope stability measures should be allowed in low susceptible areas.
- It is recommended that more priority should be given in increasing awareness amongst people through Community Based Disaster Management Programme (CBDMP). The awareness should include information about the potential danger, its identification and its communication; the physical significance of hazard and inherent uncertainties; ways to reduce landslide risk and the available local mitigation options

Analysis and Outcome

The present study carried out Landslide Susceptibility Mapping during the field season programme 2015-16 (Item No.: LSM/NER/TRM/2015/060) in parts of North Tripura and Dhalai districts, Tripura covering about 1327 sq. km study area. A qualitative landslide susceptibility map on 1:50,000 scale for the study area is prepared demarcating the low, moderate and high susceptible areas based on knowledge driven methodology in GIS platform. A total of six factor maps were prepared for susceptibility analysis (viz., Slope, Curvature, Landuse/ Landcover, geomorphology, Slope Forming Material and Regolith thickness maps).

A total 255 landslides were considered for comparative study from satellite data and field. Out of these, a detailed inventory of 64 landslides, containing 41-point parameter, was prepared including, majority (53 Nos.) of debris slides; 4 earth slide; 5 rockslides and 2 rock falls. Landslide susceptibility map indicates only about 2.73% (36.17 sq. km) of the study areas falls under high susceptibility class covering some stretch along the western and eastern slope of Jampui hill range, parts of Sakhan range and few areas to the north east of Kathalbari, Uttar Longtarai area in the Longtarai hill range. Moderate susceptible zone covers 6.29% (83.43 sq. km) area along the periphery surrounding the high susceptible slopes. And major part of the study area, about 90.99% (1207.40 sq. km) falls in the low susceptible class.

The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency

Study Title

Detailed Seismological Study of the Tripura Fold Belt and its Adjoining Areas

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Tripura, 2015

Objective

To carry out a comprehensive seismic monitoring to understand the seismicity pattern, nature of faulting and sub-surface heterogeneity in the Tripura Fold Belt and its adjoining areas, by setting up of seismic network consisting of nine number of seismograph stations at different locations of Tripura state

Study Recommendation

- Except two clusters in the NW of Tripura state, no other clustered events were observed for detailed analysis.
- Events are distributed all over the study area thereby revealing that the area under study is strained due to differential stress condition and thus accumulated energy is being released in terms of micro tremors.

Analysis and Outcome

The study outcome shows the epicentral map of the combined data set two prominent clusters along Sylhet fault in Bangladesh near north of Khowai and Agartala seismic stations. Apart from these, the sparse seismicity is observed in entire Tripura fold belt and its adjoining area. 418 local earthquakes located within latitude 22°N-25°N and longitude 90°E-93°E, located by multi station method and with RMS values ≤ 1.0 were selected for detailed analysis. The b-value for the study area has been estimated to be 0.95 which is lesser than normal and indicates a comparatively stressed regime and occurrences of moderate magnitude earthquakes cannot be ruled out. The b-value ranges between 0.25 to 1.27 in different blocks in the study area indicates the uneven distribution of stress in different blocks may be due to sub-surface lithospheric heterogeneity that have appreciable control on the litho-static stress pattern of the area and may also be due to E-W compression resulting from eastward subduction and collision of the India plate along the Arakan-Yoma suture zone.

The composite fault plane solution of different blocks is comparable to the b-values and it shows a differential direction of compressive forces acting on these blocks. The depth section and composite fault plane solution at different depth ranges for the clustered events near Sylhet fault shows a thrust faulting with strike slip solution.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority



Study Title

A Study of Landslides through Hazard Zonation Risk Analysis and Preparation of Landslide Inventory of Dhalai District in the State of Tripura Using RS and GIS Techniques

Implementing Institution

Tezpur University

Project Location/Completion Year

Tripura, 2012

Objective

- To generate detailed data base and maps of different parameters like lithology, structure, relative relief, average slope, drainage density, ground water hydrology, rainfall, land use and land cover; Landslide Hazard Zonation maps and their assessment.
- To assess the geo-technical properties of soil samples through laboratory and field analysis, prepare detailed data base of socio-economic parameters for preparing landslide inventory and vulnerability analysis.
- To analyze Landslide Hazard Risk on the basis of hazard and vulnerability.

Study Recommendation

- Construction of suitable protective structure, i.e. retaining walls with weep holes. Retention wall should be constructed with proper engineering manner.
- To reduce the pore-water pressure, proper drainage including sub-surface or perched water construction of surface as well as underground drainage is necessary to prevent entry and activity of water.
- Afforestation especially by grass, bushes and shrubs are recommended on the affected slope.

Analysis and Outcome

Landslide is a common hazardous phenomenon in hilly tracts of Tripura especially in North and Dhalai District. These phenomena commonly occur in between Atharamura and Longtarai hilly regions mainly along the nation high way (NH44) and along the rail way track in the districts of Tripura. The prepared regional LHZ map serves as the instrumental feature for identifying the vulnerable sections of considered elements. The each vulnerable element falls within each level of susceptibility were extracted and analyzed. Vulnerability risk analysis was made over the four major parameters such as roads, settlements, built-up area and shifting cultivation area. The road vulnerability assessment shows that 3.99 km of national highway is very high vulnerable. This very high vulnerable roads road section experiences landslides in every monsoon season. Unscientific cutting of hillside slopes for widening of the road increases this vulnerability. So, urgent measure is necessary to prevent this hazard and reduce the vulnerability. The destruction of forest cover in the area for settlement, cultivation, roads and settlement on steep slopes are the major contributing factors to slope instability hilly terrains of Dhalai district resulting in landslides. It has been observed that the study outcome/ recommendations is incorporated in Dhalai District Disaster Management Plan 2016/17 ^[181].

Agencies responsible for implementation:

- Tripura Disaster Management Authority, Government of Tripura
- National Disaster Management Authority

Study Title

Macro Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 83H/13, 83H/14, 83L/1 & 83L/2 In Imphal East, Imphal West, Thoubal and Bishnupur Districts of Manipur

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2019

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs.
- To prepare toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input maps.
- To prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

- The low susceptible zone covers 54% of the study area and any planning and constructional activities can be done in these zones.
- The moderately susceptible zone covers 35% of the study area and precautions have to be taken before starting construction activities of buildings in these places. Geotechnical studies such as soil sampling, core logging, geotechnical strength parameters studies and ground water movements etc has to be done.
- The highly susceptible zones accounts for 11% in the study area. No civil construction recommended in this area. But if any, mitigative or remedial measures such as benching of the slope, retention wall, stabilization, etc have been recommended.
- Landslide awareness programme should be given to local village communities by the state government as well as GSI.

Analysis and Outcome

This study carried out a Landslide Susceptibility Mapping in parts of Toposheets nos. 83 H/13 & 83 H/14, 83L/1, 83L/2 of Imphal East, Imphal West, Thoubal and Bishnupur districts of Manipur covering 1550 sq.km area. Landslide Susceptibility Mapping in parts of Toposheets nos. 83 H/13 & 83 H/14, 83L/1, 83L/2 of Imphal East, Imphal West, Thoubal and Bishnupur districts of Manipur covering 1550 sq.km area. Lineament map was prepared for the study area which includes structural lineaments such as joint, fracture and fault lineaments as well as geomorphologic lineaments like drainage and ridge lineaments. The majority of structural lineaments are showing a general trend towards north-east.

The Landslide Susceptibility map shows that out of the total study area, 837 sq.km (54%) area falls under Low Susceptible zone, 542.5 sq. km (35%) area falls under moderate susceptible zone and 170.5 sq.km (11%) area falls under high susceptible zone. The study recommendation was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets 78K/09,K/10, K/11, K/12, K/13 And K/16 Parts of North Garo Hills, East Garo Hills, South Garo Hills, West Khasi Hills & South West Khasi Hills Districts, Meghalaya and Goalpara

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2019

Objective

To prepare landslide susceptibility map using heuristic method and multi-class index overlay technique on GIS platform and classify the area into varying degree of landslide prone zones.

Study Recommendation

The assessment of the landslide susceptibility is extremely important because it help in identifying the potential landslide prone areas, evaluating the regional relative stability of slopes and gives basic construction standards for new civil structures such as roads or buildings.

Analysis and Outcome

The Landslide inventory database of the area along with limited field observations suggest that most of the slides are triggered largely by rain during monsoon season. Further, significant anthropogenic interference through modification of slope profile for construction of new roads and civil structures, has been found to be a major causative factor for inducing local instability. The study carried out for the current item indicates that only 2.20% (67.21 sq km approx.) of the total area comes under highly susceptible area while moderately susceptible area accounts for 19.40% (592.67 sq km approx.) and low susceptible area accounts for 78.39% (2394.81 sq km approx.).

The Susceptibility Map of the study area reveals that high and moderate susceptible areas are mostly confined to the South and Northeastern parts which may be attributed to the presence of a number of faults & thrusts in these areas which have considerably affected the rock strength. The susceptibility map is the outcome of mainly remote sensing inputs with limited field inputs and hence the map generated has certain limitations and inherent uncertainties. The map provides qualitative estimate of landslide susceptibility of the study area in 1:50,000 and is regional in application.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83 F/11, 83 F/12 And Parts Of Toposheet No. 83 F/16 in Karbi Anglong and Golaghat Districts of Assam and Wokha District of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2019

Objective

To prepare landslide susceptibility map using heuristic method and multi-class index overlay technique on GIS platform.

Study Recommendation

- Landslide susceptibility map indicates that 2.6% (37sq km) of the study area is characterized by high susceptibility zone, moderate susceptibility zone comprises 12.06% (172sq km) while that of low susceptibility zone covers majority of the study area i.e., 85.30% (1216sq km). The high susceptible zone includes Ralan road section (Wokha, Nagaland) in T.S. No. 83 F/16 and few localized places near Thedang Tansegao along Daigurung River in T.S. No. 83 F/11.
- Short term measures such as awareness drive for locals residing on or near hilly areas on how to identify different signatures for any possible landslide occurrence in their surroundings such as crown cracks, tilting of trees or objects, etc.
- Long term measures can be adopted depending on the terrain, landslide type, etc. such as breaking the slope into terraces (for thick soil cover), using toe support such as gabion wall, retaining wall with sufficient weep holes on sound foundation, plantation of deep fibrous root plants e.g. vetiver grass on slopes with thick regolith cover by constructing small benches type.

Analysis and Outcome

The present study carried out Landslide Susceptibility mapping covering an area of 1425 sq. km and 18 landslide incidences have been recorded in Ralan (Nagaland) and Daigurung in Karbi Anglong, Assam, out of which 14 are debris and two composite (two soil and two rock slides). Field studies indicate that all the landslide incidences are human-induced. The landslide dimension ranges from 10 m to 60 m (length) and 8 m to 40 m (width). These slides are caused due to extensive slope excavation for road construction, triggered by incessant rainfall. Other major contributing factor includes poor slope forming material comprising highly weathered rock (W4).

Landslide susceptibility map indicates that 2.6% (37sq km) of the study area is characterized by high susceptibility zone, moderate susceptibility zone comprises 12.06% (172sq km) while that of low susceptibility zone covers majority of the study area i.e., 85.30% (1216sq km). The high susceptible zone includes Ralan road section (Wokha, Nagaland) in T.S. No. 83 F/16 and few localized places near Thedang Tansegao along Daigurung River in T.S. No. 83 F/11. The landslide incidences exhibits positive spatial distribution to higher dissection hill slope with Tertiary rocks belonging to ferruginous sandstone (Tipam Sandstone) in Ralan, Nagaland and weathered granitic terrain (Assam Meghalaya gneissic complex) in Kailamati-Daigurung, Karbi Anglong.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83h/05 And 83h/06 in Tamenglong, Noney Districts of Manipur and Cachar District of Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2019

Objective

- Categorization of hill slope in terms of landslide susceptibility,
- Preparation of landslide inventory database using high resolution remote sensing data, archival information and field inputs
- Preparation of spatial database for geo-factors of landslides.

Study Recommendation

- Civil construction in and around high susceptibility zones should be avoided and in case of non-avoidance, proper safety measures and regulations needs to be taken before construction.
- Sufficient buffer zone should be provided between the settlements/civil structures that are located in the vicinity of the high susceptibility zone.
- Unscientific slope cutting for the construction of road and modification of the slope for settlements are the major stability problem in the study area. So while doing these activities these methods should be followed; proper drainage alignment should be maintained, toe supporting structures should be constructed to avoid further modification in the natural slope.

Analysis and Outcome

The present study carried out Macro-scale (1:50,000) landslide susceptibility mapping in toposheets nos. 83 H/05, and 83 H/6 covering 1409 Sq. Km. area in parts of Tamenglong and Noney districts of Manipur and Dima Hasao (erstwhile North Cachar Hills) district of Assam. Landslides inventory map was validated for accessible landslides and 42 parametric datasheet was prepared for 114 numbers of landslides. Most of landslides have occurred in extensive slope cut during construction of road/ railway line. The unscientific slope cutting coupled with unstable lithology of the Upper Disang cause a number of slides in the eastern part of the mapped area.

Most of the landslides (31%) occur in the Bhuban Formation, which constitutes 31% of the area followed by 23% in the Disang Formation constituting 22% of the total area. Out of 114 landslides validated in field, 96% of the landslides are anthropogenic and only 4% occur in natural slopes. The susceptibility score map is classified into 3 classes according to the formula applied as per break values of the Analytical Hierarchy Process (AHP) method. In the study area 15% of the area falls under high susceptible zone, 44% in moderate and 41% in low susceptible zone.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority

Study Title

Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet No.78J/07, 78J/08, 78J/11, 78J/12 AND 83B/04 in Golapara, Bongaigaon, Barapeta Districts, Assam and West Garo Hills and Ri-Bhoi Districts Meghalaya

Implementing Institution

Geological Survey of India, State Unit: Assam

Project Location/Completion Year

More than one state, 2019

Objective

To prepare landslide inventory database, spatial database for geo-factors of landslides and categorization of hill slopes in terms of landslide susceptibility.

Study Recommendation

- As observed majority of the landslides are slope cut failures, therefore, during construction of any new road or even the existing roads utmost care must be taken to ensure that the slope maintains its stability.
- In case if any developmental activities needs to be set up in these high susceptible zones, then the proposed area should undergo proper geotechnical investigation and approved by the concerned authorities.
- Water is almost always a contributing factor for landslides and thus drainage correction should be done in hilly areas with settlement and along road cuts.
- Basic mining laws should be followed i.e., excavation from top to bottom of hill. Any kind of slope modification if required should be done maintaining the critical angle of repose.

Analysis and Outcome

The present study carried out a landslide susceptibility mapping in parts of toposheet no.78J/07, 78J/08, 78J/11, 78J/12 and 83B/04 in Golapara, Bongaigaon, Barapeta districts, Assam and West Garo Hills and Ri-bhoi districts Meghalaya. During field study, 09 landslides of varied nature, failure mechanism, slide material type and dimensions were studied and detailed inventory containing 42-points geoparametric datasheet for each landslide was prepared. In toposheet no. 78J/07 which occupies the north-western part of the study area, a natural landslide was recorded caused due to high slope angle comprising weathered rock aided with rainfall.

The analysis indicates that 2.8% of the study area is characterized by high susceptibility zone, moderate susceptibility zone comprises 11.9% while that of low susceptibility zone covers majority of the study area i.e., 85.3%. Part of the study recommendation was partially implemented.

Agencies responsible for implementation

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 83 K/10, 83 K/14, 83 K/15 & 83 O/2 in Phek, Kiphire Districts of Nagaland and Ukhrul District of Manipur

Implementing Institution

Geological Survey of India, State unit:
Manipur – Nagaland

Project Location/Completion Year

More than one state, 2018

Objective

- Preparation of landslide inventory database using high resolution remote sensing data, archival of information and field inputs.
- Preparation of spatial database for geo-factors of landslides
- Categorization of the hill slope in terms of landslide susceptibility.

Study Recommendation

Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes. Disang shale should be avoided wherever possible since it has been observed that the response of the overburden material on hillslopes to landslide is dependent on the strength parameters of underlying lithology.

Analysis and Outcome

The present study carried out Landslide Susceptibility Mapping in parts of Phek and Kiphire districts of Nagaland and Ukhrul district of Manipur and falling in parts of Survey of India toposheets no. 83 K/10, K/14, K/15 and 83 O/2. Landslides inventory map was validated for accessible landslides and 41 parametric datasheet was prepared for 170 numbers of landslides. Most of landslides have occurred in extensive slope cut during construction of road. Out of 170 recorded slides, only 46 nos. slides were on natural slopes and the rest were of anthropogenic origin.

For landslide incidences versus rock type, 41% falls in Disang Formation, 29% in Ophiolite suite and 11% in Nimi Formation. Susceptibility map was prepared by multi-class overlaying of slope, curvature, LULC, geomorphology, SFM and SFM thickness. It was classified into three classes using manual break. Most of the mapped area falls under Moderate susceptibility class. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 83J/10, 83J/13, 83M/04 & 83N/01 in Mon, Mokokchung, & Longleng Districts of Nagaland and Sibsagar District of Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

- Preparation of landslide inventory database using high resolution remote sensing data, archival information and field inputs.
- Preparation of spatial database for geofactors of landslides.
- Categorization of the hillslope in terms of landslide susceptibility.

Study Recommendation

Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Surma and Barail country rocks since it has been established that the response of the overburden material on hillslopes to landsliding is largely or directly controlled by the underlying lithology.

Analysis and Outcome

The present study carried out a macro-scale Landslide Susceptibility Mapping in parts of toposheet nos. 83J/10, 83J/13, 83M/4 & 83N/1 83G/11 and 83G/12 in Mon, Mokokchung, & Longleng districts of Nagaland and Sibsagar district of Assam. 54 landslide incidences were picked up from multi-temporal google-earth data. Out of the 54 landslides, 30 numbers of natural landslides which are of smaller dimensions could not be field verified due to inaccessible terrain condition. 24 landslides were physically visited out of which 8 were found out to be jhum cultivation and no traces were found for another 6 landslides due to change in land cover and land cover pattern. In addition 88 landslides were physically visited and 41 parameters for each landslide were taken.

Susceptibility map was prepared by multi-class overlaying of slope, curvature, land use/land cover, geomorphology, slope forming material and slope forming material thickness maps. Out of 1573 km² area 1038 km² (66%) area falls under low susceptibility class, 378 km² (24%) area falls under moderate class and 157 km² (10%) falls under high susceptibility class. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Authority



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83 G/5 and 83 G/9 in Parts of Karbi Anglong, Dima Hasao and Nagaon Districts of Assam and Dimapur District of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

To map landslide susceptibility areas and to recommend remedial measures

Study Recommendation

- Utmost care must be taken to ensure that the slope maintains its stability while construction of roads. For any developmental activities the proposed area should undergo proper geotechnical investigation and approved by the concerned authorities.
- Drainage correction should be done in hilly areas with settlement. Impermeable concrete should be used to prevent erosion. Basic mining laws should be followed i.e., excavation from top to bottom of hill.
- Avoid construction on steep slopes and existing landslide scars, or by stabilizing the slopes. In areas of weak lithology and thick soil development, construction of retaining walls with adequate weep holes is suggested.
- It is recommended to construct road over bridge (like the railways) in sections passing through weak slope forming material and incompetent lithology characterized by continued subsidence of road. Awareness drive for locals residing on hilly areas on how to identify different signatures for any possible landslide occurrence in their surroundings such as crown cracks, tilting of trees or objects, etc. Provide basic knowledge of landslide hazards, causative factors and preventive measures to the local populace in the form of seminars, electronic Medias etc. Local government bodies should check and maintain strict land use policies.

Analysis and Outcome

Geologically, the study area largely falls in the Tertiary sedimentary belt comprising Jaintia, Surma and Tipam Group of rocks, uncomfortably overlying the basement Assam-Meghalaya Gneissic Complex (present as inliers). Geomorphologically, the study area is characterized by low hillocks and gentle mounds which present a matured topography. High height plantations (Teak, rubber, etc.) are common land use features prevailing in the study area. Geomorphology, Slope Forming Material and Regolith Thickness) of 1399 sq km was covered during Field Season Programme 2017-18. A total of 20 landslides were identified, out of which 8 numbers fall in T.S. No. 83 G/05 and 12 numbers in T.S. No. 83 G/09. Field studies indicate that 95% of the landslide incidences are human-induced while 5% are natural.

The analysis indicates that 0.06% (0.84 sq km) of the study area is characterized by high susceptibility zone, moderate susceptibility zone comprises 1.1% (15.39 sq km) while that of low susceptibility zone covers majority of the study area i.e., 98.85% (1382.91 sq km).

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Authority

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83 K/11 & 83 K/12 And 83L/9, in Phek District of Nagaland and Ukhrul District of Manipur

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs.
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input maps.
- To prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

- The low susceptible zone covers 49% of the study area and any planning and constructional activities can be done in these zones.
- The moderately susceptible zone covers 41% of the study area and due care has to be taken before starting construction activities of buildings in these places. Geotechnical studies such as soil sampling, core logging, geotechnical strength parameters studies and ground water movements etc has to be done.
- The highly susceptible zones accounts for 10% in the study area. No civil construction recommended in this area. But if any, mitigative or remedial measures such as benching of the slope, retention wall, stabilization, etc have been recommended.
- Resettlement for those lying in red zone.
- Landslide awareness programme has to be given to the stake holders and local villagers.

Analysis and Outcome

The present study carried out a Landslide Susceptibility Mapping in parts of Toposheets nos. 83 K/11 & 83 K/12 and 83L/9, Phek district of Nagaland and Ukhrul district of Manipur covering 1422 sq.km area. Landslides are widely distributed in the study area. A total of 248 nos. of slides were identified in the field. For each of these landslides, the field-based landslide inventory data was prepared as per the 41 point geo-parametric sheet. Out of 248 landslides, 156 nos. (63%) are debris slides, 87 are (35%) are soil slides, 5 are (2%) are rock slides. The Landslide Susceptibility map shows that out of the total study area, 697 sq.km (49%) area falls under Low Susceptible zone, 583 sq.km (41%) area falls under Moderate Susceptible zone and 142 sq.km (10%) area falls under High Susceptible zone.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Authority



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Toposheets 78O/06 & 78 O/07, Parts of West Khasi Hills & South West Khasi Hills Districts, Meghalaya and Parts of Kamrup District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

The objective is to prepare landslide susceptibility map using heuristic method and multi-class index overlay technique on GIS platform and classify the area into varying degree of landslide prone zones.

Study Recommendation

- There is non-uniform spatial distribution of landslides in the study area. While a few natural landslides are common phenomenon and invariably associated with the moderate to steep slopes, the study area is relatively stable in natural setting where slope modification is absent.
- However, unsustainable anthropogenic activity along a few stretches of communication corridors has played considerable role in inducing slope failures.
- The studies and analysis of the existing baseline information of landslide inventory data and field observations suggest that land-use pattern has relatively more significant influence in inducing instability in the slope mass.

Analysis and Outcome

The study carried out landslide susceptibility mapping during the Field Season 2017-2018, covering an area of approx. 1391 km², on macro-Scale (1:50,000) in parts of Toposheets 78 O/6 & 78 O/7 parts of East Khasi Hills, South West Khasi Hills Districts, Meghalaya. Altogether, 25 landslides have been documented following 42-point proforma out of which 22 are debris slides, 3 are rock slides and 1 earth flow. In addition, about 27 natural landslides were identified through google earth imagery. Amongst the six geo-factor themes considered in the study, the slope and LULC carry an integer weight of 13 and 9 respectively and have maximum control in spatial distribution of landslides.

The current study shows that only 0.67% of the total area is under highly susceptible area while moderately susceptible area accounts for 10.06% and low susceptible area for 89.27%. The susceptibility map is the outcome of both remote sensing and field inputs and the map shows qualitative estimate of landslide susceptibility of the study area in 1:50,000 and is regional in application. The map can be of immense help in identifying the potential landslide prone areas to zero down on specific locations of interest and therefore to evaluate the regional relative stability of slopes before and during the course of constructing civil structure

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Authority

Study Title

Macro-Scale(1:50000) Landslide Susceptibility Mapping in Parts of TS Nos 83C/16 & 83H/1 in Dima Hasao & Cachar Districts in Assam, East Jaintia Hills District of Meghalaya & Tamenglong and Jiribam Districts of Manipur

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

To map landslide susceptibility areas and to recommend remedial measures

Study Recommendation

- Utmost care must be taken to ensure that the slope maintains its stability while construction of roads. For any developmental activities the proposed area should undergo proper geotechnical investigation and approved by the concerned authorities.
- Avoid construction on steep slopes and existing landslide scars, or by stabilizing the slopes. In areas of weak lithology and thick soil development, construction of retaining walls with adequate weep holes is suggested.
- Awareness drive for locals residing on hilly areas on how to identify different signatures for any possible landslide occurrence in their surroundings such as crown cracks, tilting of trees or objects, etc. Local government bodies should check and maintain strict land use policies.

Analysis and Outcome

The present study carried out a landslide susceptibility mapping in parts of TS nos 83C/16 & 83H/1 in Dima Hasao & Cachar districts in Assam, East Jaintia Hills district of Meghalaya & Tamenglong and Jiribam districts of Manipur. As per the calculation, 3.43% (48.10 sq km) of the study area falls under high susceptibility zone, 10.35% (145.06 sq km) under moderate susceptibility zone and the rest i.e. 86.21% (1207.84 sq km) under low susceptibility zone. Approximately 97% of the landslide recorded in the study area is located along the road sections. Based on field studies and susceptibility map, seven major roads sections are identified as landslide prone area viz. (1)Retzawl-Harangajao; (2) Bara Narayanpur-Bandarkhal-Tibong road; (3) Phulerthal-Lalpani road; (4) Mukthahal-Makru; (5) Kaiphundai-Sajang road; (6) Malong Dipuchhara- Bara Arkap road; (7) Retzawl- Arda (Old-Silchar road).

Natural landslides are observed in the steep slopes of the high hills and are mostly shallow translational in nature due to failure along weak plane (bedding/Joints) triggered during heavy rainfall. Road and railway line construction affect the natural surface and subsurface drainage pattern of a watershed or an individual hillslope. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Authority



Study Title

India: North-East (Assam And Manipur) Floods

Implementing Institution

Indian Red Cross Society (IRCS)

Project Location/Completion Year

More than one state, 2017

Objective

The overall objective was to ensure that the immediate needs of the 5,000 flood-affected families were met through provision of emergency relief items, safe drinking water, temporary toilets and hygiene promotion over a three-month period.

Study Recommendation

- Distribution of relief items to 5,000 affected families – available items released from IRCS warehouses
- Replenishment of relief items to 5,000 families
- Transportation of 500 family tents for prepositioning and need based distributions
- Safe drinking water storage and supply to the affected families through deployment of four water purification units (two each in Manipur and Assam)
- Procurement of two water tanks of 5,000 litre capacity (added on during the middle of the operation and accomplished)
- Deployment of one RDRT member with relief and WASH experience in Manipur to support the operation as per technical requirement
- Deployment of 2 NDWRT members in different phases as per technical requirement
- Installation of temporary toilets
- Hygiene promotion activities – distribution of soaps and sanitary napkins and promotional messages
- Relief distributions using ODK
- Organization of lessons learned workshop
- Organization of one training on finance

Analysis and Outcome

All the key recommendations were fully implemented; except for few changes that were incorporated for capacity building activities and the budgets were reallocated to cover the increased costs for transportation. As per the recommendation of the project team, a needs assessment was carried out by the state and district branches. A total of 70 volunteers in Assam and 45 volunteers in Manipur were mobilised to support relief operations. Volunteers were provided orientation on relief management. Especially in the case of Manipur, most of the activities were implemented by the branches. Additional support and training were given to the volunteers in Manipur on documentation and financial reporting. ODK kits were sent to Assam and Manipur and both state branches organized ODK trainings. The Manipur branch used the kit for relief distributions. Though the Assam branch tried to do this too, they could not use the kit due to technical challenges. The significance of the ODK tool has been recognized by all branches. Development of an integrated ODK platform for assessments and data analysis was planned but due to operational priorities, this activity was taken out. Training on finance was added for IRCS staff from Manipur, Assam, Bihar, West Bengal and Uttar Pradesh where DREF operations were being implemented simultaneously. However, the training could not be completed due to engagement of key finance staff and volunteers in the operations, making it difficult for them to take the time out for the purpose of training. The objective and recommendation of the study is fully implemented.

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets 78 O/13 & 83 C/01, Ri-Bhoi & West Khasi Hills Districts, Meghalaya & Karbi Anglong District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2017

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs.
- To prepare Toposheet-wise 1:50,000 scale spatial database for geo-factors of landslides for use as input thematic maps.
- To prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

- Few stretch of the national highways NH-6 (erstwhile NH-40) have been identified as moderate to high susceptible primarily due to extensive slope cut and widening of the road along steep slopes.
- Slope modification for four laning of the road has led to steepening of existing/earlier cut slope, re-alignment and new excavation at places that may have disturbed the slope stability.
- A number of settlements/dwellings situated at the edges of near-vertical slope cuts are highly vulnerable and may be relocated.
- The excavated dump material resting in immediate down slope of road bench also pose vulnerable as it increases the static loading of already weak overburden slope material.

Analysis and Outcome

The present study carried out a landslide susceptibility mapping covering an approx. 1400 sq.km. Landslide initiation in the study area is found mainly caused due to road cutting and widening of road bench in moderately to highly dissected hill slope. The post modeling results show that maximum area is covered by thick vegetation followed by sparse vegetation, moderate vegetation and cultivated land in the LULC theme. Geomorphologically, the study area is largely covered by highly dissected slopes, followed by moderately dissected slopes and lowly undulating slopes. In terms of the Slope Forming Material (SFM), the area is found largely dominated by in-situ soil. The output of the study i.e., the Landslide Susceptibility Map classifying the study area into three classes of High, Moderate and Low susceptible zones will be useful in identifying landslide prone zones, aid in the development of effective stabilization designs to minimize impact and efficient planning for developmental activities based on the landslide susceptibility zones of the area.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83 J/4 & 83 J/7 in Wokha, Zunheboto and Sibsagar Districts of Nagaland and Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2017

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs.
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input thematic maps.
- To prepare landslide susceptibility map using Multi-class index overlay method in a GIS platform.

Study Recommendation

- Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Lower Barail country rocks since it has been observed that the response of the overburden material on hillslopes to landsliding is dependent on the strength parameters of underlying geology.
- Strict implementation of rules [The control of National Highways (Land and Traffic) Act, 2002] laid down by the National Highway Authority of India (NHAI) in this regard is highly recommended.
- Detailed study, including the geotechnical aspects of the slope forming material and its underlying bedrock as well as the hydrological condition/s are highly recommended prior to the execution of any future developmental activity over the categorized high susceptibility hillslopes, particularly those slopes represented by Renji, Bhuban, Tipam and Girujan country rocks.

Analysis and Outcome

Landslides inventory map was validated for accessible landslides and 41 parametric datasheet was prepared for 117 numbers of landslides. Naturally occurring landslide are less in numbers (39%) in the area. Most of landslides have occurred in extensive cut slope during the road construction. For landslide incidences versus rock type, 30% fell in Renji Formation, 15% in Bhuban Formation and 12% in Tipam Formation which are predominantly sandstone and 14% fell in Girujan Formation which is predominantly clay and, 9% in Disang Formation. For Natural slides Slope was the most important factor. In Anthropogenic slides, Land Use Land Cover was the most important factor and the rest of the factors followed in the same order of importance as it was for natural slides. Most of the mapped area falls under low susceptibility class. Evaluation of the LSM indicates that High, Moderate and Low susceptibility classes accounts for 3%, 11% and 86%, respectively of the total study area. About 86% (1206 Km²) of the area falls under low susceptibility class. The study area falls largely 'Belt of Schuppen' but no correlation could be established with the thrusts and incidences of landslides.

Agencies responsible for implementation:

- State Disaster Management Authority
- State Urban Development Agency

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Toposheet Nos. 83 G/11 & 83 G/12, In Peren District of Nagaland and Tamenglong District of Manipur

Implementing Institution

Geological Survey of India, State Unit:
Manipur – Nagaland

Project Location/Completion Year

More than one state, 2017

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs,
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input thematic maps
- To prepare landslide susceptibility map using Multi-class index overlay method in a GIS platform.

Study Recommendation

Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Surma and Barail country rocks since it has been established that the response of the overburden material on hillslopes to landsliding is largely or directly controlled by the underlying lithology.

Analysis and Outcome

The macro-scale Landslide Susceptibility Mapping was carried out in the toposheets 83G/11 and 83G/12 in Peren district of Nagaland and Tamenglong district of Manipur. For susceptibility modelling, thematic maps viz. geomorphology, landuse/landcover (LULC), slope forming material (SFM) and slope forming material (SFM) thickness maps were prepared using sources such as google earth imagery, 50k geological map, toposheet and remote sensing data. 79 landslide incidences were picked up from multi-temporal google-earth data. Out of the 79 landslides, 36 landslides could not be field verified due to inaccessible terrain condition. 43 landslides out of 79 and in addition 102 landslides were physically visited and 41 parametric data for each landslide were taken. Landslide inventory map was validated by field checks in the accessible areas and 41 parametric datasheet was prepared for 145 numbers of landslides. The landslide susceptibility map prepared as the result of a combination of various factors responsible for landslide susceptibility, in which each factor has relative importance to probable landslide activity.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority
- State Urban Development Agency



Study Title

Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 83C/9,10 &13 in Nagaon, Karbi Anglong & Dima Hasao in Assam and Jaintia Hills Districts of Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2017

Objective

To prepare GIS-based seamless Landslide Susceptibility Maps

Study Recommendation

- Proper maintenance of road side drains and construction of retaining walls and slope easing/benching (for thick soil cover) at vulnerable sites along these road sections is highly recommended.
- Construction of building on the steep slopes comprising of poor slope forming material without proper preventive measures in this locality may lead to landslide hazard in the near future.

Analysis and Outcome

The north-western part of the study area, where the hills rises steeply from the flood plains dissected by the Borpani river is found to be vulnerable to landslides especially south west of Baithalangso and South of Amtreng. The central part of the study area characterised by weathered migmatitic rocks (W4) are found to be the most landslide prone areas particularly along the road section from Hamren to Umpu. The southern part of the study area comprising mostly of low undulatory hills dissected by interspersed valleys are found to be less prone to landslide with the exception of few minor cut-slope failures. The landslide susceptibility map showing high zones in areas other than road cuttings and settlement are due to the steepness of the slope angle and weak overburden material but are relatively safe unless there are external (anthropogenic) interferences. The recommendation of the study is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 83 C/2 & 83 C/3, East Khasi Hills, West Jaintia Hills & Karbi Anglong Districts, Meghalaya and Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2016

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs.
- To prepare Toposheet-wise 1:50,000 scale spatial database for geo-factors of landslides for use as input thematic maps. 3. To prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

- Significant anthropogenic interference through modification of slope profile has been found to be a major causative factor for inducing local instability. Hillslopes currently classified in low to moderate susceptibility are anticipated to undergo their susceptibility status when subjected to extreme anthropogenic interference without methodical approach in the near future.
- The information depicted in the derived susceptibility map is on 1:50,000 scale and accordingly the map can serve as the basis for further investigation for the areas of interest in case civil structures are planned.

Analysis and Outcome

The landslide susceptibility mapping was carried out during the Field Season 2015-2016, covering an area of approx. 1400 sq. km. The current study shows that only 1.06% of the total area comes under highly susceptible area while moderately susceptible area accounts for 7.9% and low susceptible area accounts for 90.99%. The highly susceptible areas are mostly confined to the south west quadrant of Toposheets 83 C/2 and 83 C/3. The susceptibility map is the outcome of both remote sensing and field inputs and the map shows qualitative estimate of landslide susceptibility of the study area in 1:50,000 and is regional in application. The map can be of immense help in identifying the potential landslide prone areas and therefore to evaluate the regional relative stability of slopes before and during the course of constructing civil structures.

Agencies responsible for implementation:

- State Disaster Management Authority



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83 G/15 & 83 G/16 in Senapati & Tamenglong Districts of Manipur & Peren District of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2016

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs.
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input thematic maps.
- To prepare landslide susceptibility map using Multi-class index overlay method in a GIS platform.

Study Recommendation

- Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Barail country rocks since it has been established that the response of the overburden material on hillslopes to landsliding is largely or directly controlled by the underlying lithology.
- The susceptibility map is generally meant for regional application because the information is shown on scale 1:50,000; however they are still of considerable significance from the point of specific land use and urban planning. Nevertheless, it is recommended that a detailed site-specific study may be duly conducted before planning and execution of the civil construction works. Areas with high susceptibility falling under high hazard should be given due attention while executing civil constructions
- Some remedial measure such as treatment of slope, proper drainage system, afforestation, construction of benches may reduce the risk of landslides.

Analysis and Outcome

A multi-temporal landslide inventory map for the study area was prepared from field based studies and using high resolution, open source Google Earth imageries dated for the period from 2002 to 2015. Most of the smaller landslides and slope failures were identified and delineated in the field, and are largely found in the vicinity of the road benches. The prepared landslide inventory map of the study area contains a total of 136 landslides. It covers total area of 0.75 sq. km. The largest recorded landslide in the study area is the debris slide towards 2km west of Gopibung village along Hawa nala with an approx. area of 467107 m² (excluding the run-out zone).

Analysis of the rainfall data collected from nearby area (Zubza GREF Rainguage station) that the average annual rainfall in the area is around 1680 mm/year and the rainfall period in the area is from May to October during which time an approx. 90% of rainfall is recorded. Analysis of the rainfall data collected from nearby area (Zubza GREF Rainguage station) that the average annual rainfall in the area is around 1680 mm/year and the rainfall period in the area is from May to October during which time an approx. 90% of rainfall is recorded. Key recommendations of the study are implementable for future infrastructure expansion and development.

Agencies responsible for implementation:

- Geological Survey of India.
- Department of Municipal Administration, Housing & Urban Development (MAHUD), Govt of Manipur/ Nagaland
- Department of Relief & Disaster Management, Government of Manipur/ Nagaland



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheets Nos. 83k/3 & 83k/4, Senapati, Imphal East, Ukhrul & Phek Districts of Manipur & Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2016

Objective

- To prepare landslide inventory database using high resolution remote sensing data and field inputs,
- To prepare Toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input maps,
- To prepare landslide susceptibility map using multi-class index overlay method in a GIS platform.

Study Recommendation

- Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Barail country rocks since it has been observed that the response of the overburden material on hillslopes to landsliding is dependent on the strength parameters of underlying geology.
- Detailed study, including the geotechnical aspects of the slope forming material and its underlying bedrock as well as the hydrological condition/s are highly recommended prior to the execution of any future developmental activity over the categorized high susceptibility hillslopes, particularly those slopes represented by Disang country rocks.

Analysis and Outcome

Some of the major outcome of the study include preparation of a multi-temporal landslide inventory map for the study area from field based studies and using high resolution, open source Google Earth imageries dated for the period from 2006 to 2014. Most of the smaller landslides and slope failures were identified and delineated in the field, and are largely found in the vicinity of the road benches. The prepared landslide inventory map of the study area contains a total of 102 landslides, of which 96 are debris and 06 are rockfall. Based on the landslide characteristics, eight (8) geofactor maps were prepared and presumed to be the main causal factors for the initiation of landslides in the study area. The assessment of factor class ratings (LOFS) after AHP calculations were also shown. For understanding the relative importance of every geofactor that is specific to the terrain, inter-predictor weights were calculated for the six selected geofactors. The six (6) weighted and selected geofactors were integrated for the preparation of the susceptibility score map. The recommendations of the study were implemented successfully.

Study Title

Report on Preparation of Landslide Susceptible Maps (1:50,000 Scale) for Mountainous/Hilly Terrain in Toposheet Nos. 83K/2, K/6 & G/14 (Parts of Kohima, Phek, Peren & Dimapur Districts, Nagaland and Senapati District, Manipur)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2016

Objective

- Categorization of the hill slopes as per their relative susceptibility for landslides/slope failures.
- To prepare 1:50,000 scale spatial database for relevant geofactors of landslides in the area for use as input maps using available baseline data of high resolution remote sensing data and field inputs.

Study Recommendation

Future developmental planning like expansion of township, development of infrastructure, etc., may be carried out in the designated low susceptibility slopes, particularly those hillslopes underlain by Surma and Barail country rocks since it has been established that the response of the overburden material on hillslopes to landsliding is largely or directly controlled by the underlying lithology.

Analysis and Outcome

A landslide inventory map for the study area containing a total of 1601 landslide incidences was prepared using high resolution, open source Google Earth imageries and validated in the field for understanding their spatial relation with the spatial geofactors as well as to facilitate the predictive modelling of landslide susceptibility. Most of the smaller landslides were identified and delineated in the field. Based on the landslide characteristics, nine (9) geofactor maps were initially prepared and presumed to be the main causal factors for the initiation of landslides in the study area. A quantitative spatial association analysis of the landslide inventory map with that of the nine geofactors maps was carried out for the calculation of the Yule's coefficient (YC) and the assessment of factor class ratings known as the Landslide Occurrence Favourability Score (LOFS). The study recommendations are highly implementable.

Agencies responsible for implementation:

- State Disaster Management Authority
- State Urban Development Agencies



Study Title

Updation of Existing Landslide Inventory of North Eastern Region Based on the New Incidences as and when Occurs During the Period

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2016

Objective

- To visit all possible landslide incidences for recording all related morphometric, geomorphologic, geological parameters including their dimension, nature and type of movement, causes etc.
- To suggest short term remedial measures at each of the affected sites and to recommend for any future detailed investigations (if required) etc. for planning long term mitigation measures.

Study Recommendation

- Hydro-meteorological study with relation to initiation/triggering of landslides.
- Detailed site specific study of recurring and active large landslides based on the elements at risk.
- Geo-dynamics study of recurring landslides through monitoring

Analysis and Outcome

The present study carried out up dation of the existing Landslide Inventory of the North Eastern States during FS 2016-2017 viz., Arunachal Pradesh (08 landslide incidences), Assam (66 landslide incidences), Manipur (02 landslide incidences), Mizoram (04 landslide incidences), Nagaland (01 landslide incidence) and Sikkim (01 landslide incidence). As such, no landslide incidences were reported from the states of Meghalaya and Tripura during the period under study. The database generated during the period incorporates detailed attributes of the landslides in respect of location, morphometry, materials, movement, activity, history, geo-factor, etc., formulated in 41 points landslide inventory sheet. Study of the generated database indicates that the recorded landslides are triggered by both incessant rainfall and/or anthropogenic interferences acting on the slope having variable surficial geology, geo-mechanical character of the bedrock, slope, landuse/landcover, structure/lineament, etc. The database so generated will be immensely useful during the assessment of landslide susceptibility, hazard and risk in the region.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Authority

Study Title

Updation of Existing Landslide Inventory of North Eastern Region with Photographs and Index Maps

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2016

Objective

- Coordinating and undertaking geological studies for landslide Hazard Mitigation
- Carrying out landslide susceptibility zonation.
- Monitoring of conspicuous, recurring and large scale landslides.
- Studying the factors responsible for initiation of landslide and suggesting precautionary as well as preventive measures

Study Recommendation

- As the road has been washed away for a stretch of nearly 500 m is to be realigned.
- Recommended to construct retaining wall with back filling and stone pitching for the down slope at 1:1 angle.
- The drainage maintenance is of paramount. Arrange proper drainage facility at road with concrete lining to prevent water infiltration.
- The clogged drainage has to be cleaned.

Analysis and Outcome

The present study carried out Landslide inventory updation during FS 2015-2016, in five North Eastern States viz: Assam, Meghalaya, Manipur, Nagaland and Sikkim. The same is done with the objective of augmentation and updation of the landslide inventory database of the North Eastern Region. The data base generated incorporates detailed attributes of the landslides in respect of location, morphometry, materials, movement, activity, history, geofactor, etc., formulated in 41 points landslide inventory sheet. During the period, based on the information received from various sources, landslides inventory exercises have been carried out to document 19 nos. of landslides, of which 11 nos. of landslides are debris slide, 6 nos. soil slide, 1 Rock and 1 Rock cum debris slide. It is found that landslides are triggered by both rainfall above threshold limit and/or anthropogenic interferences acting on the slope having variable surficial geology, geo-mechanical character of the bedrock, slope, land use/ land cover, structure/ lineament, etc. The database, so generated, will be immensely useful for the assessment of the landslide susceptibility, hazard and risk in the North Eastern states.

Agencies responsible for implementation

- Geological Survey of India
- State Disaster Management Authority
- Respective State Government Authorities



Study Title

Forest Fire Assessment in North East India Under North Eastern Regional Node-Disaster Risk Reduction Program

Implementing Institution

North Eastern Space Applications Centre,
Department of Space, Govt. of India

Project Location/Completion Year

More than one state, 2014

Objective

- Previous or historical forest fire location data analysis
- Forest fire hazard alerts
- Vulnerability zonation: to identify forest fire vulnerability zones based on multi-criteria decision analysis technique.
- Burnt area assessment: estimation of the total area burned during the fire season in the year 2014.

Study Recommendation

- Tree lines or fire break line may be a mandatory activity for slash and burn cultivation in the region to prevent the spread of fire. Number of fire break lines may be increased depending on the vulnerability of spread in bamboo areas or dry deciduous forest.
- Dried leaved, debris may be collected before set up of fire around the vulnerable forest areas particularly along the protected areas. In states, such as Meghalaya, pine needles may be collected before fire season. These needles may in turn be used as fuel source as they have high calorific value due to high resin content.
- Protected areas such as national parks, sanctuaries etc may be provided with sufficient fire watch towers and may well equipped with fire extinguishers and water storage tanks in case of emergency
- Creation of awareness among public regarding forest fire and its associated risk to human life, global warming, economic and biodiversity loss.
- Policy may be made to divert shifting cultivation to alternative agricultural activities or economic activities to reduce deforestation of forest.

Analysis and Outcome

The present study indicates that forest resources of NER India are threatened due to seasonal fire and evergreen/semi evergreen forest is the most targeted forest type for fire. Effort should be made to reduce the anthropogenic fire incidences in the region and some alternative agricultural activities or economic activities need to be encouraged to save the forest resources and associated biodiversity from further loss. Since, our attempt is to provide fire hazard alerts considering vegetation type, topographic factors influencing fire and meteorological parameters; it may help the state forest department to adopt mitigation measures to reduce the spread of fire during fire season. Further, fire vulnerability mapping based on historical data analysis may serve as a reference to identify vulnerable areas and take necessary measures to control fire. Post fire assessment may further help to identify the status of loss so that effort may be made to minimize loss in future. The recommendation of the study is fully implemented.

Study Title

Updation of the Existing Landslide Inventory of North Eastern Region

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2014

Objective

- To document a detailed inventory of all kind of landslide and slope failure in the region.
- The database thus generated will form the basis for further site-specific studies, hazard assessment and risk in the region; such as the detailed site-specific studies of Tawang Monastery landslide taken up as standard item of annual field season programme during FS 2013-2014.

Study Recommendation

- Debris flow susceptibility mapping.
- Hydro-meteorological study with relation to initiation of landslides.
- Detailed site-specific study of recurring and active large landslides, vulnerable of damaging structure and property.
- Geo-dynamicity and susceptibility of slope study in Arunachal Pradesh. Probability of seismic induced landslides, consequences and vulnerability.

Analysis and Outcome

A total of 84 landslides incidences have been documented covering parts of the states of Arunachal Pradesh, Assam, Meghalaya, Mizoram, Nagaland and Sikkim in the North Eastern Region, with a break-up of 55 nos. of landslides incidences in Arunachal Pradesh, 2 nos. in Assam, 2 nos. in Meghalaya, 8 nos. in Mizoram, 13 nos. in Nagaland and 2 nos. in Sikkim. All the landslide incidences documented are reported during active monsoon season and interpreted to be triggered due to high anomalous rainfall. The same implied the greater role of hydrological factors for initiation of all the five principal types of slope movement. Anthropogenic interferences were observed at a number of landslides, which may have aggravated the initiation of slope failures.

The landslide inventory database prepared during the period of study can be utilized for identification of potential landslides prone areas, recurring landslide based on temporal data of landslide incidences. The database will be helpful in augmentation of landslide susceptibility mapping in the form of historical records. The database may also help in decision making, while implementing a development project in the terrain avoiding the highly 27 susceptibility zones but, if not possible, corrective measures may be worked out to minimize landslide occurrences based on the landslide attribute data. The study objective were successfully carried out, key recommendations highlighted are all implementable.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster Management Department



Study Title

Updation of Existing Landslide Inventory of North Eastern Region with Photographs and Index Maps (Linkage Item)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2013

Objective

Objective of this study is to document of the detailed landslide attributes and formulation of short term remedial measures.

Study Recommendation

As a part of the landslide inventory exercises, short term site specific remedial measures are formulated based on the documented landslide attributes such as dimension, material, hydrology condition, causal factor, etc. for stabilization of the distressed slope. Some of the remedial measures suggested are:

- Modification of slope.
- Arrangement of drainage network.
- Provision of retaining structures.
- Re-enforcement wherever necessary.
- Vegetation cover.

Analysis and Outcome

A total of 19 landslides incidences have been documented covering parts of the states of Assam, Manipur, Meghalaya, Nagaland and Sikkim in the North Eastern Region, with a break-up of one rock-debris slide in Assam, one debris slide in Manipur, 4 debris slide in Meghalaya, 9 nos. of debris and soil slide in Nagaland and 4 nos. of rock and debris slide in Sikkim. All the landslide incidences documented are reported during active monsoon season and interpreted to be triggered due to high anomalous rainfall. The same implied the greater role of hydrological factors for initiation of all the five principal types of slope movement, i.e. fall, slide, subsidence and flow failures in the region. Involvement of anthropogenic interferences, such as extensive slope cutting, haphazard disposal of excavated material, dumping of non-biodegradable waste, etc. are observed at a number of landslides, which may have aggravated the initiation of slope failures.

The landslide inventory database prepared during the period of study can be utilized for identification of potential landslides prone areas, recurring landslide based on temporal data of landslide incidences. The database will be helpful in augmentation of landslide susceptibility mapping in the form of historical records. The database may also help in decision making, while implementing a development project in the terrain avoiding the highly susceptibility zones.

Agencies responsible for implementation:

- Geological Survey of India
- Assam Disaster Management Authority

Study Title

Interim Report on Geochemical Mapping in Parts of Toposheet Nos 83E/10 and 13 Covering Parts of Kurung Kumey, Lower Subansiri and Papum Pare Districts of Arunachal Pradesh

Implementing Institution

Geological Survey of India, State Unit: Assam

Project Location/Completion Year

Arunachal Pradesh, 2019

Objective

To generate geochemical database of degree sheet 83G of Assam state using multi-elemental analyses

Study Recommendation

Large scale mapping to be carried out in both the toposheets. However, before launching an investigation programme, it would be prudent to conduct a study in the cells that shows high values. Besides terrain condition and accessibility, distribution of data, which is positively skewed, should be considered prior to formulating an FSP programme.

Analysis and Outcome

A total area of 708 sq. km was covered on 1:50,000 scale under National Geochemical Mapping (NGCM) in the Toposheet Nos 83E/10 and 83E/13 falling in Kurung Kumey, Lower Subansiri, and Papum Pare districts of Arunachal Pradesh with collection of 148 stream sediment samples, 18 soil samples (9 C-horizon and 9 top soil), and 09 water samples. Twelve Petrological samples were also collected from various lithologies of the area to understand the geological setup. The analytical results and interpretation of stream water from Toposheet Nos 83E/10 and 83E/13 show that the water is fit for drinking and domestic use when compared with the prescribed limit of BIS (2012). The PH of all the water samples collected is within range 7.3–8.0 and TDS is below 100, which make it excellent for drinking.

Agencies responsible for implementation:

- Geographical Survey of India



Study Title

Report on Preliminary Exploration for Graphite Around Taliha, Upper Subansiri District, Arunachal Pradesh (G-3 Stage)

Implementing Institution

Geological Survey of India, State Unit:
Arunachal Pradesh

Project Location/Completion Year

Arunachal Pradesh, 2019

Objective

To delineate and assess the graphite mineralized zones

Study Recommendation

- The consistency of fixed carbon values across several meters of thickness of rock and about 500 m of strike length shows that similar FC grades can be expected along rest of the graphite-rich marble exposed between Taliha and Kodak.
- However, the mineralization is located in a tribal area and the land holding system is with the individual, clan, or village. The terrain is also rugged with steep slopes, dense vegetation and thick soil cover, which are the major constraints for further subsurface exploration as they limit the availability of suitable locations for drilling. Hence, the UNFC norms of borehole spacing and level of intersection cannot be met most of the time.
- Keeping in mind the several constraints of the area, the richness and continuity of mineralization does merit further investigation.
- Further laboratory studies are needed to determine the exact nature of the graphite and other carbon forms present in the area so as to have more control on the nature and origin of the mineralization.

Analysis and Outcome

Preliminary exploration for graphite has been carried out in Kodak-Dupit-Taliha-Mara area, Upper Subansiri District of Arunachal Pradesh, in parts of Toposheet No. 82L/4, with an objective to delineate and assess the potentiality of graphite mineralized zones. Large-scale mapping (1:12,500 scale) was carried out for an area of 50 sq. km and detailed mapping (1:2,000 scale) was carried out for 0.40 sq. km in Dupit village area, which is one of the blocks during the F.S 2016-17. The litho-package in the mapped area consists mainly of granite gneiss, banded biotite-augen gneiss of Taliha Formation, Se La Group and phyllite of Chilliepam Formation of Bomdila Group.

The gneissosity is discernible in banded biotite gneiss. The foliation and cleavage are discernible in phyllite, schistose quartzite, and quartz-mica schist. A total of 128 core samples were analysed for fixed carbon from which a resource of 3.21 million tonnes of graphitic marble by cross-section method and 3.06 million tonnes of graphitic marble by LVS method with an average grade of 26.06% F.C. at cut-off 16% F.C. has been estimated. On the basis of nature and quantum of work carried out around Taliha area, the resource is categorized under 'Indicated Inferred Mineral Resource' with UNFC-333 classification.

Agencies responsible for implementation:

- Geographical Survey of India

Study Title

Report on Geological Mapping with the Aid of Remote Sensing and Photogeology in Inaccessible Areas of Toposheet No. 82K/4, 8 and 82 L/1, 5 of Upper Siang and West Siang Districts of Arunachal Pradesh

Implementing Institution

Geological Survey of India, State Unit:
Arunachal Pradesh

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

- To prepare geological map of unmapped area on 1:50,000 scale
- To link it with the already mapped adjacent areas

Study Recommendation

- Detailed mapping with geochemical sampling is recommended near Kopu village around the marble band to ascertain the occurrence of carbonate mineralization.
- Geochronological studies should be carried out to establish the proper dates of the rocks. An expedition upstream of Tsangpo River will be extremely fruitful in further establishing the geological set-up of the valley.

Analysis and Outcome

The study carried out remote sensing and photogeology aided geological mapping in parts of Toposheet Nos 82 K/4, 8 and 82 L/1 and 5, bounded by Longitude 94°00'–94°30'E s and Latitude 28°45'–29°15'N, covering 1600 sq. km. The litho-tectonic succession in this area of Upper Siang district, Arunachal Pradesh, comprises the Rungong Formation, Siang Group and the Pari Mountain Gneiss (from west to east). The Siang Group overrides the Pari Mountain Gneiss.

The Pari Mountain comprises biotite gneiss and garnet-biotite-kyanite-sillimanite gneiss. The adjacent Rungong Formation comprises schistose quartzite, garnet-bearing quartzite, graphite schist, limestone, and quartz-mica schist.

The total REE in the samples analysed in the metasediments ranges from 75.42 to 180.23 ppm, which is less than average crustal abundance. Ce and La are the most abundant elements. Negative Europium anomaly is also observed. A sample of graphite schist is showing 1523 ppm of barium. Vanadium values range from 5 ppm to 292 ppm, with an average of 115 ppm. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Report on Geological Mapping with the Aid of Remote Sensing and Photogeology in Inaccessible Areas of Toposheet Nos 82 K/11, 12 and 16 of Upper-Siang District of Arunachal Pradesh

Implementing Institution

Geological Survey of India, State Unit:
Arunachal Pradesh

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To prepare geological map of unmapped areas on 1:50000 scale with the help of Remote Sensing techniques and limited field checks

Study Recommendation

- Detailed mapping with geochemical sampling is recommended near Kopu village around the marble band to ascertain the occurrence of carbonate mineralization.
- Geochronological studies should be carried out to establish the proper dates of the rocks. An expedition upstream of Tsangpo River will be extremely fruitful in further establishing the geological set-up of the valley.

Analysis and Outcome

The present study was carried out to map some parts of Arunachal Pradesh that are yet to be covered by systematic geological mapping due to inaccessibility and remoteness and to cover the existing gaps. An area of 1300 sq. km was mapped on 1:50,000 scale. The study area forms parts of Survey of India Toposheet Nos 82 K/ 11, 12 and 16 falling in Upper Siang and West Siang districts of Arunachal Pradesh, bordering China. River Siang and its tributaries constitute the drainage system of the area.

Three units were interpreted on the basis of photo elements using aerial photographs and Landsat Imagery of the area. The first unit exhibited light tone, high reflectance, fine texture, relatively steep ridges, and deep valleys pattern (broad at places), dendritic to sub-dendritic drainage pattern, with medium drainage density, and crystalline limestone/marble. The second unit showed medium tone, medium reflectance, and medium relief with steep prominent ridges and narrow valleys with the absence of bedding planes, biotite granite of Lohit Granitoid Complex. The third unit showed dark tone, low reflectance, and low relief with moderate to low steep ridges and found to be meta-volcanic rocks of Tuting Volcanics. The recommendation of the study was partially implemented.

Agencies responsible for Implementation:

- Geological Survey of India

Study Title

Report on Geological Mapping with the Aid of Remotesensing and Photogeology in Inaccessible Areas of Toposheet Nos 82H/7, 8 and 12 of Kurung Kumey District of Arunachal Pradesh

Implementing Institution

Geological Survey of India, State Unit:
Arunachal Pradesh

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To prepare geological map of unmapped areas on 1:50000 scale with the help of Remote Sensing techniques and limited field checks.

Study Recommendation

- Further mapping on large scale will help to understand the interrelationship among lithounits of this terrain. Subsequently, collection of samples for determination of age will help to understand the stratigraphy as well as tectonics of the region
- Study of basemetal mineralization in Puri-Padum Para village (Toposheet No. 82H/8) in terms of economic viability as well as structural disposition is recommended
- Study of crystalline limestone bands at Sector 34, Sakehugu and Padumpara is recommended. The high REE concentration in one sample needs to be studied in detail

Analysis and Outcome

The geological mapping is done mainly based on PGRS and Remote Sensing in a terrain that is full of surface cover in the form of thick foliage. Only a small part of the area could be field checked. Therefore, the accuracy of the map has severe constrains. The data must be used considering the limitations.

- The mapped area comprises Galensiniak Formation of Se La Group and Chielliepam Formation and Bomdila Gneiss of Bomdila Group. RGM was taken up to map areas covering 1600 sq. km on 1:50,000 scale with the help of photogeological and remote sensing techniques. Several litho units were interpreted on basis of tone, texture, colour, drainage pattern, etc. from geocoded sheet studies and study of the geology of the adjoining areas. The mapped area comprises Galensiniak Formation of Se La Group and Chielliepam Formation and Bomdila Gneiss of Bomdila Group. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Specialized Thematic Mapping in and around Palin-Dem-Sikhe Area with Special Emphasis on Base Metal Mineralization in Kra-Daadi and Lower Subansiri Districts of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

- To elucidate the stratigraphy, metamorphism, and deformation history of the area
- To search for sulphide mineralization in the area

Study Recommendation

Projects may be proposed for further G4 and G3 stage programmes in order to delineate the Vanadium bearing carb phyllite and assess the economic potentiality and resource of Vanadium and other associated minerals.

Analysis and Outcome

The present study area covered part of Toposheet No. 83E/10, located in the southwestern part of Arunachal Pradesh, which exposes Bomdila Group of rocks of Palaeoproterozoic age. The area surveyed for the present project was part of Toposheet No. 83E/10. The Bomdila Group in the area comprises NE-SW trending meta sedimentaries of Khetabari Formation and Bomdila Gneiss. The Bomdila Group in the area comprises NE-SW trending meta sedimentaries of Khetabari Formation and Bomdila Gneiss. The Bomdila Group in the area comprises NE-SW trending meta sedimentaries of Khetabari Formation and Bomdila Gneiss. LSM block has been identified for vanadium investigation stratigraphy, metamorphism, and deformation has been established and two band of graphite schist/carbonaceous phyllite has been mapped, which have high value of vanadium.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Reconnaissance Survey for Coal in the Eastern Parts of Namchik-Nampuk Coalfield, Changlang District, Arunachal Pradesh (G-4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2017

Objective

To delineate and assess the coal potentiality in the eastern parts of Namchik-Namphuk Coalfield

Study Recommendation

The eastern extension of the coal seams may be investigated through drilling; however, the security considerations might limit such work in the near future

Analysis and Outcome

The present study carried out a preliminary investigation for coal in the Namchik-Namphuk coalfield and its eastern extension extending to Kharsang-Longkhum hka-Panchum area falling in parts of Survey of India Toposheet No. 92 A/3 in Changlang district of Arunachal Pradesh to delineate and assess the coal potentiality for FS 2016–17.

On the basis of large-scale mapping, eight major coal horizons, ranging from 1.0 to 6.0 m in thickness, were delineated in the investigation area extending discontinuously along a strike direction of about 9 km. Starting from River Namchik in the west, the coal zone is disposed along the northern slope of the Kuwen Bum range. Towards the eastern end, the coal extends till some few meters beyond River Namphuk. The coals of Namchik-Namphuk coalfield are non-coking grade with moisture content more than 2% and volatile matter content more than 35%. Tertiary coal contains high sulphur content ranging from 1.63% to 10.45% with an average of 3.315%.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Coal



Study Title

Remote Sensing and Photogeology Aided Geological Mapping in Unmapped Terrain in Parts of Anjaw District of Arunachal Pradesh (T. S. NOS. 91 D/ 11, 15 and 16) on 1: 50000 Scale

Implementing Institution

Geological Survey of India, State Unit:
Arunachal Pradesh

Project Location/Completion Year

Arunachal Pradesh, 2017

Objective

- To prepare geological map of unmapped areas on 1: 50,000 scale with limited field checks

Study Recommendation

- Photogeological mapping with field checks in the study area indicates that the area is lithologically and structurally complex. Detailed field work could not be undertaken due to inhospitable terrain conditions. It is suggested that systematic geological mapping, on expedition basis, may be proposed in the area for refining the detailed geology and structure of the area.
- The contact of the diorite/amphibolite and leucogranite/granodiorite/migmatites could not be mapped during the present study. Hence, during systematic geological mapping in this area, it may be carried out to know the age of younger granitic intrusions and emphasis may be given to ascertain the contact relationship.
- Further studies for sulphide mineralization in Yasong and Meiliang areas are suggested.

Analysis and Outcome

Photogeology and Remote Sensing studies were carried out, using satellite imagery and aerial photographs, covering an area of 1400 sq. km, in S.O.I.T.S. Nos. 91D/ 11, 15 and 16 on 1:50,000 scale. The study area is a part of Anjaw district in Arunachal Pradesh bounded by Latitude 28°00'00"E to 28°30'00"E and Longitude 96°30' 00"E to 97°00' 00"E. The area is sparsely inhabited and, hence, there were very few foot tracks and fieldwork was carried out in accessible areas on motorable roads and trekking along hunting tracks and field trials.

The three major set of lineaments were observed along NW-SE, NE-SW, and WNW-ESE direction. A total of 15 granitoid samples were collected for petrochemical analysis. Four samples of stream sediment samples were collected for analysis of heavy minerals. Hornblende and magnetite were the common mafic minerals. Rutile, amphibole, hornblende, apatite, tourmaline, magnetite, zircon, and garnet were the heavy minerals observed from the sample of stream sediments. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Specialized Thematic Mapping of the Northwest of Yazali with Special Emphasis on Base Metal and Associated Precious Metal Mineralization in Papum Pare and Lower Subansiri Districts, Arunachal Pradesh

Implementing Institution

Geological Survey of India, State Unit:
Arunachal Pradesh

Project Location/Completion Year

Arunachal Pradesh, 2017

Objective

- To elucidate the stratigraphy and structure of the area
- To search for incidences of mineralization (if any) in parts of Papum Pare and Lower Subansiri districts, Arunachal Pradesh

Study Recommendation

From the economic potential point of view, the only sulphide mineralization found is associated with carbonaceous phyllite and graphite schist where pyrite is a major sulphide in which trace element value is very less. However, magnetite mineralization is recorded in Banded magnetite quartzite at Did section and River Ranga near Ambaam. Therefore, further detailed investigation can be carried out in Did and Ambaam sections.

Analysis and Outcome

The study carried out specialized thematic mapping in parts of northwest part of Yazali, falling in parts of Survey of India Toposheet No. 83E/11 in Papum Pare and Lower Subansiri districts, Arunachal Pradesh. A total area of 220 sq. km was mapped on 1:25,000 scale to elucidate the stratigraphy and structure of the area with special emphasis on search for base metal and associated precious metal mineralization.

Bed rock sample of carbonaceous phyllite and quartzite, ppm value of basemetal is less. Banded quartzite-bearing magnetite bands measuring 2mm–4m cm width along the strike extension of 20–50 m is reported along Did section and Panyor River near Balo village. Alternate bands of graphite schist and carbonaceous phyllite (5-m width) is delineated in mapped area in Khetabari Formation near Did village. The post-magmatic phase of Rilo Granite occur in the form of quartz and pegmatite vein rich in tourmaline, therefore the potentiality of tin and tungsten deposits is high in this region. Four selected thin section samples of Khetabari Formation have been studied under scanning electron microscope for the search of sulphides and other precious minerals.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines



Study Title

Final Report on Photogeological Mapping on 1:50,000 Scale in Parts of East Kameng, Papum Pare, Kra Daadi, and Lower Subansiri districts, Arunachal Pradesh with Limited Field checks, Toposheet Nos 83E/7 and 10

Implementing Institution

Geological Survey of India, State Unit:
Arunachal Pradesh

Project Location/Completion Year

Arunachal Pradesh, 2016

Objective

- To prepare geological map of unmapped area on 1:50,000 scale and to link it with the already mapped adjacent area

Study Recommendation

- Photogeological mapping with limited field checks in the study area indicates that the area is lithologically and structurally complex. Detailed field work could not be undertaken due to inhospitable terrain conditions. Therefore, it is suggested that systematic geological mapping may be proposed in the area for refining the stratigraphy and establishing the detailed geological structure of the area.
- Isotope study of younger porphyritic granite and tourmaline-bearing granite mapped in the study area may be carried out to know the age of younger granitic intrusions.

Analysis and Outcome

The present study was carried out to facilitate the task of completion of geological mapping on 1:50,000 scale of gap areas in Arunachal Pradesh. A total of 1400 sq. km unmapped area of Toposheet Nos 83E/7 and 83E/10 was covered using remote sensing tool with limited field checks during FS 2015–16. The study area exposes Palaeoproterozoic rocks of Bomdila Group represented by Khetabari Formation and Bomdila Gneiss. Bomdila Gneiss covers a major part of the area and Khetabari Formation occurs as northeast–southwest trending bands within Bomdila Gneiss. Younger amphibolite and dolerite dykes, porphyritic granite, pegmatite and quartz veins intrude the rocks of Khetabari Formation as well as Bomdila Gneiss.

The mineral assemblage in the various lithounits exposed in the study area with characteristic presence of garnet and sillimanite suggests that the area has been subjected to middle to upper amphibolite facies of regional metamorphism. A total number of 70 lineaments have been delineated in the study area. Mesoscopic folds, faults, and joints have been observed in the study area. Tight isoclinal, recumbent, reclined, and open-type folds/warps are recorded in mica schist and quartzite of Khetabari Formation whereas prominent ptygmatic folds are present in migmatite and pegmatite veins. The study of microstructures and mesoscopic folds present in the Bomdila Group of rocks exposed in the area suggest that the rocks have been subjected to multiple episodes of deformation. The study recommendation was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Final Report on Specialized Thematic Mapping of the Contact Between Rilo Granite and Bomdila Group of Rocks in Parts of East Kameng and Papum Pare Districts, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2016

Objective

- To establish contact relationship between Rilo Granite and Bomdila Group
- To establish deciphering geochemical characteristics of litho-units
- To evaluate the REE potential of Rilo Granite and basemetal occurrences in the surrounding meta-edimentaries

Study Recommendation

- The higher values of copper and REE are associated with the lithologies of Khetabari Formation, i.e, garnet-quartz-mica-schist with intrusion of later quartz veins within them, which are found from south-east of Pakke-Kessang.
- As gold grains are also observed from these rocks so it is recommended that further investigation for basemetal and gold may be taken up in the area.

Analysis and Outcome

The present study carried out specialized thematic mapping in parts of East Kameng and Papum Pare districts, Arunachal Pradesh during field season 2014–16. An area of 440 sq. km was covered in Toposheet Nos 83E/4 and E/8. The overall highest metamorphic assemblages found are of epidote-amphibolite facies. From the ore-microscopic study it is seen that sulphides have two types of mode of occurrences. The majority of the sulphides occurring in the schist are pyrite with some chalcopyrite.

The available REE analytical data shows that the total REE of the Rilo Granite ranges from 110.41 to 331.54 ppm. Ziro Gneiss 71.1–208.42 ppm, quartz-mica schist of Khetabari Formation 10.69–1128.49 ppm and quartz vein in Khetabari Formation 24.1–449.21 ppm. The values of copper ranges from 2 ppm to 3234 ppm. Higher values of copper are associated with the lithologies of garnet-quartz-mica-schist with intrusion of later quartz veins. In sample no. OMS-4 one gold grain of ~ 0.65 μm size associated with pyrite is found. In sample no. OMS-5 four gold grains, one of 3.5 μm size associated with quartz, one ~1 μm size associated with chalcopyrite and two grains of ~1 μm size associated with amphibole is reported. The Zircon U-Pb isotopic dating of Rilo Granite using LA-MC-ICPMS at G&IG Division, CHQ, Kolkata yielded 496.1 \pm 5 Ma indicating that the granite is a product of Pan-African thermal event, thus conclusively establishing the younger status of Rilo Granite with respect to the Bomdila Group of rocks. The study recommendation was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines



Study Title

Final Report on Specialized Thematic Mapping to Study the Evolution of Gondwana Supergroup and Siwalik Group in Parts of Papum Pare and Lower Subansiri Districts, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2016

Objective

- To establish the mutual field relationship of Gondwana Supergroup and Siwalik Group in parts of Papum Pare and Lower Subansiri districts
- To study their geochemical characteristics
- To establish the provenance, dispersal pattern, and history of tectono-sedimentation of the lithounits; palaeontological studies; economic potential of coal and clay
- To compare and correlate with other similarly placed units of Lesser Himalaya

Study Recommendation

- Blocking of Kud and Kimin nala due to landslide activities are causes of devastating flood. This area offers the scope of landslide studies. In tandem with it, geotechnical investigation and landslide hazard zonation mapping can be followed up in the area as well as other adjacent areas.
- Further study on neotectonics in the area is recommended which may help in understanding the causes leading to the flood havoc in the adjoining low-lying areas of Assam.
- In order to further confirm the status of Tipam Formation and the existence of Naga-Patkai belt in the present study area, a detailed search for fossil woods and other Mio-Pliocene fauna is warranted.

Analysis and Outcome

The present study carried out a specialized thematic mapping to study the evolution of Gondwana Supergroup and Siwalik Supergroup in parts of Papum Pare and Lower Subansiri districts, Arunachal Pradesh in an area 440 sq. km on 1:25,000 scale. Tectono-sedimentation study suggests that Gondwana sandstones and mudstones have been deposited in active continental margin and oceanic island arc and Siwalik Supergroup have been deposited in active continental margin with a few exceptions in passive margin. Petrographic study of Gondwana coal reveals that the dominant maceral is vitrinite. Rank of the coal was categorized under sub-bituminous, matured to particular level and are likely non-coking type.

Correlation wise, all the fossil occurrences from the Gondwana rocks in the study area taken together constitute a great majority of taxa, which are common and bear resemblance to Agglomeratic Slate fauna of Kashmir and ranges from Asselian to Artinskian or dated as Early Permian. Lithostratigraphic study of Siwalik Supergroup of Arunachal Pradesh revealed that the Dafla Formation of Lower Siwalik can be correlated with Chinji Formation of Lower Siwalik rocks of Jammu and Kashmir, Nahan Formation of Himachal Pradesh, Lower Siwalik of Uttarakhand, Chunabati Formation of Lower Siwalik Subgroup in Darjeeling in West Bengal, Bokabil and lower part of Tipam sandstone of Tertiary Group. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- State Disaster and Management Authority

Study Title

Report on Preliminary Investigation for Graphite in Khetabari and Ragidoke Formations of Bomdila Group, West Siang District, Arunachal Pradesh (G3-Stage)

Implementing Institution

Geological Survey of India, State Unit:
Arunachal Pradesh

Project Location/Completion Year

Arunachal Pradesh, 2016

Objective

- To study the mode of occurrence of graphite and assess the economic potentiality of Khetabari and Ragidoke formations

Study Recommendation

Based on the fixed carbon values 8.04 to 20.09% FC, the graphite is of good grade and may be useful for industrial purpose. But as most of it is of amorphous nature, so suitable beneficiation is needed. The rugged terrain conditions having steep slopes and dense vegetation and soil cover are the major constraints for further sub-surface exploration.

Analysis and Outcome

The present study carried out an investigation for graphite in Tai-Tachidoni-Tirbin-Sodudoke area, West Siang District, in parts of Toposheet Nos 82L/12 and 83I/9. Large-scale mapping (1:12,500 scale) has been carried at Tai-Badak-Yagri-Tirbin-Sodudoke-Shibe- Lutak area covering 110 sq. km in the F.S 2014-16. Available analytical results provide 0.02% to 16.06%, 4.35% to 20.09%, 1.02% to 23.87% fixed carbon for 36 number of spot bedrock, 55 number of channel samples in exposure, and 79 number of trench samples, respectively.

Considering the analytical data of graphite and correlation of channel and trenches, one correlated zone has been established as 10.46% FC over a width of 5 m and 50 m strike length with an estimated resource of 4960 tonnes near Tai. Considering the analytical data of graphite and correlation of channel and trenches, two correlated zones have been established as 10.05% FC over a width of 6 m and 100 m strike length and over a width of 10 m and 240 m strike length in Tachidoni block A and block B respectively, with estimated resource of 37200 tonnes. In Tai area, estimated tonnage of TA-1 and TA-2 is 318,744 tonnes or 0.32 million tonnes at an average 7 grade of 12.27% FC. From Tai and Tachidoni block, a cumulative resource of 360,904 tonnes or 0.36 million tonnes (UNFC 334 category) of graphite with an average grade of 12.01% FC has been estimated. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Search for Gold and Associated Mineralization in Metasedimentary Sequence of Bomdila Group in Papum Pare and Lower Subansiri Districts, Arunachal Pradesh (G-4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2016

Objective

- To delineate the possibility of gold, copper, and associated mineralization in extension of Potin polymetallic prospect.

Study Recommendation

Based on the encouraging Gold value upto 0.40 ppm in the altered metabasic rock near Kamcha Village, having an approximate thickness of 1 m and strike length around 180 m, and gold value of 0.05 ppm in each sample from two altered ferruginised zones in Posa-Potin section, the area is recommended for further detailed investigation for gold mineralization. Alteration zone (IVB) having Cu value varying from 975 to 1002 observed near Amgi village also may be taken up for further detailed study for Cu and other associated metal mineralization.

Analysis and Outcome

The study was carried out on the basis of the gold potentiality of the Ranga valley polymetallic sulphide prospect, which was assessed during FS 1998–99 and 1999–2000 by traverse mapping on 1:50,000 scale, stream sediment sampling, and bed rock sampling. Analytical results indicated gold values from 115–300 ppb in BRS samples and 05 samples indicating 1 ppm to 2.1 ppm Au value in stream sediment samples. The study was undertaken in and around Posa–Yazali area, Lower Subansiri and Papum Pare Districts, Arunachal Pradesh.

Two types of mineralized zones are demarcated in the area: (1) highly ferruginized and limonitized zone in garnetiferous quartz mica schist and quartzite with stringers, patches of magnetite, and sulphide minerals mainly pyrite, chalcopyrite, bornite. Three such zones are marked in Posa-Potin area. Zone 1 has a strike length of 1125 m and width of 45 m. A sample from the zone has given 0.05 ppm Au value and maximum of 573 ppm Cu. Zone 2 has strike length of 300 m and width of 65 m. Analytical result of one BRS sample from this zone shows 1170 ppm Cu. Zone 3 has a strike length of 250 m and width of 35 m. Analytical result of one sample from this zone shows 0.05 ppm Au value and a maximum of 407 ppm Cu. (2) The other type of mineralized zone is in the form of highly altered metabasic rock (exposed near Kamcha area on Pitapoll-Sagali road section. Here a gold mineralized zone with gold value from 0.05 to 0.20 ppm having a thickness of 0.95 m and strike length of 180 m is demarcated. A composite sample from the zone has given a gold value of 0.40 ppm. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines

Study Title

Search for Iron and Associated Sulphide Mineralization in Metasedimentary Sequence of Bomdila Group in West Siang and Upper Subansiri Districts, Arunachal Pradesh (G4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2016

Objective

To delineate the iron oxide-copper-gold mineralized zones

Study Recommendation

Geological investigation in this rugged area is constrained largely due to thick vegetation and soil cover. The investigation would be more tenable if carried out with a holistic approach. However, scout search for iron ore and associated sulphide mineralization can be carried out in the adjacent areas.

Analysis and Outcome

The study carried out a preliminary investigation for iron and associated sulphide mineralization in Gadimendi-Degam-Yardo-Liromoba-Maró-Baririjo area falling in parts of Survey of India Toposheet Nos 82 L/8, 12 and 83 I/5 in West Siang and Upper Subansiri Districts of Arunachal Pradesh. On the basis of large-scale mapping, nine iron and sulphide mineralized zones have been delineated in the investigation area. Four iron-enriched zones, with mineralization manifested in the form of haematite-goethite-quartz band, thin (1–3 mm) bands, and as disseminations of magnetite in quartzite and chlorite-biotite-quartz schist have been delineated. Three sulphide mineralized zones have been delineated at Gadimendi and Tode. Two iron formation associated sulphide mineralized bands have been delineated at Karte and Baririjo area.

Channel samples from pyrite-bearing talc-tremolite schist yielded an average of 32.25 ppm Cu and 6.09% Fe. Channel samples from pyrite-bearing smoky quartz vein at Tode yielded an average of 43.14 ppm Cu and 1.719% Fe. Channel samples from magnetite-bearing chlorite-biotite-quartz schist at Lama Deke yielded average values of 9.315% Fe and 72.90 ppm Cu. Analytical results from the trench at Takam in the haematite-goethite-quartz band yielded average values of 6.616% Fe and 33.875 ppm Cu. Trench samples from iron formation at Baririjo yielded average values of 28.189% Fe, 367.6 ppm Cu, 74.4 ppm Pb, and 123.8 ppm Zn. The study recommendation was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines



Study Title

Interim Report on Preliminary Investigation for Graphite in Khetabari and Ragidoke Formations of Bomdila Group, West Siang District, Arunachal Pradesh (G3)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2015

Objective

- To assess the economic potentiality
- To study the mode of occurrence of graphite in Khetabari and Ragidoke formations

Study Recommendation

Study recommends these points:

- Based on the fixed carbon values, the graphite is of good grade and may be useful for industrial purpose.
- Because of its amorphous nature, suitable beneficiation is needed.
- The rugged terrain conditions having steep slopes and dense vegetation and soil cover are the major constraints for further sub- surface exploration.

Analysis and Outcome

The study on graphite investigation has been carried out in Tai-Tachidoni area, West Siang District, in parts of Toposheet Nos 82L/12 and 83I/9. Large-scale mapping (1:12,500 scale) has been done in Tai-Badak- Yagri area covering 55 sq. km area. Detailed mapping (1:2,000 scale) has been carried out for 0.75 sq. km in Tai area. The litho-package in the mapped area consists mainly of quartzite, phyllite, quartz-mica schist, staurolite-garnetquartz- mica schist, lenses of carbonaceous phyllite hosted graphite schist, and small patches of magnetite-hematite quartzite of Khetabari and Ragidoke formations of Bomdila Group.

Considering the analytical data of graphite and correlation of channel and trenches, one surface correlated zone has been established as 10.46% FC over a width of 5 m and 50 m strike length with estimated resource of 4960 tonnes. The estimated tonnage of TA-1 and TA-2 is 318744 tonne or 0.32 million tonne at an average grade of 12.27% FC. A cumulative resource of 323704 tonne or 0.32 million tonne (UNFC 334 category) of graphite with an average grade of 12.24% FC has been estimated from the area. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Investigation for Basemetal and Associated Precious Metal Mineralization in Pakke Kessang-Khadaso Areas, East Kameng District, Arunachal Pradesh with Detailed Mapping of Ningcho Block (G4)

Implementing Institution

Geological Survey of India, State Unit:
Arunachal Pradesh, Itanagar

Project Location/Completion Year

Arunachal Pradesh, 2015

Objective

- To delineate basemetal and associated precious metal mineralization in Pakke Kessang-Khadaso areas
- To assess the economic potentiality of the Ningcho block

Study Recommendation

The thick soil and vegetation cover are the major constraints for exploration in the area. The delineated mineralization southeast of Pakke Kessang can be taken up for further exploration with integrated geophysical techniques.

Analysis and Outcome

The item for investigation of base metal and associated precious metal mineralization in Pakke Kessang-Khadaso and Ningcho areas, East Kameng district, Arunachal Pradesh was taken up in parts of Toposheet Nos 83 E/4 and 83E/8. An area of 51 sq. km was mapped on 1:12,500 scale around Pakke-Kessang. The mapped area consists of Palaeoproterozoic rocks of Bomdila Group having metasedimentary enclaves of Khetabarif within the gneiss of Bomdila Gneiss.

Sulphide mineralization in Pakke Kessang-Khadaso area is generally confined within the garnetiferous-quartz-mica schist and ferruginous quartzite. Analytical data from this mineralized zone has indicated a 3-m thick zone having 0.14% Cu over a strike length of 20 m with maximum of 0.30 ppm Au. The gold values range from 150 ppb to 300 ppb, south-east of Pakke Kessang. Detailed mapping of Ningcho block has been carried out for 0.5 sq. km on 1: 2,000 scale to delineate the copper mineralization associated with gold. The rock types in the mapped area comprises garnet-mica schist, biotite-muscovite schist, ferruginous quartzite of Khetabari Formation, and biotite gneiss belonging to the Ziro Gneiss intruded by quartz veins. A potential sulphide mineralized zone has been delineated for 60-m strike length over a width of 20-m. It hosts a copper mineralized zone of 0.15% Cu x 9 m over a strike of 55 m. Maximum gold value from the delineated zone is 150 ppb.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines



Study Title

Report on the Construction Stage Geotechnical Investigation of Pare H.E. Project, Papum Pare District, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2015

Objective

- To provide geotechnical services to Project Authorities, as and when required, for the purpose of smooth execution of construction work at site

Study Recommendation

- The Project Authority may adopt suitable design to strengthen the foundation grade rock and improve the bearing capacity of the foundation media so that it can sustain under static and dynamic load due to the proposed structure in order to avoid risk of differential settlement. The dam has ski jump kind of energy decapitating device wherein residual energy is likely to create ground vibrations. Keeping in mind poor cohesion between rock and concrete (as reported), anchors in the bucket should be considered in order to avoid detachment of concrete.

Analysis and Outcome

The present study carried out foundation grade geological mapping on 1:100 scale for an approximate 5010 sq. m area (in total) covering five dam block No. 4 (part), 5, 6, 7, and 8. The rock exposed in the foundation area of these dam blocks is represented by gritty sandstone (soft and friable sandstone) with occasional pebble beds, coal fragments, chert and pebble-rich patches belonging to Kimin Formation of Upper Siwalik Group of Pleiocene–Pleistocene Age. The general trend of bedding shows a variation in Latitude from N75°W–S75°E to N15°–60°E to S15°–60°W with dip ranging from 10° to 40° in S20°W to S10°–70°E direction.

The inferences drawn on the basis of the geotechnical assessment and the geomechanical properties of the rock mass present as the foundation media indicate that the foundation grade of the proposed dam comprises very poor category of the rock mass (Class-V, based on the results of deformation modulus, result provided by the Project Authority). As such this type of foundation is not acceptable for construction of a 63-m high concrete gravity dam. Water Percolation Test results indicate low to moderate conductivity and tightness of the discontinuity (1.3-3.9 Lugeon). However, seepage is noticeable at various locations such as abutment slopes and in cut-off trenches.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Investigation for PGE and Gold Mineralization in Mafic-Ultramafic Suites in Anjaw, Lohit and Lower Dibang Valley Districts of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

To carry out the detail sampling of the mafic-ultramafic rocks for delineation of PGE and gold mineralization zones

Study Recommendation

- The serpentinite body of Tidding area though shows presence of very poor content of platinumoid group of elements as per analytical results, however, it does not indicate any value of economic significance.
- The serpentinite body shows no stratification or layering nor they show any visible veins of sulphide within which the PGE are known to occur.
- Moreover, no auriferous or PGE mineralized zones were identified in the investigation area, except manifestations of sulphide mineralization occurring as disseminations both in mafic and in ultramafic units. Hence, the area is not recommended for any further PGE and gold investigation.

Analysis and Outcome

The study carried out investigation for PGE and gold mineralization during FS 2012–13 and 2013–14 in Tidding area, falling in Toposheet Nos 92A/5 and 91D/8 in Anjaw and Lohit Districts, Arunachal Pradesh. A total area of 100 sq. km was covered by large-scale mapping on 1:12,500 scale and detail mapping of 5 sq. km on 1:2000 scale. The study area lies in the Trans-Himalayan belt comprising the Suture package categorized under two different litho packages.

The serpentinite body is massive; however, small-scale ductile shear zones with mylonitic fabric and associated folds parallel to the contact with the crystalline limestone is being reported for the first time. These zones are conceptually the potential locales for PGE mineralization. However, no chromite or sulphide zones have been located, instead disseminated crystals of pyrite are noticed under thin section. Analytical results of samples from serpentinite show value of 5 ppb to 15 ppb for PGE, less than 50 ppb for gold and MgO from 39.34% to 44.77%. Analytical results of some bed rock samples from serpentinite show values of 0.02%–0.69% for Cr and 0.08%–0.25% for Ni. The U.N.F.C scheme of the present investigation is categorized by 334.

The recommendation of the study was fully implemented.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines



Study Title

Report on Feasibility Stage Geotechnical Investigation of Noa-Dehing Multipurpose Project, Changlang District, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

To provide geotechnical inputs (by means of site geological studies at several project components and subsequent recommendations as per site requirements) to the Project Authorities, as and when requested

Study Recommendation

- Core recovery and RQD in the logged drill holes is very poor, and due precautions should be taken in future to improve the core recovery.
- All the project components should be designed considering seismic parameters such as Peak Ground Acceleration (PGA), which is a measure of earthquake acceleration on the ground.

Analysis and Outcome

The study carried out drill cores for 10 numbers of bore hole to know the nature of sub-surface rock mass and to ascertain the depth of fresh rock level for a cumulative length of 449.80 m. The lithology encountered in the drill cores comprises brown clayey soil, irregular boulders, and pebbles of granite and quartzite, granite gneiss, silty sand, loose and friable sandstone with coal stringers at places and riverine sand. Core recovery vary from 3% to 53%, RQD vary from nil% to 7.3%, and the in-situ fresh rock level varies from 6.0 m to 26.10 m with W1 weathering grade. Considering the percentage of core recovery, Rock Quality Designation (RQD), weathering grade along the depth sections, the rock is soft and friable in nature and the quality of the rock may belong to very poor to poor category.

Permeability value (in terms of lugeon) has been determined and it is found that the highest lugeon value is 31.5 with turbulent flow type encountered in bore hole no. 21 and the lowest lugeon value is 1.1 encountered in bore hole no.19 with laminar flow type. As the core recovery and RQD in the logged drill holes is very poor, due precautions should be taken in future to improve the core recovery. The recommendation of the study was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Geological Report on Exploration for Dolomite in Rupa Prospect, West Kamang District, Arunachal Pradesh, India

Implementing Institution

Mineral Exploration Corporation Limited

Project Location/Completion Year

Arunachal Pradesh, 2012

Objective

- To delineate the depth continuity of dolomite in the area by test drilling
- To estimate *in-situ* geological resources and quality of dolomite upto 100 m vertical depth

Study Recommendation

- Systematic detailed geological mapping is recommended on 1:2000 scale in the central portion of exploration block, which covers the area between section line S-2 to S-4, so that all the geological features such as different lithological contacts, attitude of formations, minor fold, faults, joints, etc. can be recorded precisely on map.
- Resources estimated in the prospected area require systematic exploration by drilling in regular close space grid pattern. For this purpose, an accessible area of 1.0 sq. km may be selected to bring resources under 331 of UNFC. An utmost care has to be taken while drilling boreholes in order to get still better core recovery in future.
- Deeper boreholes beyond 100 m depth may be taken as most of the boreholes drilled have been closed in dolomite.

Analysis and Outcome

Rupa Dolomite Prospect was identified for exploration in the report of 'Task Force' for the mineral development in the north-eastern states. The Rupa Dolomite Prospect lies in the Survey of India Toposheet No. 83 A/8 and bounded by Latitude 27°10'39"-27°11'45" N and Longitude 92°21'44"-92°23'33" E. Rupa village is approachable from Assam planes through Bhalukpong-Bomdila and Doimara-Shergaon Rupa road. Rupa prospect is 12 km. Southwest of Rupa village, MECL has drilled six vertical boreholes covering 3.20 sq. km area. Mostly single borehole was drilled on each section. Boreholes were not drilled on a regular grid pattern of 500 m x 500 m as proposed, due to inaccessibility of location. Only one GSI borehole RD-1, is falling within prospect area, hence data of this borehole was considered for resource estimation. A total of 935.46 million tonnes gross *in-situ* (561.26 million tonnes of net *in-situ*) dolomite resources with grade SiO₂ 1.37%, CaO 30.50%, and MgO 20.95% were estimated. These resources have been kept at 332 and 333 of UNFC and under 'C' category. The study recommendation was partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines, Government of India



Study Title

Interim Report on Geochemical Mapping in Parts of Toposheet no 83 F/6 & 83 F/10 of Golaghat, Sonitpur & Karbi Anglong Districts Assam

Implementing Institution

Geological Survey of India, State Unit: Assam

Project Location/Completion Year

Assam, 2019

Objective

The main objective of this programme is to generate geochemical database of degree sheet 83F for distribution of 68 elements and to prepare geochemical dispersion maps of these elements.

Study Recommendation

The area is environmentally challenged for the biodiversity of Kaziranga National Park. As the rivers are extremely unstable at many places due to intense 'braiding' and large water discharge causing river bed high due to sediment deposition, Erosion measures are vital to the area as the mighty Brahmaputra and its tributaries wiped out many bank areas every year during floods.

Analysis and Outcome

The study carried out a Geochemical mapping in parts of toposheet no. 83F/6 and 83F/10 in Golaghat, Sonitpur & Karbi Anglong districts, Assam' during F.S. 2018. The study involved the geochemical mapping on 1:50,000 scale covering 768 sq km area (out of which about 260 sq km area is covered by Brahmaputra River and inaccessible part of Kaziranga National park) which include collection of 127 nos. of stream sediment samples from the 2 nd or 3rd order streams to higher order streams, 10 nos. of regolith and 'C' horizon samples, 07 nos. of duplicate samples and 10 nos. of stream water samples in 5x5 grid.

Some of the key findings of the study were: Heavy metal contamination of soils is widespread and there is a risk of transfer of toxic and available metals to agricultural crops, animals and humans. As observed, the metal content of the study area is found that Cr, Ni, Pb, and V are considerably high for the plants

Study Title

Report on Geophysical Mapping in Toposheet Nos. 83B/16 and 83G/1 Covering Parts of Hojai and Karbi Anglong Districts of Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2019

Objective

To generate gravity-magnetic data for the delineation of the subsurface geological structures and to establish the geophysical database under project NGPM.

Study Recommendation

- Bouguer gravity and magnetic anomaly maps prepared for 1 mGal and 50 nT intervals respectively, have shown distinct gravity and magnetic signatures over granitic and gneissic rocks of AMGC.
- The Bouguer gravity anomaly values show a variation of the order of 49 mGal, ranging from -85 to -36 mGal, thereby implying that both crustal structures and formation lithology have role in the development of gravity responses in this part of AMGC. However, such high variation in Bouguer gravity anomaly accounts for dominance of structures over lithology in the development of gravity signatures of the area.

Analysis and Outcome

The geophysical mapping represent the geology of an area by illuminating those features and subsurface which are not apparent from a geologic map alone. Geophysical maps play a very important role in the exploration of mineral & geothermal resources, and monitoring of groundwater, etc. The geophysical mapping of Hojai and Karbi Anglong districts of Assam will help in identifying the mineral resources. The current study is aimed at generating magnetic data essential for the delineation of the subsurface geological structures for establishing the geophysical database under project NGPM. The recommendations of the project have been implemented which can be seen in the form of Bouguer gravity and magnetic anomaly maps for 1 mGal and 50 Nt intervals, respectively. The value of Bouguer gravity anomaly ranged from -85 to -36 mGal implying that both crustal structures and formation lithology have role in the development of gravity responses in this part of AMGC.

Implementable recommendations:

- To generate gravity-magnetic data for the delineation of the subsurface geological structure

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Directorate of Geology & Mining (State Government)



Study Title

Specialized Thematic Mapping in Assam Meghalaya Gneissic Complex and Tertiary Rocks in Sarkherbasti-Longlai-Larab Area in Nagaon and Karbi Anglong Districts, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2019

Objective

- To elucidate the deformation and Metamorphism of the gneissic complex,
- To map out the extension of limestone unit,
- To find out mineralization, if any and to reconstruct the depositional history of Tertiary sediments

Study Recommendation

- Pockets of very low-grade coal (peat to lignite) are present in the area which is not economically viable due to its limited extent and very low grade. However, it can be utilized for domestic and local brick industries.
- The fossiliferous limestone exposed is of moderate quality having high SiO₂ for cement industries. However, desilicification method can be deployed for upgrading the grade of limestones for industrial purposes.
- Due to its limited areal extent, it does not promise any economic viability to set up a cement factory. However, it can be supplied to the nearest existing limestone factory.
- Granites and gneisses can be used as building stones as well as for decorative purposes.

Analysis and Outcome

The thematic mapping is a kind of mapping which represents the geographic patterns of a particular theme in a geographical area. It uses map symbols to visualize the selected properties of geographic features which are not usually visible such as temperature, language, population, etc. In this study, the thematic mapping was carried out to elucidate the deformation and metamorphism of gneissic complex, limestone unit, mineralization and reconstruction of depositional history of Tertiary sediments.

The recommendation of the report is satisfactory and is partially implemented for the mentioned purposes. The report revealed the presence of very low-grade coal which was not economically viable. It was recommended to be used for domestic purpose and brick industry. The report stated that the fossiliferous limestone was of moderate quality with high SiO₂. The desilicification can upgrade the quality of limestone. The areal extent of the limestone was limited. Therefore, the report did not recommend to set up any cement factory but can be supplied to the nearest limestone factory. Further, the report identified that the granite and gneiss can be used as building materials and for decoration purpose.

Implementable recommendations:

- Utilization of low-grade limestone in domestic and local brick industry
- Desilicification of fossiliferous limestone to upgrade the quality of limestone

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Directorate of Geology & Mining (State Government)

Study Title

Interim Report on Geochemical Mapping in Parts of Toposheet No. 83G/05 of Karbi Anglong District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

To generate geochemical database of degree sheet 83G of Assam state using multi-elemental analyses

Study Recommendation

- REE, Zr and Hf: The anomalies of LREE, Zr and Hf in the north eastern and north western side of toposheet should be studied in detail to evaluate its occurrence.
- Considering the fact that the northern part of the Toposheet is falling under OGP area, a G4 investigation for REE may be taken up. However, before launching an investigation programme, it would be prudent to conduct a study in the cells that shows high values.
- U, Th, Sn: The anomalies of U, Th and Sn in and around Amlakhi village may be taken up for reconnaissance survey for granophile elements.
- The high levels of As, Cr have been identified and these could also have been contributed possibly by insecticides, pesticides being used in agriculture and may be studied in detail. Though at present, there is no danger from these to human health but there is a need to generate a base line data to prevent or minimize the related health hazard and land and water degradation.

Analysis and Outcome

The present study carried out geochemical mapping in T.S. No. 83G/5 and covered an area of about 688 sqkm including the collection of 172 nos. of stream sediment samples from the first or second or third order streams, 09 nos. of regolith, 'C' horizon and stream water sample from 5x5 grid, 6 nos. of XRD and 6 nos. of petrographic samples. During the course of mapping 172 nos. of stream sediment, 09 nos. of regolith, 'C' horizon and stream water and 06 nos. of petrographic and XRD samples were collected and submitted to chemical division of petrology division, NER, Shillong.

The study area exposes rocks of the Assam, Meghalaya Gneisses Complex overlain by Tertiary sediments of Jaintia, Sirma and Tipam Groups and Quaternary Alluvial sediments of Barpeta Formation. Gneisses rocks of Archaen to Proterozoic age consist of Grey and Pink granitic gneiss and granitoids. These are unconformably overlain by Jaintia Group of rocks comprising of Shella Formation (Fossiliferous limestone and ferruginous sandstone and clay) and Kopili Formation (shale, siltstone, and sandstone) of Palaeocene to Eocene age overlain by Barail Group consisting of (arenaceous sequence with calcareous sale) of Eocene to Oligocene age. Barail Group is unconformably overlain by Surma Group consisting of Bokabil Formation (Thinly bedded shale and siltstone) of Miocene age, which is unconformably overlain by Tipam Group consisting of Tipam sandstone Formation (Ferruginous sandstone) and Girujan clay Formation (mottled clay) of Miocene to Pliocene age. Tipam Group is unconformably overlain by Barpeta Formation of Holocene age.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Preliminary Exploration for Low Grade Iron Ore in Chandardinga Area, Dhubri (Erstwhile Goalpara) District, Assam, (G-3)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

To assess the low-grade iron ore resources in the study area.

Study Recommendation

- Chandardinga Area, Dhubri Sulphide mineralization of mainly pyrite, chalcopyrite and pyrrhotite in the form of specks and disseminations have been intersected in BH no DCB-3, 4,6, 7,9,11,13,15,16 and 17 along with BIF and amphibolite. Therefore details works on sulphide mineralization may be taken up as part of further investigation
- During detailed mapping, mafic-ultramafic intrusive rocks have been reported for the first time from Chandardinga area. These mafic-ultramafic rocks such as peridotite, actinolite-anthophyllite schist, variants of gabbro contain high Cr from 1129 ppm to 4834 ppm , Ni from 565 to 1926 ppm and V from 127 to 262 ppm. In petrography, these mafic-ultramafic rocks also consist pyrite, pentlandite, pyrrhotite along with chromite and magnetite. On the basis of above observations detail works on Cr-Ni-PGE may be taken up for further investigation.
- The block may be explored for upgradation of resources in 332 categories.

Analysis and Outcome

The study is aimed at exploration of low-grade iron ore resources in Chandardinga area, Dhubri. Located on the north bank of river Brahmaputra and is about 2 km away from Salkocha Inspection Bungalow on NH 31. In this region, three bands of iron ore are found with thicknesses of 49.85 m, 16 m, and 53 m. The current report corroborated the presence of sulphide mineralization. The area was dominated by the presence of of mainly pyrite, chalcopyrite and pyrrhotite in the form of specks and disseminations which have been intersected in BH no DCB-3, 4,6, 7,9,11,13,15,16 and 17 along with BIF and amphibolite. Therefore, a detailed work on sulphide mineralization was recommended. The presence of mafic-ultramafic instrusive rocks were reported for the very first time in Chandardinga which contain high content of chromium, nickel, vanadium, etc. Based on the above observations, it was recommended to do detail works on Cr-Ni-PGE.

Implementable recommendations:

- Details works on sulphide mineralization
- Detail works on Cr-Ni-PGE Multi-level strategic planning

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)

Study Title

Preliminary Exploration of Glass Sand in Shillong Quartzite Occurring in Silpata-Bamuni-Chapanala-Borhola Block of Nagaon and Karbi Anglong Districts, Assam (G-3)

Implementing Institution

Geological Survey of India, State Unit: Assam

Project Location/Completion Year

Assam, 2018

Objective

To delineate the strike extension and vertical continuity of silica sand of Jiyajuri area was carried out with the help of detailed mapping and subsurface exploration.

Study Recommendation

- The fragile quartzite of Jiyajuri area after wash can be used for refractory (upto Grade-I) and foundry industries.
- Wash samples of Jiyajuri fragile quartzite show enhanced SiO₂ content of more than 98% with reduced Fe₂O₃% and TiO₂% below the maximum cut-off value but the Al₂O₃% is still more than the maximum bearable value to be qualified for glass sand.

Analysis and Outcome

The Jiyajuri area of Silpata-Bamuni-Chapanala-Borhola Block is situated 150 km from Guwahati and about 40km from Nagaon. It is well connected by the NH-37 passing through Puranigudam, Samaguri and Barhampur. The exploration block is about 15km from Puranigudam, Samaguri and about 25km from Barhampur which connects with the NH-37 by metal road. Formations encountered were Unclassified Quartzite of Shillong Group including quartzite, metabasic and quartz vein. The vertical thickness of fragile quartzite in the explored area varies from 15 to 88m (9- 48m thick), while the thickness of the Shillong quartzite is not known. The depth range of occurrence was found to be 15.00 m to 88 m. After washing or beneficiation, the chemical quality of the quartzite can be improved up to 98% or more of SiO₂. Since the Al₂O₃ content is high (~1%) after washing, this fragile quartzite can be suitably used in refractory (Grade-I) and foundry industries after washing. However, the quality of the fragile quartzite may further be improved by washing with attrition for utilization in glass sand.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Report On Geophysical Mapping in Parts of Karbi Anglong and Nagaon Districts of Assam Covering Toposheet nos. 83F/4 and 83F/8

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

To generate gravity-magnetic data for the delineation of the subsurface geological structures and to establish the geophysical database under project NGPM.

Study Recommendation

- Bouguer gravity and magnetic anomaly maps prepared for 1 mGal and 50 nT intervals respectively, have shown distinct gravity and magnetic signatures over granitic and gneissic rocks of AMGC.
- The Bouguer gravity anomaly values show a variation of the order of 49 mGal, ranging from -85 to -36 mGal, thereby implying that both crustal structures and formation lithology have role in the development of gravity responses in this part of AMGC. However, such high variation in Bouguer gravity anomaly accounts for dominance of structures over lithology in the development of gravity signatures of the area.

Analysis and Outcome

The geology of an area is represented by the geophysical mapping by illuminating those features and subsurface which are not apparent from a geologic map alone. The exploration of mineral & geothermal resources, and monitoring of groundwater, etc. is done using Geophysical maps. The geophysical mapping of Karbi Anglong and Nagaon districts of Assam covering Toposheet nos. 83F/4 and 83F/8 will help establishing the geophysical database. The current study is aimed at generating magnetic data essential for the delineation of the subsurface geological structures for establishing the geophysical database under project NGPM. The recommendations of the project have been implemented which can be seen in the form of Bouguer gravity and magnetic anomaly maps for 1 mGal and 50 Nt intervals, respectively. The value of bouguer gravity anomaly ranged from -85 to -36 mGal implying that both crustal structures and formation lithology have role in the development of gravity responses in this part of AMGC.

Implementable recommendations:

- Gravity-magnetic data for the delineation of the subsurface geological structures

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Directorate of Geology & Mining (State Government)

Study Title

Specialised Thematic Mapping of the Assam-meghalaya Gneissic Complex and Shillong Group of Rocks With Special Emphasis on Base Metal and REE Mineralization, Between Hahim and Ukium Along the Assam-Meghalaya Border in Kamrup (Rural) District of Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2017

Objective

- To establish the structural, geological and metamorphic history of different litho-units of the area.
- To search for mineralisation potentialities of Iron Ore, Base metal, REE, Zirconium and other elements, in the area between Hahim and Ukium

Study Recommendation

Geochemical studies reveal that the granitic rocks, in the study area, mostly indicate a calc alkaline, per aluminous affinity of S-type origin and discriminate towards the syn collision orogenic setting. The area may be checked for demarcation of REE bearing zones in granite gneiss and granites.

Analysis and Outcome

In thematic mapping, the geographic patterns of a particular theme in a geographical area are represented using map symbols. The purpose of using map symbols is to visualize the selected properties of geographic features which are not usually visible such as temperature, language, population, etc. In this study, the thematic mapping was carried out to establish the structural, geological and metamorphic history of different litho-units in Assam-Meghalaya Gneissic Complex and Shillong Group of Rocks by thematic mapping. In addition to this, the search of mineralisation potentialities of Iron Ore, Base metal, REE, Zirconium and other elements, in the area between Hahim and Ukium was also intended. The study revealed the presence of the granitic rocks, in the study area, mostly indicated a calc alkaline, per aluminous affinity of S-type origin and discriminate towards the syn collision orogenic setting. It was recommended to check for demarcation of REE-bearing zones in granite gneiss and granites. The recommendation is partially implemented.

Implementable recommendations:

- Check for demarcation of REE bearing zones in granite gneiss and granites

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)



Study Title

Specialised Thematic Mapping of the Gneissic Complex and Rocks of Shillong Group in Kathalguri-Borjuri-Diju Valley in Nowgong and Karbi Anglong Districts, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2017

Objective

To bring out the mineralization zone, structural and depositional history of the gneissic unit of Assam Meghalaya Gneissic Complex (AMGC) and rocks of Shillong Groups of Kathalguri, Borjuri and Diju valley area

Study Recommendation

The study has given two recommendations for further study:

- Geochemical analytical values of the oxides and rare earth elements are not so encouraging for mineralization though during the field work gossan is recorded at the surface of the hornblendite / metagabbro units from the mapped area in and around Bijanbari, sikaribegaon and Parkup Pahar area within the TS no. 83B/15. For detail study it can be taken as a project in future for economic purposes.
- Detailing petrology project and mineralization for the volcanic package (in and around Jala pahar, Rion Pahar, Sabor peak of T.S. 83F/3) can be taken in future

Analysis and Outcome

The thematic mapping is a kind of mapping that represents the geographic patterns of a particular theme in a geographical area. It uses map symbols to visualize the selected properties of geographic features which are not usually visible such as temperature, language, population, etc. In this study, the thematic mapping was carried out to elucidate mineralization zone, structural and depositional history of the gneissic unit of Assam Meghalaya Gneissic Complex (AMGC) and rocks of Shillong Group in Kathalguri-Borjuri-Diju Valley in Nowgong and Karbi Anglong Districts of Assam. The recommendation of the current study have been partially implemented. The report recommended work on the project related to gossan, which was recorded at the surface of hornblendite /metagabbro unit. The project of detailing petrology and mineralization for volcanic package was also recommended in the near future. The recommendations are justified with the project studied. These are suggested to start in the future by considering the environmental conservation.

Implementable recommendations:

- Project related to gossan which was recorded at the surface of hornblendite /metagabbro unit was
- Detailing petrology project and mineralization for the volcanic package

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Final Report on Regional Exploration for Gondwana Coal in and Around Bhutidanga Area, Singrimari Coalfield, Dhubri District, Assam at the Border of Assam and Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2016

Objective

The exploration was carried out with the objectives to explore the behaviour and extension of the Gondwana coal seams in the down dip direction of Sukchar-Singrimari area and to evaluate the coal resource. The investigation was carried out in a 2.5 sq.km block bounded by latitude 25°45'40" to 25°46'30" N and longitude 89°54'00" to 89°55'00" E falling in Survey of India Toposheet No. 78G/13.

Study Recommendation

- On the basis of occurrence of coal-carbonaceous shale zones in borehole SB-1 and a thin coal seam in borehole SB-2, the possibility of extension of coal seams further towards Northeast can be inferred.
- Since the possibility of occurrence of some coal seams cannot be ruled out properly in these carbonaceous shale zones due to the poor core recovery, further exploration in the deeper part of the Singrimari basin towards the Northeast of Bhutidanga area is recommended.

Analysis and Outcome

The current project was based on the study of behaviour and extension of the Gondwana coal seams in the down dip direction of Sukchar-Singrimari area and to evaluate the coal resource. The study was carried out in 2.5 sq. km block which was bounded by latitude 25°45'40" to 25°46'30" N and longitude 89°54'00" to 89°55'00" E. The report recommended the possibility of extension of coal towards Northeast. The possibility of occurrence of some coal seams can not be ruled properly in such carbonaceous shale zones. Therefore, the report also recommended the exploration in the deeper part of the Singrimari basin towards the Northeast of Bhutidanga area. The recommendations of the report are partially recommended. The sustainable exploration and extension of the Gondwana coal seams in the Bhutidanga area, Singrimari coalfield, Dhubri District of Assam might be also one of the important recommendations.

Implementable recommendations:

- Possibility of extension of coal towards Northeast
- Exploration in the deeper part of the Singrimari basin towards the Northeast of Bhutidanga area.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Final Report on Preliminary Appraisal To Locate Potential Coal Zone in Tertiary Sequence by Large Scale Mapping on 1:10,000 Scale in Parts of Toposheet No. 78G/14 Around Shalibhuin in Dhubri District of Assam and Nakaigiri-Ujanggihiri in West Garo Hill

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2014

Objective

- The primary objective is to prepare detailed geological map of the terrain on 1:10,000 to identify the Tertiary bearing sequence.
- To find out the extent of coal occurrences of the area.
- To establish the contact relationship of Tertiary sequence with Precambrian inselbergs/Gondwanas/Quaternary sediments and to find out occurrences of Gondwana sequence, if any below Tertiary sequence.

Study Recommendation

- The area can be taken up for further exploration of Tertiary coal by scout drilling in order to have a better understanding of the behaviour and extension of the Tertiary coal seams depending on the improvement of ground situation of the area.
- Large scale mapping is also suggested to find out the extension of the lignite bands exposed in and around Jamali area.

Analysis and Outcome

A large scale maps display a smaller amount of area with a greater amount of informations. The geographic extent shown on a large scale map is small. A large scaled map has a smaller number to the right of the ratio. For example, a large scale map could have a RF scale of 1:1,000. The large scale maps are typically used to show neighborhoods, localized areas, small towns, etc. The primary objective is to prepare a detailed geological map of the terrain on 1:10,000 to identify the Tertiary bearing sequence. Finding the occurrence of coal and establishing contact relationships of tertiary sequence with the Precambrian inselbergs/Gondwanas/Quaternary sediments. The investigation of Gondwana sequence was also one of the objectives of this study. On the basis of the result obtained, the report recommended to find out the extension of the lignite bands exposed in and around Jamali area. The present investigation suggested that the recommendations given in the report were partially implemented.

Implementable recommendations:

- Further exploration of Tertiary coal by scout drilling
- Finding out the extension of the lignite bands exposed in and around Jamali area

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Directorate of Geology & Mining (State Government)

Study Title

Preliminary Investigation for REE in Southern Part of Agia Around Sijukona Hill and Tukureswari Hill in Parts of Goalpara District, Assam (G4 Stage)

Implementing Institution

Geological Survey of India, State Unit: Assam

Project Location/Completion Year

Assam, 2014

Objective

Preliminary investigation for REE in southern part of Agia around Sijukona hill and Tukureswari hill in parts of Goalpara district, Assam

Study Recommendation

- Few samples of metabasics show high HREE especially Sm, Nd and Eu. Further, one of oxidised metabasic sample shows high Ho and Dy (total ~130 ppm) which is very important and hence emphasis may be given for HREEs in such rock. Some higher values of Σ REE (~1000ppm) in migmatite, granulite and metabasic are observed during the study. However, clear cut enriched zone is not evident rather they are sporadically distributed without any geological control.
- Out of total 258 sample collected from 80 sq km for REEs, only 4 samples show >1000ppm (2 SS, 1 BRS, 1PCS) which are sporadically distributed. Hence, the area does not warrant further investigation for REE. However, analytical data for REE for the channel sample (DM area) are yet to receive.
- High analytical values of Zn (min. 26 ppm, max. 7618ppm, mean 1088ppm), Pb (min. 8 ppm, max. 6617 ppm, mean 247 ppm) and Zr (min. 85 ppm, max. 835ppm, mean 435ppm) values are yielded by channel samples (31 nos) from the shear zone of Phoponga hill. Reanalysis of sample yielding maximum Pb has been requested. The sample belongs to the innermost part of the channel beyond which it is covered by thick soil and vegetation. To assess the extension of mineralized zone towards north and its strike length, pitting & trenching along with detailed sampling and geophysical survey is recommended.

Analysis and Outcome

The rare earth elements (REEs) are a group of 17 chemical elements appearing in the periodic table consisting of the 15 lanthanides (lanthanum to lutetium) plus yttrium and scandium. The REEs are more abundant in the Earth's crust than the underlying layer of mantle [61]. It is more common in the upper continental crust than in the lower crust. The REEs are very essential for the production of clean energy, electric vehicles, consumer electronics, national defense, etc. Therefore, it becomes very important to identify the possible deposition of REEs in the earth's crust. The major objective of the current study was the investigation for REE in southern part of Agia around Sijukona hill and Tukureswari hill in parts of Goalpara district of Assam. The report recommended to give emphasis to HREEs in the oxidized rocks. The pitting & trenching along with detailed sampling and geophysical survey was also recommended to assess the extension of mineralized zone towards north and its strike length. The recommendations of the current report are not implemented

Implementable recommendations:

- Emphasis for HREEs in the oxidized rocks
- The pitting & trenching along with detailed sampling and geophysical survey towards north and its strike length
- Agencies responsible for implementation:
- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Directorate of Geology & Mining (State Government)



Study Title

Systematic Geological Mapping on 1:50,000 Scale in Toposheet Nos.78J/9 & 10 in Goalpara District, Assam

Implementing Institution

Geological Survey of India, State Unit: Assam

Project Location/Completion Year

Assam, 2014

Objective

- To prepare geological map of the terrain on 1:50,000 scale in gap areas for completion of the compiled geological map.
- To delineate lithostratigraphy and morphostratigraphy of the area.
- To evaluate effects of neotectonic elements and search for mineral occurrences, if any.

Study Recommendation

- A paleochanel has been mapped in the Hatipota area of 78 J/10, but the dating has not been made till date. Hence it is recommended to make age dating of the sediments of the paleo channel.
- As the area is highly covered by the cultivated lands, it was very difficult to find out any other features for the study of event stratigraphy. Hence, it is recommended to carry out the detailed study of the area to find out more features for event stratigraphy with the study of satellite imagery, study of cut off meanders with the dating of samples, detailed study of abandoned channels and detailed study of exposed sections with the age dating of samples.
- The shifting of Ai River towards east has created a major problem for habitation as it erodes heavily in the eastern side and deposits in the western side. For this a detailed study may be carried out to find out the reason behind the shifting of major river towards east within a very short time.

Analysis and Outcome

The systematic geological mapping on 1:50,000 scale is the fundamental and elementary mapping program of the Geological Survey of India. Using this program, the GSI has covered the accessible part of the total mappable area of the country. Such kind of study is very useful in building the knowledge base and database for future geo-scientific studies [62]. The objectives of the study were preparation of geological map of terrain on 1:50,000 scale, delineation of lithostratigraphy and morphostratigraphy, the evaluation of effects of neotectonic elements, and search of minerals were important targets of this study. The study recommended for age dating of the sediments of the paleo channels. The study also recommended to do a detailed study to find out the reason for river shifting. The analysis of the report revealed that the recommendations like age dating and reason for river shifting were considered seriously and implemented carefully. The recommendations were studied via a separate project with the mentioned objective and successfully completed [63]. At present, all the recommendations of this study are implemented completely.

Implementable recommendations:

- Age dating of the sediments of the paleo channels
- Detailed study of river shifting

Agencies responsible for implementation:

- Geological Survey of India (GSI)
- Ministry of Environment, Forest and Climate Change (MoEFCC)

Study Title

Interim Report on Geochemical Mapping in the Ophiolite Belt in Parts of Ukhrul District, Manipur in T.S. No. 83k/8

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2019

Objective

- The main objective of the programme is to generate seamless geochemical baseline database which will be helpful in identification of target areas for mineral exploration,
- Managing and development of natural resources, applications in environment, soil fertility, human and animal health, agriculture, forestry, waste disposal, natural hazards and other societal concerns.
- Ophiolite suite of rocks are exposed about 24% of the study area , which can be categorized as Semi Obvious Geological Potential area.

Study Recommendation

- Detail subsurface study is required along the NNE-SSW trending ridges of Phangrai, Shirui and Gamnom village where preliminary findings of podiform chromite/ferric chromite hosted by mafic/ultramafic rocks of ophiolite occurred.
- The stream sediments having its provenance from mafic/ultramafic rocks exposed along east of Kalhang Khullen, Phangrai, Shirui and Gamnom village give high values of Cr (4810 ppm), Ni (5681 ppm) and Co (678 ppm). The thick limonitic and saprolitic soil capping developed above the mafic/ultramafic rock shows supergene enrichment of Fe₂O₃, Cr, Ni and slightly Co. The mineral investigation of supergene enrichment deposits of Ni and Co by systematic detail sampling of different soil horizons of the laterite, limonitic and saprolite is required.
- The detailed specialised thematic mapping is recommended for identification of the different facies of limestone which is exposed in and around Ukhrul town, Shangshak Khullen, Hundung, Choithor, Khangkhui, Mova villages, east of Phangrai village, Phangrai-Sihai village section and Kalhang Khunou-Huishu villages section. The detailed lithofacies mapping along with systematic sampling of limestone for paleontological studies and chemical analysis for preliminary limestone grade classification can be taken up

Analysis and Outcome

The analytical results of major oxides (package A), trace & REE's (package H) are available. Analytical results of the stream sediment/slope wash samples for 46 elements were received, of which analytical data of stream sediment/slope wash samples of 10 major oxides and 22 trace elements, 14 REEs were interpreted by univariate and bivariate statistical methods to understand the nature of distribution of the elements as well as the interrelation between the elements. Geochemical maps depicting spatial distribution of the elements were prepared to interpret their distribution pattern in a secondary geochemical environment.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines



Study Title

Specialised Thematic Mapping in Ophiolite Suite of Rocks Around Gilchingnang, Chalong Khullen and Chattrik Khullen in Ukhrul District, Manipur With Special Emphasis on PGE Mineralization

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2018

Objective

To establish the detailed structural characteristics of the belt and to locate potential zones of mineralisation including PGE in mafic-ultramafic rocks. During the course of mapping, 30 Nos. of PS, 40 Nos. of BRS, 15 Nos. of PCS, 10 Nos. of XRD and 5 Nos. of OM samples were collected.

Study Recommendation

- Residual body of chromite occurs at Pinghang hills, the size of the chromite blocks ranges from 0.16 metre to 1.32 metres. It is massive, having high specific gravity and exhibit spheroidal texture. As per field observation, the chromite of Pinghang originally occurs as lensoidal body which is confirmed by the presence of lensoidal chromite within serpentinised harzburgite in the fresh outcrop.
- Aishi Formation which lies conformably above the Lushat Formation in the study area and at places with a patchy basal conglomerate has similar physical appearance with the Laisong Formation of Barial Group. But due to its field disposition above the Lushat
- Formation in study area and Laisong above the Disang Fm in other parts of Manipur, It is premature to correlate them merely on physical appearance without proper source rock characterization for both the rock types based on heavy minerals study, geochemical parameters, fossil content and geochronology.

Analysis and Outcome

In this study, the thematic mapping was carried out to establish the detailed structural characteristics of the belt and to locate potential zones of mineralisation including PGE in mafic-ultramafic rocks. The current study will help to develop the geographical pattern of Ophiolite suite of rocks [88]. The report of the study suggested several important recommendations. The report recommended the proper characterization for the rock types based on heavy minerals study, geochemical parameters, fossils content and geochronology. The recommendations of the report were found to be genuine and should be implemented for achieving the targeted objectives. The proper action on the recommendation is still awaited because the characterization of rock based on heavy metal profile is yet to be done. As the completion of recommendations needed a new study which needed more time. That is why the recommendations were partially implemented.

Implementable recommendations:

- Proper characterization for the rock types based on heavy minerals study, geochemical parameters, fossils content and geochronology

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Photo Geological Mapping in Part of Manipur With the Help of Remote Sensing Studies on 1:50,000 Scale

Implementing Institution

Geological Survey of India, State Unit:
Manipur – Nagaland

Project Location/Completion Year

Manipur, 2017

Objective

- The objective of the work is to prepare geological map of unmapped areas on 1:50,000 scale with limited field checks.
- During the course of the field season attempts were made to classify the rock types as per the International Code of stratigraphy.

Study Recommendation

- The area is quite inaccessible hence STM programme of area mapping is not feasible where as detailed line mapping along the road sections can be taken to study structural framework
- Lithological and geochemical characteristics of these rocks in detail to find out their genesis, mode of emplacement and contact relationships between different formations of Disang, Barail and Surma Groups.

Analysis and Outcome

The geophysical mapping epitomize the geology of an area by illuminating those features and subsurface which are not apparent from a geologic map alone. The major objective of the present study were the preparation of geological map of unmapped areas on 1:50,000 scale. An attempt was also made to classify the rocks according to International Code of stratigraphy. Such kind of study will help in understanding the geochemical characteristics of rocks of Manipur region [89]. The report of the study recommended that the STM program of the area mapping was not feasible because the area was inaccessible. Further is added that the detailed lime mapping along the road section could be taken to study the structural framework. It was recommended to find out the lithological and geochemical characteristics of those rocks in details for analyzing their genesis, mode of emplacement and contact relationships between different formation of Disang, Barail and Surma Groups. Till date, no actions are taken on the recommendations and hence these were partially implemented. The reason behind the partial implementation is the time constraints as the recommendations were study-based and just completed in 2017, hence needed further time.

Implementable recommendations:

- lithological and geochemical characteristics of those rocks in details

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Magnetic Survey for Chromite Bearing Ultramafics in Kwatha Area, Chandel District, Manipur

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2015

Objective

- In the study area, five pods of chromite have been demarcated by earlier workers vary in size from 2 m x 5 m to 20 m x 80 m.
- To assess the economic potentiality of the reported occurrences and also to search for new ones, the detailed geophysical survey within ultramafics in Kwatha area was proposed by Directorate of Commerce and Industries (DCIDGM), Government of Manipur

Study Recommendation

- The detailed magnetic survey was conducted over an area of 3.3 sq. km. by taking about 3507 magnetic observations on highly rugged terrain having steep valleys and ridges.
- The Magnetic survey has delineated few significant magnetic anomalies along different traverses that may correspond to chromite mineralization of podiform type.
- The Magnetic (TF) map has clearly demarcated the contact between sedimentaries and ultramafics in the study area by showing changes in the magnetic response over different litho units and variations in magnetic contour pattern.
- The processed, filtered and various derivative magnetic maps were helpful in identifying different formations and structural features besides demarcating continuation of ophiolites with depth.

Analysis and Outcome

The present study was aimed at assessing the economic potentiality of five pods of chromite which were reported earlier. In addition, the search for new economic pots was also an important objective. Such studies help in evaluating, detecting, and mapping of archeological artifacts and features [91]. The study suggested that the processed, filtered, and other magnetic maps helped in the identification of different features. The analysis of the report did not find any specific recommendations against the study.

Implementable recommendations:

- The analysis of the current report did not identify any recommendations

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Report on the Preliminary Stage Geotechnical Assessment of Slope Stability Along the Proposed New Broad Gauge Railway Line Project, Northeastern Frontier Railway From Chainage 98.00 km to Chainage 106.00 km Between Tupul and Imphal, Manipur

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2015

Objective

- To provide topographical contouring map of the project site on 1:1000 scale with 2m contour interval, up to 50m on both side of the Railway alignment
- To demark all the control points (i.e. Project layout plan) in the ground
- Recommended to carry out the geotechnical tests for determining the "C" & "Ø" values of the slope forming material. Accordingly, the cut slope should be designed considering the "C" & "Ø" values of the material.

Study Recommendation

- To provide topographical contouring map of the project site on 1:1000 scale with 2m contour interval, up to 50m on both sides of the Railway alignment,
- To demark all the control points (i.e. Project layout plan) in the ground and
- Recommended to get the geotechnical tests carried out for determining the "C" & "Ø" values of the slope forming material of both the tunnel sites. Accordingly, the cut slope should be designed considering the "C" & "Ø" values of the material.

Analysis and Outcome

Tupul is the proposed railway station in Imphal where the railways lines pass through the hilly region on the tallest pier bridge. For the stability purpose, it becomes very important to assess the geotechnical stability of the slope. Such kind of study is very useful in designing slopes in hilly and developing railway transport facilities. The current study was aimed at the same [92, 93]. The objective of the present study was the preparation of topographic contour map on 1:1000 scale, demarking of all contour points. The report of the project recommended to carry out geotechnical tests to determine the "C" & "Ø" values of slope which would help in designing the slope of the railway track along Tupul-Imphal railway line. The analysis of the report finds that the recommendations given in the study were very important and implemented as well for the mentioned cause. Presently, all the recommended points of the report have been achieved.

Implementable recommendations:

- Geotechnical tests to determine the "C" & "Ø" values of slope

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Report on the Preliminary Stage Geotechnical Investigation of Sekmai Multipurpose Project, Chandel District, Manipur

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2015

Objective

The objective of the investigation includes preliminary geological appraisal of the dam site and selection of dam axis. During the course of investigation reconnaissance geological traverse has been carried out along the proposed dam axis for selection of dam axis.

Study Recommendation

At the proposed dam site no. 1, the dam axis on the left bank of river Sekmai is located in the slide zone, which may cause slope stability problem on the left bank. To avoid this, and also in order to take advantage of the exposed hard shale and siltstone on the left bank, it is recommended to shift the dam axis about 10m -15m further upstream. By shifting this, length of the dam will be shortened by a few metres. In order to carry out detailed geological mapping of the dam site, the Project Authority is requested to supply/provide following viz., i) Topographical contouring map of the dam site on 1:1000 scale with 2m contour interval, from 200m upstream to 300m downstream of the dam axis and up to 940m on both the abutments ii) X- Section along dam axis and iii) L- Section perpendicular to Dam axis (i.e., 150m upstream & 200m downstream of the dm axis). The Project Authority should provide the latest salient features and detailed layout plan of the project.

Analysis and Outcome

It was planned to build 60 metres high earthen dam under Sekmai Multipurpose Project across Sekmai river at Kangoi in Tengnoupal district. The main objective of the present study was preliminary geological appraisal of the dam site and selection of dam axis. Such study will help in developing highly stable dam which can minimise the flood disasters [90]. After the study, the report recommended that the axis of the dam might cause problems related to the stability of slope on the left bank of the river. Therefore, it recommended to shift the dam axis further 10-15 m towards upstream to avoid the stability problem. The report also recommended to provide the latest salient features and detailed layout plan of the project. The analysis of the report revealed that the recommendations were taken seriously and the axis of the dam shifted accordingly. All the recommendations made by this report were implemented well.

Implementable recommendations:

- lithological and geochemical characteristics of those rocks in details

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Specialised Thematic Mapping of Ophiolite Suite of Rocks of Manipur Between Ningthi to Nungbi Khullen, Ukhrul District, Manipur

Implementing Institution

Geological Survey of India, State Unit :
Manipur – Nagaland

Project Location/Completion Year

Manipur, 2015

Objective

- To establish the contact relationship between the ophiolite and oceanic pelagic sediment
- To locate potential mineralization.

Study Recommendation

- More detailed sampling and Petrographic studies can be carried out for possible deposits along major fault zones.
- More systematic and detailed structural mapping in the area can be carried out.
- Investigation can be carried out for sub-surface nature of the chromitite bodies which mostly occurs as small lensoidal body.

Analysis and Outcome

In this study, the thematic mapping was carried out to identify the possible contact relationship between the ophiolite and oceanic pelagic sediment. In addition, locating potential mineralization was also one of its objectives. Such studies are very essential for identification of mineral resources and relationship between the sediments in a particular area [88]. The report recommended the detailed sampling and petrographic study for identifying the deposits of mineral along major fault. It is also recommended to carry out systematic and detailed mapping in the proposed area. The study also recommended to investigate the sub-surface nature of chromite bodies. The analysis of the report revealed that the recommended detailed sampling and petrographic study had been done. All the recommendations have been implemented accordingly.

Implementable recommendations:

- Detailed sampling and petrographic study for identifying the deposits of mineral along major fault
- Systematic and detailed mapping in the proposed area.
- Investigation of sub-surface nature of chromite bodies.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Magnetic Survey for Chromite Bearing Ultramafics Bodies in Moreh Area, Chandel District, Manipur (G4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2013

Objective

To delineate the chromite within ultramafics.

Study Recommendation

- The detailed magnetic survey was covered over an area of 4.0 sq.km by taking about 4400 magnetic observations on highly rugged terrain having steep valleys and ridges.
- The magnetic survey has brought out few isolated high magnetic anomalies besides demarcating different litho units.
- The Magnetic (T.F) map has clearly demarcated the northern and southern extension of ultramafic body by linear magnetic closures.
- The processed magnetic maps were helpful in identifying different formations besides demarcating the disposition of ultramafic body.
- The southern part of the ophiolite belt beyond S 300 traverse is covered under thick soil with few rock exposures at nala portions. The magnetic (T.F) data has delineated the extension of ophiolite belt in southern part very clearly. The eastern contact of ultramafics with sediments in the northern part is also clearly demarcated.

Analysis and Outcome

The current study was aimed at delineating the chromite within ultramafics bodies in Moreh area, Chandel district, Manipur. Such kinds of studies are very essential for representing the deposits of minerals in a specific region [94]. The report did not mention any recommendations for this study. The study observed clear demarcation in Northern and Southern extensions of ultramafics. In addition, the magnetic maps also identified different formations. The study revealed that at nala portion, beyond 300 traverse was covered with thick soil as well as exposure of few rocks. The extension of ophiolite belt in Southern part was very clearly delineated by magnetic data. Moreover, the Eastern contact of ultramafic with sediments in the Northern part was also demarcated very clearly.

Implementable recommendations:

- No clear recommendations were made by this report

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

District Survey Report for Minor Minerals in East Jaintia Hills District

Implementing Institution

District Level Task Force, Government of Meghalaya

Project Location/Completion Year

Meghalaya, 2019

Objective

To bring administration closer to the people at the grass- root level.

Study Recommendation

No Recommendation

Analysis and Outcome

In this study an attempt has been made to investigate the presence of minor minerals in this region. The main objective of the current study included the establishment of potential relationship between administration and local people at grass-root level. Such kind of study is very useful in implementation of governmental schemes and creating awareness against any project for its completion [100]. The analysis of the report did not reveal any recommendations for this study. The possible recommendations might be systematic sampling of different locations.

Implementable recommendations:

- Systematic sampling of a different location

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India
- Universities



Study Title

District Survey Report for Sand Mining and Riverbed Mining

Implementing Institution

District level taskforce, Government of Meghalaya

Project Location/Completion Year

Meghalaya, 2019

Objective

To survey sand mining and river bed mining in Ri-Bhoi District, Meghalaya

Study Recommendation

Recommendation has not been outlined in this report

Analysis and Outcome

Sand mining is the extraction of sand, mainly through an open pit (or sand pit) but sometimes mined from beaches and inland dunes. Sand mining or river bed mining affects the biodiversity up to a great extent. Therefore, such mining activities must be done under proper regulations [106]. This kind of study will help in conservation of biodiversity. The objective of the current report was surveying of sand and river bed mining in Ri-Bhoi District of Meghalaya. The report did not mention any recommendations for this study. The possible recommendation might be the use of strict environmental regulations

Implementable recommendations:

- Strict environmental regulations

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Final Report on Reconnaissance Survey for Lateritic Bauxite and Associated Minerals in the Eastern Part of Umsung Area, West Khasi Hills District, Meghalaya (G4 Stage)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2019

Objective

To delineate the lateritic bauxite capping within Precambrian Gneissic Complex.

Study Recommendation

- The bauxite prospect of Umsung area with a high concentration of aluminium as well as gallium with a considerable thickness of 7m indicate towards a promising future of bauxite exploration in Assam Meghalaya gneissic complex. This may lead to a new chapter on mineral wealth of the Meghalaya state in particular and North East India in general.
- It is strongly recommended to take up UNFC G2 stage of investigation after the law and order problem is solved.
- Paleo-geomorphological reconstruction and the identification of paleo valley could give more light on the process of formation and controlling factors for Umsung bauxite.

Analysis and Outcome

Bauxite is a variety of laterite which is as residual sedimentary rock. Therefore, it has no precise chemical formula. It is composed mainly of hydrated alumina minerals such as gibbsite $\text{Al}(\text{OH})_3$ or $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ in newer tropical deposits. The study was aimed at delineation of lateritic bauxite capping existing in Precambrian Gneissic complex. This study is very useful in delineating lateritic bauxite [109, 110]. The analysis of the report investigated that the report recommended few points for this study. The presence of bauxite in Umsung area of thickness 7 m encouraged to recommend bauxite exploration in the Assam Meghalaya gneissic complex. There was a strong recommendation to take up an investigation of the stage UNFC G2 after solving the law and order problem. It also recommended the Paleo-geomorphological reconstruction and identification of paleo valley. The work on the recommendations have been initiated. The analysis identified that the recommendations made here were important and partially implemented.

Implementable recommendations:

- Investigation of the stage UNFC G2
- Paleo-geomorphological reconstruction and identification of paleo valley

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Reconnaissance Survey for Phosphate in Shales of Kopili Formation in and Around Pala-Larket Village, Litang Valley, East Jaintia Hills District, Meghalaya (STAGE: G-4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2019

Objective

The objective of the investigation is to demarcate phosphate horizons within shales of Kopili Formation and to delineate prospective zones enriched with phosphate nodules and resource assessment, if any.

Study Recommendation

- The phosphatic nodule-bearing shale horizon in the area investigated is only 1.5 to 2 m thick and the average lateral extension is 35m as observed in the six locations mentioned earlier with a mean volumetric concentration of nodules in these shales is only 0.002 Cubic metres by volume of shale is very low so as to be of any economic utility.
- Because of the very low concentration of Phosphatic nodules in the area and non-uniform distribution of the Phosphate nodules in the shale horizon, the phosphate deposit of this area is not economic.
- As no significant mineralisation could be established henceforth no further work is recommended.

Analysis and Outcome

The study was targeted to investigate the demarcation of phosphate horizons in Kopili formations. The identification of perspective zones rich in phosphate nodule and other resources was also targeted. Such kind of study creates a clear picture of potential historic resources in a particular location at a specific point in time [101]. The study recommended that the phosphate nodule containing shale was only 1.5 to 2 m thick with lateral extension of 35 m. It was found at six locations having mean volumetric concentration of 0.002 cubic meter. The report recommended that the Pala-Larket village, Litang Valley, East Jaintia Hills district were not economically important due to very low concentration. Therefore, the report finally recommended not to initiate any future work in these regions. The analysis of the report found that the mining work on Litang valley and other are closed for phosphate mining. Currently, no mining work related to phosphate is operated there. The analysis of the report concluded that the recommendations made were implemented well.

Implementable recommendations:

- Systematic sampling of different location

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Survey and Mapping the Extent and Distribution of Soil Acidity in Agricultural Lands of Meghalaya by Using Geospatial Techniques and Soil Health Card

Implementing Institution

District and Local Research Station & Laboratories, East Khasi Hills, Shillong

Project Location/Completion Year

Meghalaya, 2019

Objective

- To describe the trends in the distribution and extent of soil acidity for the whole state of Meghalaya
- To Survey, Classify and Mapped the extent of Soil Acidity in the whole state of Meghalaya by using Geospatial techniques and Soil Health Card data
- Classification of Agricultural Soils according to pH value classes and to create District & Block level Soil Acidity Maps.

Study Recommendation

Crop Production in acid soils requires optimum soil fertility management, ensuring plant nutrient availability to crops in ample quantity as per soil test based recommendations of the Soil Health Card.

Analysis and Outcome

The pH of the soil affects the agricultural production. Too acidic and basic soil decreases the production. Therefore, the identification of such problems become an urgent need. The aim of the study was to investigation of extent of soil acidity in the whole state. Such study will help in increasing the agricultural production of crops and play an important role in achieving sustainable development goals 2030. The analysis of the report revealed that the recommendations given for the current study were very essential [105]. It recommended optimum soil fertility management for the production of crop in acidic soil which require plant nutrient in ample quantity. The analysis of the report finds that the recommendations were partially implemented which are needed to be implemented urgently. As the recommendations given for this study is needed research and development for the proper soil management which is time taking. Therefore, the recommendations are yet to be achieved.

Implementable recommendations:

- Creating awareness about natural resource conservation
- Sustainable use of forest resources

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

District Survey Report of Minor Minerals Other Than Sand Mining and River Bed Mining, South West Khasi Hills

Implementing Institution

Forests & Environment Department,
Government of Meghalaya

Project Location/Completion Year

Meghalaya, 2018

Objective

- Identification of river sand mining areas with geo references.
- Identification of potential area of river silt with geo reference, which is being used for filling purposes.
- Identification of other minor minerals with geo reference.
- Identification of other mineral resources if available.

Study Recommendation

- Rainwater harvesting should be promoted by constructing structures such as gully plugs, check weirs and check dams and also roof-top rainwater harvesting structures. For roof-top rain water harvesting, rainwater can be collected from the PVC/GI or concrete rooftops through bamboo, GI or PVC gutters and pipes.
- Hydrogeological studies have indicated that lineament, joint, fracture, and fault are the main controlling factors for the occurrence and distribution of groundwater. Thus, the potential fractured zones must be confirmed by Geophysical Survey and lineaments studies by Remote Sensing Studies.
- People in the rural areas are mainly dependent on spring water, there is an urgent need for a scientific approach for proper development and management of these springs. It may be recommended that the development of springs will help in mitigating the water requirement of the people to a large extent.
- Sporadic occurrence of high concentration of iron in groundwater has been reported in some pockets in the District. So, the water supply agencies should take precautionary measures to provide iron free water for potable purposes.
- Mass Awareness Programme to the users and stakeholders on water consumption and protection of water quality will help in managing the precious resource in scientific ways for optimum benefits.

Analysis and Outcome

The South West Khasi Hills region is rich in minor minerals. The detailed survey of this region is very economical. The major objective of this study was to identify the river sand mining area, the potential area, minor minerals and other minerals along with geo-referencing. Such kind of study is very useful in locating the area of sand mining along the rivers [125]. The analysis of the report revealed that either the report did not mention any recommendations for this study or missed to recommend.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Final Report on Integration of Geological, Geochemical, Geophysical, Aero-Geophysical, Remote Sensing and Drilling Data of Toposheet 780 To Identify the Mineralization Pattern

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

- To integrate the available geo-datasets in toposheet nos. 780/2, 6, 9 and 10, which falls in Ri-Bhoi district, Meghalaya.
- To identify mineralization patterns and further predict the mineral potential zones.

Study Recommendation

- The present study depends entirely on the data collected by previous workers, its accuracy depends on the quality of such data and the present authors do not have any control over it. Hence it is recommended to carry out detailed sampling and specialized thematic mapping in the areas marked as highly favourable and favourable area.
- To initiate integration studies, a good number of established mineral deposits are required for validating the GIS models. Presence of very few proved mineral deposits in the area is a severe constraint in validation of the models. No model can be successful without proper validation with the known deposits. Hence, it is recommended to carry out such data integrated studies where good numbers of established mineral occurrences/deposits exist.
- In course of the present study, it has been observed that in most of the unpublished investigation reports, the detail maps do not contain any reference lines / features, by which they can be correlated to real life coordinates. Even the coordinates given in the locality index are neither precise, nor accurate. Consequently, the data available in such reports/maps cannot be used for any further study.

Analysis and Outcome

The current study was aimed at integrating the geological, geochemical, geophysical, aero-geophysical, remote sensing and drilling data to construct a toposheet. These studies help in identifying the pattern of mineralization [127]. The present study was conducted by using the data collected by the previous work. Therefore, its accuracy would be depending on the accuracy of the data collected previously. Hence, the report of the study recommended detailed sampling and thematic mapping in those areas which were marked as highly favourable. As the recommendations were based on further study, the present status of the recommendation are yet to be achieved. The analysis of the study concluded that the recommendation made was perfect and partially implemented.

Implementable recommendations:

- Detailed sampling and thematic mapping those areas which were marked as highly favourable and favourable

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Final Report on Preliminary Investigation for Limestone in Umkyrpong Block, Litang Valley, East Jaintia Hills District, Meghalaya (G-3 Stage)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

- To carry out detailed mapping on 1: 4000 scale in Umkyrpong area
- To map the continuity of limestone in the northern part of the basin.
- To carry out exploration using drilling operations 3 drilling units to be deployed.

Study Recommendation

- In view of considerable limestone resource potential in the area, further exploration is suggested to continue in the adjacent areas.
- The overburden ratio is acceptable, hence large scale open cast mining can be undertaken using modern technology, so as to improve the socio-economic condition of the local inhabitants in particular and the region in general.

Analysis and Outcome

Umkyrpong village is located in Saipung Tehsil of Jaintia Hills district in Meghalaya. Litang valley of East Jaintia Hills is rich in limestone deposits. The main objective of the current study was detailed mapping of Umkyrpong area on 1:4000 scale and continuity of limestone in the northern section of basin. In addition, the exploration by deploying 3 drilling units. Such kind of study will lead to investigate and find easily the deposits of limestone [113]. The report recommended few important points for the study. It recommended further exploration in the adjacent area. It also recommended to do open cast mining at large scale using modern technology for improving socio-economic condition of the local inhabitants. The analysis of the report concluded that the recommendations were not achieved and hence, it can be said that these are partially implemented.

Implementable recommendations:

- Further exploration in the adjacent area
- Open cast mining at large scale using modern technology

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Invertebrate Faunal Associations From the Early Palaeogene Jaintia Group and Their Palaeoenvironmental Reconstruction

Implementing Institution

Palaeontology Division, Mission – IV,
Northeastern Region, Shillong

Project Location/Completion Year

Meghalaya, 2018

Objective

- Taxonomic studies
- Palaeoenvironmental reconstruction
- Palaeobiogeographic implication based on the previous and present findings.

Study Recommendation

- The southern fringe of Meghalaya Plateau is mostly covered by rocks that have been divided into Khasi Group of Upper Cretaceous age and Jaintia Group of Palaeogene age (Palaeocene to Eocene).
- The Khasi Group consists of Basal Conglomerate Formation and Mahadek Formation and the Langpar Formation.

Analysis and Outcome

The current study was aimed at the taxonomic studies from the early Paleogene Jaintia group and reconstruction of its paleo-environment. Such kinds of studies are very useful in understanding the paleoenvironment and taxonomic subdivision [114]. The outcomes of the study exhibited that the Southern Meghalaya Plateau was covered with rock and Khasi group contains Basal Conglomerate, Mahadek, and Langpar formation. The report of the study did not mention any essential recommendations for this study. The possible recommendations might be the detailed screening of the area regarding faunal associations.

Implementable recommendations:

- The analysis of the report revealed no recommendations

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Preliminary Exploration for Limestone in East of Laphet Area, Litang Valley, East Jaintia Hills District, Meghalaya (G-3 Stage)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

To assess potentiality of different grades of limestone of Shella Formation in South of Akshe area, Litang Valley, East Jaintia Hills district Meghalaya

Study Recommendation

- In view of considerable resource potential coupled with high grade limestone in the area, G2 exploration may be proposed by putting borehole between two drilled boreholes.
- Further open cast mining operation could be taken up using State-of-Art technology so as to improve the socioeconomic condition of the local population.
- Dating for glauconite associated with fossils in limestone may be carried out to know the age and span in formation of Upper Sylhet limestone deposit of Shella Formation
- In view of vast thickness of limestone about 120 m of the targeted zone of Upper Sylhet Limestone, further G-2 stage drilling is recommended in the exploration block and G-3 stage of exploration may be taken up in northern western continuity of the South of Akshe area towards the up dip direction in the adjoining accessible areas to make the proper assessment of limestone in the Litang Valley.

Analysis and Outcome

G-3 Exploration is generally carried out for smaller area, a few kilometers to tens of kilometers. The geological mapping of such area is done on the scale of 1:25000. The objective of this study was to assess the potentiality of different grades of limestone present in Shella Formation. The current study is very beneficial for investigating the various grade of limestone [117]. The analysis of the report revealed few recommendations. The major recommendation was carrying out G2 exploration. The open cast mining was also recommended to improve socio-economic condition of local population. The dating of glauconite associated with fossils in limestone was also recommended. All the recommendations of the report were very essential. It was observed that the recommendations and were found to be partially implemented.

Implementable recommendations:

- Carrying out G2 exploration
- Open cast mining
- Dating of glauconite associated with fossils in limestone

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Reconnaissance Survey for REE and Associated Elements in Laterite in Nongjyllich Block, West Khasi District, Meghalaya (G-4 Stage)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

To delineate aluminium rich laterite capping over the biotite gneiss and to search for REE in the Nongjyllich block, West Khasi Hills District, Meghalaya

Study Recommendation

- The regolith cover developed over porphyritic granite has anomalous results (Σ REE in B horizon ranging from 219.11 ppm to 2064.69 ppm and 79.72 ppm to 2206.64 ppm in the C horizon and average 640.10 ppm.
- Thus it can be recommended that further investigation for REE in the regolith developed over porphyritic granite in the adjoining areas of the present block may be carried out.

Analysis and Outcome

Reconnaissance survey comes under G-4 stage which reduces the area by identifying the selected ones for the further study. It involves systematic geological mapping on 1:50000 scale. Such study is essential for the investigation of minerals deposits ^[120]. The study was aimed at G-4 stage survey for free and associated elements in Laterite in Nongjyllich Block. The analysis of the report analyzed that the recommendation of the report were very essential and must be implemented for the mentioned cause. The report recommended that further investigation for REE in the regolith developed over porphyritic granite in the adjoining areas of the present block might be taken place. It was analyzed that the recommendations of the report were found to be implemented well.

Implementable recommendations:

- Investigation for REE in the regolith developed over porphyritic granite in the adjoining areas of the present block

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Reconnaissance Survey for REE and Associated Elements in Laterite in Nongbyrki Block, West Khasi Hills District, Meghalaya (Stage-G4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

To delineate aluminium rich laterite and bauxite capping over biotite gneiss.

Study Recommendation

- The laterite samples with Al₂O₃ wt% more than 40 (as per IBM monograph on bauxite, 1992) to be analysed for silica either free or reactive. If SiO₂ is free silica, it can be removed with a low cost of beneficiation and grade may increase.
- Detailed elemental study of REE may be carried out to understand their mobility, occurrence and enrichment in insitu soil developed over bed rocks. Hence, EPMA analysis is proposed to confirm the REE enrichment of the study area in mineral or in rare earth oxide form (REO).
- To study more soil sections with high REE anomaly developed over various parts of the South Khasi pluton.
- It is recommended that in situ weathered soil horizon developed over all other granitoid plutons in Meghalaya, with decomposed feldspar (mixed clay zone) zone can be taken up for further studies.
- It is recommended to map the shelf margin of Cretaceous sedimentation in the areas of Rambrai and Umsung block.

Analysis and Outcome

Reconnaissance survey comes under G-4 stage which reduces the area by identifying the selected ones for further study. It involves systematic geological mapping on 1:50000 scale. The major objective of the current study was delineation of aluminium rich laterite and bauxite capping over biotite gneiss. Such studies are very useful in the investigation of REE of a given region [111]. The analysis of the report found several recommendations for this study. It is recommended to analyze the laterite samples having Al₂O₃ more than 40% by wt for the presence of silica. It is also recommended to understand the mobility, occurrence and enrichment of REE in in-situ soil developed over bed rocks. Therefore, EPMA analysis was proposed for the confirmation of REE. The report also recommended to study more soil samples having greater REE. In addition, it is further recommended to study weathered soil sections present in granitoid plutons of Meghalaya and mapping of the shelf margin of Cretaceous sedimentation. The analysis of the report found that the recommendations made were of great importance and needed further research and thorough study. The recommendations were found to be partially implemented.

Implementable recommendations:

- Analyse the laterite samples
- Mobility, occurrence and enrichment of REE
- Study weathered soil sections present in granitoid plutons of Meghalaya

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Reconnaissance Survey for Titaniferous-Vanadiferous- Magnetite Around Mawkyndoor Area, West Jaintia Hills District, Meghalaya (G4)

Implementing Institution

Geological Survey of India, State Unit:
Meghalaya

Project Location/Completion Year

Meghalaya, 2018

Objective

Apatite-Magnetite: From the BRS samples Fe_2O_3 values ranging from 22.59-77.38 wt % with TiO_2 values ranging from 0.28-1.73 wt % and V values ranging from 98-1187 ppm while in PTS samples Fe_2O_3 values ranging from 8.24-75.57 wt % With TiO_2 values ranging from 0.29-4.25 wt % and V values ranging from 215-1325 ppm only.

Study Recommendation

REE values is high in perovskite bearing magnetite-serpentinite near Mawiong and in the laterites capping near Lumkyntang as described by earlier worker more samples with systematic detailed sampling from these rocks types is highly recommended to assess the REE potential in the area

Analysis and Outcome

Reconnaissance survey comes under G-4 stage which reduces the area by identifying the selected ones for further study. It involves systematic geological mapping on 1:50000 scale. The objective of the current project was G-4 stage survey of Titaniferous-Vanadiferous- Magnetite around Mawkyndoor area. This study is useful in investigating the mineral deposits^[11]. The report of the study recommended the delineation of magnetic bearing body into the apatite-magnetite, the magnetite-serpentinite and the magnetite-pyroxenite body. The report suggested that no significant anomalous zone were present except zones of slight highest values of TiO_2 and V. The analysis of the report observed that the recommendations of the report were partially implemented. At present, complete work on the recommendations is needed.

Implementable recommendations:

- Delineation of magnetic bearing bodies

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Report on Preliminary Exploration for Limestone in South of Akshe Block, Litang Valley, East Jaintia Hills District, Meghalaya (G-3 Stage)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

- To assess potentiality of different grades of limestone of Shella Formation in South of Akshe area, Jaintia hills, Meghalaya.
- Core samples (primary and check) to be collected and analysed for the grades of limestone.
- Water samples and soil samples to be analysed for the baseline parameters of environment.
- Detailed geological mapping to be carried out by using Total Station during present field session.

Study Recommendation

- The estimation of the resource is dependent on the accuracy of the borehole locations, making space for the possibility of creeping errors in the final adjustment of core thickness in case of poor recovery.
- Realistic resource estimate is beset with personal factor in analyzing the chemical parameters.
- In view of vast thickness of limestone about 120 m of the targeted zone of Upper Sylhet Limestone, further G-2 stage drilling is recommended in the exploration block and G-3 stage of exploration may be taken up in northern western continuity of the South of Akshe area towards the up dip direction in the adjoining accessible areas to make the proper assessment of limestone in the Litang Valley.

Analysis and Outcome

Litang valley of East Jaintia Hills is rich in limestone deposits. The study aimed at assessing the different grades of limestone. The collection of core samples and its analysis, analysis of water and soil samples and geological mapping were basic objectives of the present study. Such studies are used to understand the basics of limestone deposits which help in identifying its location of deposits [111, 112]. The analysis of the report concluded that the recommendations made were essential. It is recommended to avoid errors during final adjustment of core thickness when the recovery is very poor. Further, it recommended G-2 stage drilling in exploration. The G-3 stage of exploration was also recommended in the northern western continuity of the South of Akshe area. It was analyzed that the recommended G-3 stage exploration was not done yet. The recommendations made were partially implemented.

Implementable recommendations:

- Avoiding errors during final adjustment of core thickness when the recovery is very poor
- G-2 stage drilling in exploration
- G-3 stage of exploration in the northern western continuity of the South of Akshe area

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Report on Reconnaissance Survey for REE in the Area Around Jirang and Area Between Umsophria-Warmawsaw, Ri-Bhoi District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

- The primary objective was to target the upstream catchment area of higher Σ REE values reported in the NGCM unit geochemical sample.
- This mineral investigation project was confined to the well-defined co-ordinates and with the limited number of soil samples and pitting trenching samples.
- The main thrust of geochemical sampling was given only in the upper catchment area of the reported steam-sediment samples with higher geochemical values.

Study Recommendation

- Grid-pattern sampling, preferably in 200 m x 200 m or lesser may be done in the three blocks and adjoining areas of Warmawsaw area to substantiate the resource estimates made in this study.
- Orientation surveys covering in larger areas on smaller scales like 1:50000 can be taken up to identify areas of thicker regolith-thicknesses as well as with higher ion-adsorped TREE values.

Analysis and Outcome

Reconnaissance survey comes under G-4 stage which reduces the area by identifying the selected ones for further study. It involved systematic geological mapping on 1:50000 scale. This kind of study is useful in identifying the region of mineral deposits [121, 122]. The major objective of the current project was G-4 stage survey for REE in the area around Jirang and area between Umsophria of Ri-Bhoi district. The report was analyzed and found that it recommended essential recommendations. The important recommendation were grid pattern sampling in 200x200 m in three blocks and orientation survey of larger area on 1:50000 scale for identifying thicker regolith areas and TREE value with high ion adsorbed. The present status of the recommendations is yet to be implemented. The analysis of the report concluded that the recommendations of the study were partially implemented.

Implementable recommendations:

- Grid pattern sampling in 200x200 m in three blocks
- Orientation survey of larger area on 1:50000

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Study on Fluid-Controlled Charnockitisation of Granitegneiss in Parts of West Khasi Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2018

Objective

- To evaluate the process of charnockitisation
- To evaluate the role of fluids
- To evaluate possible age of charnockitisation.

Study Recommendation

- Formation of corundum in a quartz bulk composition in khondalite of Langtor – Nongdom is usually considered to be indicative of ultra-high temperature metamorphism, though, some workers have proposed this assemblage can also be formed under lower temperature under the influence of fluidal activity.
- Fluid inclusion and Raman Spectroscopic studies indicate profusion of carbonic and aqueous fluid inclusions in the charnockite gneiss, porphyritic charnockite and porphyritic granite. However, the small size of these inclusions has hindered the present course of work to a great extent.
- Due to absence of melt inclusion laboratory studies could only be taken up with equipments used for hydrothermal systems. It has been concluded that these inclusions were possibly formed at higher temperatures.
- Therefore, melt inclusion studies on the carbonic inclusion of the charnockite of the area is urgently required to determine the exact temperature of formation.
- Petrography on the charnockite gneiss indicated presence of monazite in some of the samples which can be dated to determine the time of charnockitisation.

Analysis and Outcome

Charnockite is any orthopyroxene-bearing quartz-feldspar rock formed at high temperature and pressure, commonly found in granulite facies metamorphic regions. The main objectives of the study were investigation of tectono-lithostratigraphy of the area consisting khondalitemeta-sediments of higher grade, affinity for sillimanite-micaceous ferruginous schists of khondalite. Such studies are useful in studying the khondalitemeta-sediments via lithostratigraphy [126]. The report of the study made several important recommendations. The report suggested the presence of ultra-high temperature metamorphism due to the formation of corundum in a quartz. The studies like fluid inclusion, and Raman spectroscopy indicated the abundance of carbonic and aqueous fluid. Therefore, the report strongly recommended to determine the exact temperature of formation. The time of charnockitisation can be identified by the presence of monazite. The analysis of the report concluded that the recommendations made were of great importance and partially implemented.

Implementable recommendations:

- Abundance of carbonic and aqueous fluid presence
- Strongly recommended to determine the exact temperature of formation

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Tectonothermal Evolution and EPMA Geochronology of Granulite Facies Rocks From the Gneissic Complex of Shillong Plateau, India

Implementing Institution

Gauhati University

Project Location/Completion Year

Meghalaya, 2018

Objective

- To identify and characterize the separate discrete tectono-metamorphic episodes within the high-grade metamorphic terrain in the Shillong Plateau, with particular emphasis on the role of the Grenvillian and Pan-African imprints and overprints.
- To identify the nature of the source rocks, tectonic settings on the basis of whole-rock geochemistry.
- To establish a coherent P-T-t path for high-grade metamorphic terrain within the gneissic complex in the Shillong Plateau based on the integration of petrological, geochemical and EPMA Monazite Dating.
- To develop a model for the causes of high-grade metamorphism in the Shillong Plateau and the process of cratonisation on the basis of integrated studies and to compare and contrast the results of this study with similar high-grade metamorphic terrains of comparable age such as the Eastern Ghats Mobile Belts and Prydz Bay in Antarctica for the better understanding of the global scale reconstruction of the Gondwanaland.

Study Recommendation

- Identify the crustal evolution of the Gneissic complex of the Shillong Plateau is related to the amalgamation of Mesoproterozoic Eastern Indian Plate with Prydz Bay of Antarctica during Pan-African orogeny.
- The role of thermochronological data of the high grade terrain are most essential in view of Global Pan-African reconstruction which is totally absent in the rocks of the Shillong Plateau except some rare examples.
- Geological mapping in several localities along the remote hilly tracts in the Shillong Plateau during the project work is, indeed a wealth of information for the high grade rocks in the region.

Analysis and Outcome

The current study was aimed at identifying the nature of the rock and tectonic setting, establishing a coherent P-T-t path, developing a model for high-grade metamorphic terrain on the basis of geochemistry and EPMA Monazite Dating. Such kind of study is very useful in studying the nature of rocks. It is also useful in investigating the tectonic behaviour of plates [124]. The report of the study recommended to Identify the crustal evolution of the Gneissic complex. The report suggested the importance of thermochronological data of the high grade terrain which was totally absent in the rocks of the Shillong Plateau. The geological mapping in the different localities was also one of the essential recommendations. The analysis of the report analyzed that the recommendations were essential and partially implemented.

Implementable recommendations:

- Identification of the crustal evolution of the Gneissic complex
- The geological mapping in the different localities

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

General Exploration for Limestone in North of Larket Block, West of Litang River, Jaintia Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2017

Objective

To assess the potentiality of different grade of limestone in North of Larket block, Jaintia Hills district, Meghalaya

Study Recommendation

With the outcome of the G2 exploration project the limestone proved to be economically viable for opencast exploration of cement on from grey to light grey fossiliferous variety. Down depth the very light grey to off white variety can be separated for SMS use/white cement.

Analysis and Outcome

Litang valley of East Jaintia Hills is rich in limestone deposits. The main objective of the current study was to investigate the presence of limestone in Larket Block of Litang River. This study is very useful for examining the presence of limestone with its different grades for economic purpose. The study recommended open cast mining of limestone which could be used for cement. It is also recommended to separate the very light gray to off white variety of limestone. The analysis of the report concluded that the recommendations of the present report were very feasible and within the rich. It has been observed from the secondary literature that the analysis identified that the recommendations were partially implemented because such kind of exploration work needed time where most of the time was wasted in environmental clearances ^[135].

Implementable recommendations:

- Opencast mining
- Separation of different grade limestone

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)

Study Title

General Exploration of Limestone Resources in the West Ishamati Block, Mawlong Village of Sohra Tehsil, East Khasi Hills District, Meghalaya, (Stage G-2)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2017

Objective

Assess the potentiality of different grades of limestone by G-2 stage of exploration.

Study Recommendation

- In view of vast thickness of limestone further G-2 stage drilling are recommended in the eastern continuity of the West Ishamati block (where already work carried out during FS: 2013-14 in G-3 stage) to know the exact limestone Resource in the area.
- It is also recommended that the exploration programme may be continued in the adjoining accessible areas to make the proper assessment of limestone in area between Mawlong to Shella villages.
- Moreover, open cast mining operation is recommended using modern technology so as to improve the socio-economic condition of the local population.

Analysis and Outcome

Khasi Hills are the great reserve of limestone. The West Ishamati block was also supposed to have different grades of limestone. Such kind of study is very useful in investigating the presence of limestone. The current study aimed at assessing the potentiality of limestone [118]. The present report suggested several recommendations. These recommendations were found to be feasible and essential to meet out the objectives. The suggested points were considered on priority basis and started working on that. The analysis of the report identified that all the recommendations were based on exploration which were partially implemented till date.

Implementable recommendations:

- Further G-2 stage drilling
- Proper assessment of limestone area
- Open cast mining

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Report on General Exploration for Limestone in Mynthning Block, Litang Valley, East Jaintia Hills District, Meghalaya (G-2 STAGE)

Implementing Institution

Geological Survey of India, State Unit-
Meghalaya

Project Location/Completion Year

Meghalaya, 2017

Objective

To assess the potentiality of different grades of limestone (Shella Formation) in Mynthning block, Litang Valley, East Jaintia hills district, Meghalaya

Study Recommendation

- The Upper Sylhet Limestone is the most prospective limestone horizon from the view point of thickness and grade. The limestone has been deposited under marine shelf environment as indicated by the presence of foraminifers, and the association of mud.
- The uniform thickness of the Prang Limestone along strike length along with uniform sub-horizontal disposition of the sedimentary sequence indicates no major tectonic disturbance in the area of investigation.
- On the basis of logging data the size of the fossils varies with depth; size decreases with increasing depth. Limestone with buff coloured zones, increasing stylolites, brecciated, micro fossils and lesser fossil content and lesser shale parting are seen to have higher grade.
- In Mynthning block, considering resource potential of high grade limestone has been established, explorations are suggested to continue in the adjacent area.
- Presence of glauconite in the limestone also requires in-depth R&D study to know the depositional environment and associated age and other additional inferences.

Analysis and Outcome

The Litang valley has several blocks which have limestone deposition. Mynthning block is one of them which was targeted to study the limestone exploration in this study. The major objective of the current study was assessing the potentiality of different limestone grades present in this block of Litang Valley. This kind of study is beneficial for exploring the possible deposits of limestone and other minerals [128]. There were several recommendations given by the report. One of them was the limestone present in Sylhet had the greatest potential regarding thickness and grade. It suggested that the area of investigation was free from any tectonic disturbance. The logging data revealed that the size of the fossils decreased with the increasing depth. The limestone of higher grades were found in buff colored zones. The limestone with increased stylolites, brecciated, micro fossils, and lesser fossils contents were also of higher grade. The report also recommended to explore in the adjacent area. The detailed research and development were recommended for the investigation of depositional environment and its age. The analysis of the report indicated that the recommendations were very important for the mentioned cause and were found to be implemented partially.

Implementable recommendations:

- Limestone present in Sylhet had the greatest potential regarding thickness and grade

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Report on Specialized Thematic Mapping for Characterisation of Shillong Group of Rocks and Cover Sediments, Around Pynursla and Jarain, East Khasi Hills-Jaintia Hills Districts, Meghalaya

Implementing Institution

Geological Survey of India, State Unit-
Meghalaya

Project Location/Completion Year

Meghalaya, 2017

Objective

- Characterization and metamorphic evolutionary history of Shillong Group of rocks provenance study of the low grade meta sediments of Shillong Group of Rock
- Relationship between Shillong Group and Tertiary cover sediments
- Depositional history of Tertiary cover sediments
- Search for mineralization.

Study Recommendation

The study reports the presence of mafic metavolcanic rocks as interbanded sequence within the Shillong Group. The rocks have profuse stretched amygdules and rare vesicular pipe structures in them. These subalkalic rocks vary from basaltic andesite to andesite and have a “within plate basalt” affinity.

Analysis and Outcome

The thematic map is a special kind of map which represents a particular subject or theme about a geographic area. In this study, the major objectives targeted were study of characterization and metamorphic evolutionary history of Shillong Groups of rocks, investigation of relationship between Shillong group and tertiary cover sediments and its history as well as searching the presence of minerals [131]. This kind of study is beneficial for investigating the evolutionary history. It also helps in finding the mineral deposits. The report illustrated the presence of mafic metavolcanic rocks having amygdules and vesicular pipe structures. The analysis of the report did not reveal any important recommendations. The possible potential recommendation might be characterizing the sediments of Shillong group and Tertiary cover thoroughly.

Implementable recommendations:

- Characterizing sediments of Shillong group and tertiary cover

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Report on Study on Evolutionary History of High Grade Metamorphic of Sonapahar Rambrai-Nongstoin Area of West Khasi Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2017

Objective

- Provide a comprehensive idea about the evolution of the Meghalaya Gneissic Complex and give some idea about the Sonapahar sillimanite deposit with more field evidences.
- Mapping in large scale to represent the components of the gneissic complex and their mutual relationship,
- Establishment of structural evolution combining with detailed petrology, mineral chemistry,

Study Recommendation

- Meghalaya Gneissic Complex (MGC) in Sonapahar and adjoining areas is represented by folded sequence of metasediments (cordierite gneiss and quartz-sillimanite schist) with early intrusive acid (charnockite gneiss) and basic (two pyroxene granulite) bodies.
- The observation suggests pre S2 intrusions of the charnockite and two pyroxene granulite bodies. This type of disposition of two pyroxene granulite and charnockite bodies can be explained by two possible ways viz. a) originally those were acid and basic intrusives within the metasediments and later on metamorphosed to granulite grade.
- As the orientation of the bodies are parallel to the $\lambda=1$ axis, it is the ideal site of shearing. The age of charnockite gneiss bodies will help to solve the problem further.

Analysis and Outcome

Sonapahar Rambrai-Nongstoin area of West Khasi Hills district is supposed to be a great reserve of metamorphic gneiss. The objective of the current study was investigation of Meghalaya Gneiss, mapping, geochemistry, and dating of metamorphic events. The current study was very useful in the geological study of metamorphic gneiss. The analysis of the report revealed that the recommendations of were very important and can be easily achieved once started working on that. It was concluded that the recommendations were partially implemented and still the exploration work is continued [137].

Implementable recommendations:

- Pre S2 intrusions of the charnockite and two pyroxene granulite bodies.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Social Impact Assessment Report on Land Acquisition

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2017

Objective

- The main objective for the proposed Facilitation Centre- Exit Point is to prevent and check on the influx and illegal entry into the state of Meghalaya.
- It aims to check on all pedestrian and vehicles entering the State without any valid documents and to keep records of all entries.

Study Recommendation

- Take up land management practice or soil control measure to minimize run off of excavated soil and disturbance to natural areas bordering the project side.
- Reduce Noise pollution by following the rules under Noise Pollution (regulation and control) rules, 2000 issued by the Meghalaya State Pollution Control Boards to prevent noise pollution near institution of grave importance.
- Relocation of electric post before the project implementation to avoid unavailability of electricity in the village.
- Employment preference should be given to the local people which will enable them to benefit from the project, reduce the size of intrusive work forces, and keep more of the resources spent on the project in the local economy.

Analysis and Outcome

The summary of the present study shows there are 2 land owners where it is proposed to be acquired for setting up Integrated Facilitation Centre- Exit Point. The need for resettlements does not arise as the land owner has taken the responsibility to relocate the caretaker if the land is to be acquired. Intercropping is practiced on the site with crops like paddy, bamboo, yam, brinjal, ginger etc., being grown for self-consumption as well as for sale on the market. The study concluded no adverse impact would take place on the food security, cultural or spiritual/ religious places, historical sites, entertainment areas, vulnerable groups, and social institutions.

The study observed that likely impacts drawn out by the community have very minimal impact on the community as a whole since most of the social institutions are more or less than 100m away from the proposed project site, as these impacts will be felt only during certain period of project phase. To address to the likely impacts, mitigation measures will be drawn out under SIMP. The recommendation of the study was fully implemented, including all the rehabilitation measures recommended.



Study Title

Geological Report on Detailed Exploration for Limestone in Lumshortoh Block, Litang River Valley

Implementing Institution

Mineral Exploration Corporation Limited

Project Location/Completion Year

Meghalaya, 2016

Objective

- Delineate the depth continuity of limestone in the block by drilling boreholes at 300 m x 200 m grid interval covering an area of about 1.09 sq. km.
- Upgrade earlier estimates at higher confidence level as per UNFC norms.

Study Recommendation

Area requires further exploration on closed grid to bring resources under 331 of UNFC.

Analysis and Outcome

The Litang River Valley is rich in limestone deposits. The current study was aimed at exploring the limestone in Lumshortoh block of Litang Valley. This types of study is useful in delineating the depth of limestone deposits in certain region [140]. The study revealed that the report recommended very important points. The report recommended further exploration work for limestone. The analysis of the report identified that the recommendations were feasible and were implemented well.

Implementable recommendations:

- Further exploration work for limestone

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India

Study Title

Report on Gravity-Magnetic Mapping in Parts of East Khasi Hills and East & West Jaintia Hills Districts, Meghalaya Covering Toposheets Nos. 83C/3 and Part of 83C/2, 83C/4 & 83C/8

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2016

Objective

Generate gravity and magnetic maps and to delineate subsurface geological structures in the area.

Study Recommendation

The high gravity anomaly zone associated with bipolar magnetic signature brought out in the central part around Mawpyut needs to be studied in detail employing geological and geophysical investigations to verify the possible extension of basic/ultrabasic body.

Analysis and Outcome

The Gravity-Magnetic Mapping is done to delineate the subsurface geological structures. The current study was aimed at the same. Such kind of study is very useful in understanding the geology of the subsurface of the region that could be studied easily via remote sensing [139]. The report of the study recommended several points. It recommended to have a detailed study of high gravity anomaly zone by involving geological and geophysical investments. The analysis of the report revealed that the recommendations were feasible and important. All the recommendations were found to be implemented well.

Implementable recommendations:

- Detailed study of high gravity anomaly zone by involving geological and geophysical investments

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India



Study Title

Report on Investigation for Titaniferous -Vanadiferous Magnetite Around Myniar Area, in West Khasi Hills District, Meghalaya (G-4 stage)

Implementing Institution

Geological Survey of India, State Unit-
Meghalaya

Project Location/Completion Year

Meghalaya, 2016

Objective

Delineate the titaniferousvanadiferous magnetite bodies within Precambrian Gneissic Complex

Study Recommendation

The results of the surveys have shown that most of the anomalies are discreet in nature with limited extension which are probably contributed by small lensoidal magnetite bodies/mafic rocks. Only in the western part of Traverse O, where high magnetic anomaly of the order of 50000nT is observed, further investigation may be undertaken after consideration of geological and geophysical results.

Analysis and Outcome

Khasi Hill are great reservoir of various minerals. The main objective of the resent study was to investigate the delineation of titaniferous vanadiferous magnetite bodies. The present study is useful in the delineation of minerals which can help in identification of mineral reserves. The report of the study recommended several important points which were feasible for this study. It recommended to investigate further after examining the results of geological and geophysical. The analysis of the report revealed that the recommendations were essential and implemented well [145].

Implementable recommendations:

- Examining geological and geophysical study

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Geological Report on Detailed Exploration for Limestone in Lumthalary Block, Litang River Valley

Implementing Institution

Mineral Exploration Corporation Limited

Project Location/Completion Year

Meghalaya, 2015

Objective

- Delineate the depth continuity of limestone in the block by drilling boreholes at 300 m x 200 m grid interval covering an area of about 2.10 sq. km.
- Estimate category wise in-situ geological resources and limestone quality to bring the deposit from 332 to 331 as per UNFC norms.
- Technological/beneficiation characteristic of limestone.

Study Recommendation

Area requires further exploration on closed grid in the central part of the block to bring resources of entire block under 331 Category of UNFC.

Analysis and Outcome

Litang river valley is a great reservoir of limestone. The current study was aimed at investigating the depth of limestone reservoir with its quality. This kind of study is useful in identifying and characterizing the mineral resources [140]. There were several recommendations made by this report. All the reports were important and feasible. The analysis of the report revealed that the delineation of limestone depth, estimation and characterization of limestone was carried out. It recommended to further explore the limestone in the projected locations. The recommendations of the study were implemented well.

Implementable recommendations:

- Further Exploration on closed grid

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Search for Fossils Specially Vertebrates in the Shella and Kopili Formations, Jaintia Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2015

Objective

Search and study fossils especially vertebrates in the Shella and Kopili formations, Jaintia Hills District, Meghalaya for additional record of the biota existed during Eocene time and delineating palaeoenvironment.

Study Recommendation

- Microscopic studies of phosphatic nodules and its chemical analysis should be carried out.
- SEM studies of microfossils especially foraminifera and algae needs to be carried out for comprehensive information on detailed morphological characters.
- Radiometric age dating techniques, if possible, should be implemented for precise age determination and in this regard a collaborative programme may be taken up.
- More areas should be searched for vertebrate fossils extensively in the Tertiary sediments.

Analysis and Outcome

The shella formation is present in Southern part of Jaintia groups and Kopili Formation is the youngest formation of Jaintia Group. The objective of the current study was investigation of vertebrate fossils. Such kind of study is useful in developing the additional record of biota present in Eocene time. It also helps in delineating the paleoenvironment. The report of the study recommended essential points against the target. The analysis of the report identified that no evidence of microscopic study on phosphatic nodules was found. Similarly, SEM of microfossils was also needed to be done properly. The work on radiometric dating and searching of other areas for vertebrate fossils was yet to achieve completely. It was concluded that the recommendations were partially implemented because these recommendations were based on further research work [146].

Implementable recommendations:

- Microscopic studies of phosphatic nodules
- SEM studies of microfossils
- Radiometric age dating
- Searching of more areas

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Final Report on Investigation for Titaniferous -Vanadiferous Magnetite Around Rambrai in West Khasi Hills District, Meghalaya (G-4 stage)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2014

Objective

Delineate titaniferous-vanadiferous magnetite bodies within Precambrian Gneissic Complex.

Study Recommendation

- Though these three bodies contains high titanium and vanadium two magnetite bodies (250mX 50m and 100mX50m) occurring in metanorite do not have any depth persistence, hence they are not economically viable to be explored for the present time.
- Among three meta-norite bodies the body occurring NW of Mouliah village measuring 1500m long and 300m width associated with bands of titaniferous-vanadiferous magnetite and partially laterised, shows medium value of titanium, vanadium, iron, copper but it is having depth persistence, hence it may not economically viable for the future.

Analysis and Outcome

Khasi Hill are great reservoir of huge minerals. The main objective of the resent study was to investigate the delineation of titaniferous vanadiferous magnetite bodies. The present study is useful in the delineation of minerals which can help in identification of mineral reserves [149]. The report of the study recommended several important points which could be achieved. The analysis of the report identified that all the recommendations were completely implemented. At present none of recommendations are left to be done.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)
- Department of Land Resources of Ministry of Rural Development



Study Title

Interim Report on Assessment of Limestone in the Extension Area of Mawlong-Ishamati Block of Shella-Bholaganj Belt, East Khasi Hills District, Meghalaya (G3)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2014

Objective

Assess the potentiality of limestone in the extension Area of Mawlong - Ishamati Block, Shell-Bholaganj Belt.

Study Recommendation

Due to tough terrain conditions, top of limestone ridge is unapproachable and borehole can be drilled only at lower contours of ridge. Therefore grid pattern of borehole cannot be adopted.

Analysis and Outcome

The current study was aimed at assessment of limestone of extended area of Mawlong-Ishamati Block. Such studies are useful in estimation of economic value of limestone and mineralization. The study recommended few important points. The current status of the recommendations revealed that the grid pattern of borehole should be avoided. The analysis of the report corroborated that the recommendations were completely implemented ^[147].

Implementable recommendations:

- Avoiding grid pattern borehole

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Final Report on Exploration for Tertiary Coal Around Wagopgiri, (Southeast Of Sukchar-Singrimari), West Garo Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

The primary objective of the present work is to explore the behavior and the extension of the Tertiary coal bands of the area.

Study Recommendation

- Sub-surface exploration by drilling is necessary to have a clear picture about the behaviour and the extension of the coal bands in the north eastern part of the mapped area where the coal bands are not exposed.
- Clay investigation can be carried out in order to know the resource potentiality of the area.
- Thick beds of clay can be used in potteries and ceramic industries to improve the socio-economic condition of the people.

Analysis and Outcome

The present study carried out exploration for tertiary coal by Large Scale Geological Mapping in Wagopgiri area. An area of 3.2 sq. km was covered by Large Scale Geological Mapping on 1:10,000 scale revealed the occurrence of thin bands of coal interbedded with clay.

The area have undergone at least three phases of deformation in which both the BGC and the Tertiary rocks have been affected. The coal bands are confined within the Sylhet/Tura Sandstone. There are at least two coal bands present in the mapped area and thickness of which vary from 0.14m to 0.30m. Because of the thinness of the coal bands resource assessment could not be attempted. Coal is being mined in this area for the last 10 years in the form of rat hole mining. This Coal is generally used in the nearby areas for brick making. The key recommendation of the study is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Investigation for Limestone in Umphryluh Block, Litang Valley, Jaitnia Hills District, Meghalaya (G-3)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

- Sheet wise compilation, digitization, integration with NER mosaic & uploading of all layers to GSI portal.
- Standardization of already uploaded digital data to make them seamless across the region (up to litho unit level).
- Identification of gap/misma

Study Recommendation

- In view of considerable resource potential coupled with high grade of limestone of the area,
- open cast mining operation is recommended using State-of-Art technology so as to improve the socio-economic condition of the area

Analysis and Outcome

The current study was aimed at investigation of limestone in Umphryluh Block and sheet wise compilations, digitization and integration with NER mosaic. This kind of study is useful in detailed investigation of limestone and its standardization. The report of the study recommended opencast mining with the aim of improving the socio-economic condition of the local people. The other important recommendations might be plantation and water treatment. It was identified that the recommendation of the report was accomplished on priority. It was a successful study^[100].

Implementable recommendations:

- Open cast mining operation
- Proposed recommendations might be Afforestation and water treatment.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Preliminary Investigation for REE between Lailad and Umling, Ri-Bhoi District, Meghalaya (G4 Stage)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

To evaluate potentiality of REE and presence of Lamproite within Precambrian Gneissic Complex.

Study Recommendation

- To evaluate potentiality of REE in Nongpoh Granite and residual clays develop in association with weathered granites (Ion-adsorption type REE mineralization).
- Search for pegmatitic /mineralized zones along the contact of granite and Precambrian gneiss which may host REE and
- Search for mafic/lamprophyre/lamproite rock around lineament intersections as the NW-SE, NE-SW and N-S trending prominent lineaments that intersects around 6Km east of Pahamsyiem, and west of Mawdran make the area an ideal place to search for mantle derived or mafic/ultramafic/ultrapotassic rocks that could be lamprophyre / lamproite and kimberlite clan of rocks.

Analysis and Outcome

The present study was aimed at investigating the rare earth elements. It was also aimed at investigation of Lamproite in the Precambrian Gneissic Complex. Such studies are useful in the detailed investigation of mineralization. The report of the study recommended several important points against the study. The analysis of the report analyzed that the recommended evaluations of REE in Nongpoh granite, searching for pegmatitic/mineralized zones, mafic/lamprophyre/lamproite were partially accomplished. There are needed to be completed. The analysis concluded that the recommendations were implemented well [154].

Implementable recommendations:

- Evaluations of REE in Nongpoh granite,
- Searching for pegmatitic/mineralized zones, etc.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Report on Construction Stage Geo-Technical Investigations of New Umtru H.E. Project, RI-Bhoi District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

The objective of the investigated during FS 2012-13 was to provide geotechnical inputs (by means of site specific geological studies at different project components and subsequent recommendations as per site requirements) to the Project Authorities, as and when required.

Study Recommendation

- Five drill holes have been drilled along dam axis on the recommendations of C.W.C.
- Dental treatment has been recommended for shear zone (i.e. shear zone should be excavated/ scooped out to a depth equal to twice the width of the affected zone).

Analysis and Outcome

The objective of the present study was to provide additional geotechnical inputs for standard investigation. This kind of study is useful in providing modern geotechnical tool and proper investigation. The report of the study recommended several points essential to achieve the targets. The analysis of the report revealed that the recommendation given by CWC on drilling and dental treatment were accomplished. The analysis concluded that the recommendations made were implemented well.

Implementable recommendations:

- Drilling along the dam axis
- Dental treatment

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Report on Geotechnical Investigations of Selim Hydroelectric Project, Jowai, Jaintia Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

Project Selim proposes to construct a 30m high concrete gravity dam across Myntdu River to the north of Selim in Jaintia Hills District of Meghalaya having 200m dam width to generate 90 MW electricity by utilizing 427m gross head.

Study Recommendation

- Contour plan of Dam site on 1:1000 scale covering plunge pool area in the d/s of dam axis and up to 200m u/s of intake site (which is to be finalized in next visit) upto El.
- 1220m on both banks of river. The present contour plan is on 1:5000 scale.
- Observed cross sections, one along dam axis and at 50m interval 200m d/s site of dam axis till 50m u/s of intake structure.
- Contour plan around power house area should be extended in the NW and SE directions for finding better alternative sites for power house.

Analysis and Outcome

The Selim H.E. Project is located between East and West Jaintia Hills District of Meghalaya. It is the uppermost hydroelectric project in a series of hydel projects on the Myntdu river. The major objective of the project was carrying out geotechnical investigation of the project site. Such kind of prior study is essential for finding out lacking so that a stable dam could be build. The report suggested several important recommendations. The analysis of the report identified that the recommendations such as contour planning on 1:1000 scale against 1:5000 present scale was accomplished. In addition, the recommendation to extend the contour plan around power house was also completed. The analysis concluded that the recommendations were implemented completely ^[151].

Implementable recommendations:

- Contour planning on 1:1000 scale against 1:5000 present scale
- Extention the contour plan around power house

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)
- Department of Land Resources of Ministry of Rural Development



Study Title

Report on Investigation for Sillimanite Around Mairang-Langtor-Nongdom, West Khasi Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

Delineate the potentiality of sillimanite within the Precambrian Gneissic Complex. The area is located 50 km west of Shillong falling in Survey of India Toposheet No.78O/10.

Study Recommendation

Chemical analysis result of some BRS of garnet-sillimanite schist band of Langtor-Nongdom area shows values of Al_2O_3 ranging from 24.62% to 40.15%. In Sonapahar area Al_2O_3 values range from 37.40% to 45.90%. The Al_2O_3 content of garnet sillimanite schist band is slightly lower than that of Sonapahar area. However, it is encouraging and a pilot scale mineral separation/beneficiation can reveal the quality and quantity of sillimanite.

Analysis and Outcome

The present study carried out large scale mapping (LSM) on 1:12,500 scale and detailed mapping (DM) on 1:2,000 scale. Thirty no. of Bed Rock Samples (BRS) and 22 no. of Pitting Trenching Samples (PTS) were collected and analyzed. Two trench measuring T1=23 x 0.9 x 1.0 m³ and T2=5 x 0.9 x 1.0 m³ were dugged and logged at Nongdom village (T1) and other at Tiehbah village (T2). An additional 05 nos. of samples were collected to know the REE content.

The area comprises of varied lithologies ranging in age from Archaean to Early Proterozoic belong to Riango or Sonapahar Group. The lithologies noted in Mairang-Langtor-Nongdom area are composite gneiss (Porphyritic pink granite gneiss, non-porphyritic pink granite gneiss, biotite gneiss and augen gneiss), garnet-sillimanite schist, Banded magnetite quartzite and numerous quartz veins exhibiting concordant and discordant contact relationship with the country rocks.

The recommendation of the study is partially implemented.

Study Title

Report on Search of Micro-Vertebrate Fossils And Reconstruction of Depositional Environment of Lower Tertiary Sequence of East Khasi Hills, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

The objective of the item included collection of samples for search of micro-vertebrates in sediments of Lower Tertiary age. The field work was carried out in the FSP for 2012-2013 to collect fossils and samples from the Upper Cretaceous-Eocene sediments of Khasi Hills, Meghalaya

Study Recommendation

- As noticed in the field micro-vertebrates are not known only from Langpar Formation (Palaeocene) but are also seen in Upper Mahadek Formation. A thorough search is needed to locate more fossil localities containing micro-vertebrates from Upper Mahadek Formation.
- It is necessary that detailed micropalaeontological study of Sylhet Limestone may be carried out for assigning exact age of different limestone bands.

Analysis and Outcome

The major objective of the current study was to collect the samples of vertebrate for reconstruction of depositional environment. Such kind of study is useful in developing paleo-environmental records. The report of the study suggested essential recommendations to achieve the goal. The analysis of the report revealed that the detailed investigation of fossils was recommended which was found to be accomplished. The detailed micropaleontological study of syllet limestone was also carried out as per the recommendations. The analysis concluded that the recommendations were implemented well [152].

Implementable recommendations:

- Detailed investigation of fossils
- Detailed micropaleontological study of syllet limestone

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Second Report on Geotechnical Investigations of Ganol Stage I Small Hydroelectric Project, Tura, West Garo Hills, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

The project envisages to construct a 35m high Concrete Gravity dam across Ganol river with dam foundation at RL 320.0m and a surface PH with turbine setting elevation at RL 187.50m having net head of 148 m to generate 22.5 (7.5 X 3) MW of power. Intake level is at El: 340 m. It has 2.5m dia D-shaped headrace tunnel of 2.065 km length.

Study Recommendation

- The drill holes should be cased and capped with concrete pillars to avoid collapse and further use if necessity arises.
- Penstock alignment as proposed by project authorities has number of kinks which is likely to exert pressure on bends and energy losses as well. Therefore, penstock realignment recommended may be taken into consideration.
- Further, the drill holes have no uniform "run lengths". It varies from 15 cm to 3.0m. In future it should be standardised as per BIS norms.
- Since, the depth of overburden along penstock slopes is higher, of order of more than 20m, therefore, anchor blocks (pillars) should properly be founded on firm ground, after determining the soil properties etc. It is recommended that each pillar should be erected after analysing slope stability analysis and with broader foundation, narrowing down step by step to desired dimension near surface.

Analysis and Outcome

All the three holes, DH-1 (surge shaft), DH-2 and DH-3 (along penstock alignment) having depths of 61.03m, 51.35m and 35.1m respectively, with cumulative length of 147.48m were logged and traverse from surge shaft to power house along penstock was taken to have an overview of the site and bore hole locations.

It was noted that penstock has three bends in its alignment. The bends in the penstock alignment should be avoided unless there is some constraints like topography etc. The pressurized pipes will exert thrust at the bend part and may cause energy losses. It was therefore, explored at site that with minor adjustment in location of pillars this course can be straightened. It is recommended that P5 needs to be shifted 10m northwards, P4 20m southwards and P3 approximately 50m northerly. By aligning, not only energy losses will be checked but also length of penstock pipes will be reduced and hence cost can be optimized. The recommendations of the study are fully implemented.

Study Title

Specialised Thematic Mapping to Decipher the Tectono-Magmatic and Metamorphic History of the Gneissic Complex and Granites of Shangpung and lawski, Jaintia Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

- Decipher the tectono magmatic and metamorphic history of the gneissic complex and granites of Shangpung and lawski, Jaintia Hills District, Meghalaya.
- To elucidate the tectonic history of the gneissic rock, amphibolite and granite, to determine mutual time relationship and search for mineralization potential if any.

Study Recommendation

- The quartzite found in the study area has been included in the older supracrustals of the AMGC. It is recommended that proper mapping should be done exclusively on quartzites to clearly differentiate the Shillong Group of rocks from other lithounits of older supracrustals.
- Precise palaeontological work should be done to clearly demarcate the Age and Formation of lithounits within which the fossils are found in the study area.
- As coal exposures are found in the some part of the study area within the Tertiary Formations and local people are practising rat hole mining in an unscientific manner, systematic exploration can be done to further delineate the extension of coal beds.

Analysis and Outcome

The current study was aimed at depicting the tectono magmatic and metamorphic history of gneissic complex. It was also aimed to represent the tectonic history of gneissic rock, amphibolite and granite for establishing a mutual relationship with time. Such studies are helpful in investigating the tectonic behavior of the rocks and mineralization. The report of the study recommended important points. The analysis of the report revealed that the recommended proper mapping, precise paleontological work, and systematic exploration were implemented well ^[153].

Implementable recommendations:

- Proper mapping on quartzites to clearly differentiate the Shillong Group of rocks from other lithounits of older supracrustals.
- Precise palaeontological
- Systematic exploration

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Geological Report on Detailed Exploration for Limestone in Western Part of Tongnub South East Sub-Block, Litang River Valley

Implementing Institution

Mineral Exploration Corporation Limited

Project Location/Completion Year

Meghalaya, 2012

Objective

- Delineate the depth continuity of limestone in the block by drilling boreholes at 300 m x 200 m grid interval covering an area of about 2.10 sq. km.
- Estimate category wise in-situ geological resources and limestone quality to bring the deposit from 332 to 331 as per UNFC norms.
- Technological/beneficiation characteristic of limestone.

Study Recommendation

Area requires further exploration on closed grid in the central part of the block to bring resources of entire block under 331 Category of UNFC.

Analysis and Outcome

The total net institutional resources estimated for the both in an area of 1.10 sq. km. are 274.042 million tonnes. The "Indicated Mineral Resource" category of resources contributes 160.466 m. tonnes (58.55%) and "Inferred Mineral Resource" category contributes 113.578 m. tonnes (41.45%) of total resources. The grade-wise resources by cross section method under "Indicated Mineral Resources" for Cement/BF, SMS, Chemical and LD grades computed after deduction of 10% for unknown geological factors are in the order of 37.297 million tonnes, 62.493 million tonnes, 37.351 million tonnes and 23.325 million tonnes respectively in an area of about 0.800 sq. km.

The grade-wise net institutional resources by cross section method under "Inferred Mineral Resources" for Cement/BF SMS, Chemical and LD grade computed after deduction 10% from total reserves for unknown geological factors are in the order of 20.217 million tonnes, 42.240 million tonnes, 27.043 million tonnes and 24.076 million tonnes respectively. The recommendation of the study is fully implemented.

Study Title

Middle Umiam Integrated Watershed Management Project-1

Implementing Institution

Soil & Water Conservation Department, Govt of Meghalaya

Project Location/Completion Year

Meghalaya, 2011

Objective

Establish a benchmark for assessing the impact of any intervention both pre-project and post project. Further obtain information on the project area, the people, resources.

Study Recommendation

The project is expected to:

- Create 67500 of man's days wage employment
- Benefit 1146 ST and women
- Create 73 self-employment of ST and women
- Reduce migration of people
- It also improve the livelihood, water quality and quantitative, increase the agricultural yield, landuse.

Analysis and Outcome

The Middle Umiam (IWMP-I) project is located in Myllem C&RD Block between latitudes of 25o32'0" and 25o 35'30" N and 91o 48'30" and 91o 51'30"E, East Khasi Hills District of Meghalaya. Consisting of a single micro-watershed, the project area is drained by the Umiam River. The total area is 1390 Ha. with 1000 Ha to be treated under the Integrated Watershed Management Programme (IWMP). The Project area is located at a distance of about 8 km from Shillong the State Capital. A total of four villages are covered under the project namely, Umllyngka, Nongumlong, Mawklot and Myrkhan.

Some of the major outcome of the study was marked improvement in water table, ground water structures were repaired and rejuvenated. Quality of drinking water was made potable and safe. Improved availability of drinking water, Increase in irrigation potential Ha by 240 Ha, Area under single agricultural crop Ha 37.8422 Net increase in crop production area were increase in area under vegetation Ha 258 to 658, increase in area under horticulture Ha NIL 100, increase in area under fuel & fodder Ha NIL to 80, increase in milk production Ltrs/day 1865 to 3200, No. of SHGs 11 nos. to 20 nos. SHG Federations formed from NIL to 1, Credit linkage with banks from NIL to 50 nos, Resource use agreements NIL to 20 nos, WDF collection & management from NIL to 5.475. The study recommendation is fully implemented.



Study Title

Specialised Thematic Mapping of Kawkulh-Khawzawl-Chawngtlai-Champhai-North Vanlaiphai Area, Champhai, Serchhip, Lunglei Districts of Mizoram to Elucidate Biostratigraphy and Ichnofossils Analysis in Bhuban Formation and Barail Group

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2019

Objective

- Differentiate between Barail Group and Bhuban Formation of Surma Group in Mizoram through litho-, bio-, petro- and ichno-facies analysis.
- Study the nature of contact between Barail-Bhuban rocks.
- Establish the provenance, tectonic setting and palaeoclimatic condition of the Paleogene-Neogene sediments.

Study Recommendation

- Present work on lithostratigraphy, lithofacies analysis, biostratigraphy, ichnology, granulometric and petrography of the Surma and Barail group of rocks has brought out their subtle differences in terms of litho-facies variations, mineral associations, etc. However, dearth of index fossil and poor preservation of fossils has been a constraint for proper correlation. Therefore, to corroborate the present findings, study on high resolution magnetostratigraphy along with geochronology is warranted.
- Microhabitat ecology of the recorded dominant faunal genera may further be studied in detail.
- Detailed ichnofacies analysis along with hunt for mega/body fossils may be carried out in the adjoining areas. Such work will be indispensable for correlation studies and in turn will be an asset for compiling GSI's inventory on ichno and body fossil occurrences in Northeast India.

Analysis and Outcome

An area of 440 sq km falling in parts of toposheets no. 84E/2, E/3 and E/4, was mapped in parts of Champhai, Serchhip and Lunglei districts of Mizoram to highlight the differences between Barail Group and Bhuban Formation of Surma Group on the basis of litho-, bio-, petro- and ichno-facies analysis.

The contact relationship between the two group of rocks along with its provenance was also analysed.

The study shows that the Barail sediments were deposited predominantly under inner shelf to shoreface milieu with gradual shallowing of the basin with minor tidal influence at the upper horizon. The rapid uplift of Indo-Burman Ranges post Barail sedimentation was followed by a period of non deposition and erosion as evident from regional unconformity (Nandy et. al., 1983). This was followed by development of tectonic trough west of the uplifted Paleogene blocks due to westward migration of deformed buoyant Paleogene blocks of Indo-Burman Ranges, and subsequently initiated deposition of Surma sediments during the onset of Miocene. These sediments were deposited under inner shelf to shallow marine depositional environment with gradual shift towards tidal flat with channel influence. The contact between Barail and Surma Group is faulted in the study area, and thus the unconformity is not preserved/ obliterated. The predominance of sub-lithic to lithic arenite suggests their deposition in an unstable active continental margin. The recommendation of the study is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines

Study Title

Detailed Database on Geology, Structure, Geomorphology, Slope, Land Use Cover and Landslide Causative Factors Between Aizawl Town and Lengpui Airport

Implementing Institution

Mizoram University

Project Location/Completion Year

Mizoram, 2016

Objective

- Landslide Vulnerability mapping of the road section between Aizawl Town and Lengpui Airport. The target area is shown in Fig.1.
- Generating Database of detailed landslide incidences.
- Generating detailed database on Geology, Structure, Slope, Land Uses Cover and Land Use Pattern and landslide causative factors.
- Generation of GIS database using suitable statistical method.

Study Recommendation

- Improve the sewers of the human settlements on the hill top.
- Construct terraces and retaining walls.
- Filling and grouting of highly damaged section.
- Meshing the vulnerable sections.
- Vegetation on the slopes.

Analysis and Outcome

The "Hazard Zonation Map, shows a distinct pattern of severity of landslide hazards along the study section. The road section from the starting point (Hunthar Veng) to Rangvamual and Phunchawng falls under very high – high- moderate hazard zones. The severity in this patch reflects the adverse impact of dense urbanization on the waning slopes, improper sewerage and practically uncontrolled and unmonitored constructions of buildings. On the basis of comprehensive study, it can be summarized that majority of the landslides on the study section, are most affected by human causes in combination of adversity of rainfall, Lithology and slope. Only the landslides of Rangvamual (MZ-7/Plate.III) and Lengpui Road (MZ -09/Plate.IV) are attributed to the natural causes like – slope, relief, Lithology and rainfall.

As Mizoram has highly undulating topography with steep slopes and unconsolidated sedimentary formations in addition to its location in a tectonically active zone, there is a possibility for recurrent occurrence of hazards. The present data of various significant themes and the GIS based methodology are useful for future studies intended for hazard mitigation in this area. The recommendations of the study are partially implemented.



Study Title

Palaeogene Sedimentation in Pars of Kohima Synclinorium: Changes Through Time

Implementing Institution

Nagaland University

Project Location/Completion Year

Nagaland, 2020

Objective

To understand the un-roofing history of the source area using petrographic and geochemical characteristics, which can be correlated to the geodynamics and subsequent sedimentation history of the region.

Study Recommendation

Recommendation has not been outlined in this report

Analysis and Outcome

The study attempted to reconstruct the depositional environment and also to establish the provenance and to support them relevant field photographs, photomicrographs, heavy mineral assemblage, SEM, XRD and XRF data have been used. Based on the observation and analysis the study concluded, during the early phase of Palaeogene sedimentation (Eocene) not much sediment could reach the depositional site owing to its distance from the source. Most of the sediments were supplied either from metamorphic source or a sedimentary source from east and northeast directions respectively. However, during middle/upper Eocene period sediments reached the depositional site through turbidity driven currents and some supply was made from the Indian craton also.

Sedimentation continued uninterrupted with more contributions coming from east (Naga metamorphics/Ophiolites) and north. However, during Oligocene time contributions from Indian craton increased significantly. During entire Palaeogene sedimentation, sediments were continuously being supplied from west, most probably Karbi Anglong massif, however, its contributions increased during the later phase (Upper Eocene/Oligocene). The study was purely an academic study, the objectives of which have been fulfilled.

Study Title

Interim Report on Geochemical Mapping in Parts of Imphal East, Senapati and Ukhrul Districts of Manipur in T.S. No. 83L/1

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2019

Objective

Generate geochemical database of Degree Sheet 83L of Manipur State by using multi elemental analyses as continuation of geological works by the earlier workers.

Study Recommendation

- The high concentration of toxic elements of As with maximum values of 48.17 ppm and Pb with maximum value of 91 ppm against the average crustal value of 4.8 ppm and 17 ppm observed in stream sediment samples may be studied in details for alarming health hazard to the locality.
- The concentrations of Cr & Cu in the soil are remarkably high more than the average micronutrient concentration range in soil and toxicity level. A Detail studies may be taken up regarding its effects on plants and human health.
- The observance of ripple marks in Disang shale, which are believed to be of deep marine origin and presence of Glauconitic sandstones identified from the petrography studies, are important in academic as well as economic point of view. Therefore it is recommended a detail mapping programme may be taken in near future.

Analysis and Outcome

The study carried out a geochemical mapping in T.S. No. 83L/1 F.S. 2018-19 covering parts of Imphal East, Senapati and Ukhrul districts of Manipur. Geologically, the study area exposes with Tertiary sedimentary units of Disang and Barail Groups of rocks, Quaternary alluvium deposits of Imphal valley and with thin exposure of Olistostromal unit in the extreme eastern part. A total of 672 sq. km area have been covered with the collection 168 nos. of stream sediment samples, 09 nos. each of 'R' and 'C' horizon of soil, 09 nos. of water samples, 09 nos. of duplicate stream sediment samples, 12 nos. of rock samples for petrographic studies. Over all the elemental distribution pattern of major oxides / elements in stream sediment of the area is mainly controlled either by the underlying / surrounding lithology or physiography of the area. The recommendation of the study is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Final Report on Reconnaissance Survey for Coal Around Alongtaki of Mokokchung District, Nagaland (G4)

Implementing Institution

Geological Survey of India, State Unit:
Manipur – Nagaland

Project Location/Completion Year

Nagaland, 2018

Objective

Investigation is to delineate and assess the coal potentiality around Alongtaki.

Study Recommendation

Northern and southern part of the present studies areas may be investigated by geological and geophysical survey so as to establish the presence and nature of coal seam.

Analysis and Outcome

The study carried out a preliminary investigation for coal in and around Alongtaki village, Mokokchung district, Nagaland. Large scale mapping covering an area of 50 sq. km. was mapped on 1:10,000 scale. A total of 05 nos. of coal samples were collected for petrographic studies to constrain the micro-structures of the coal. Petrographic study of coal shows that the coals are vitrain and clarain dominant.

The reconnaissance survey, coal seams which are observed to the northeast of Longtho village and at Alosi tsu seem to be the most promising in the study area. The surficial exposure of coal seam in the study area are discontinuous and shows pinching and swelling nature with coal seams thickness of upto 5m. Qualitatively, the coal which are observed in the study area have moderate to high moisture and ash content ranging from 1.33 to 6.82" % and 2.22 to 39.64" % with Gross Calorific Value (GCV) ranges from 3875 to 7005 (kcal/kg) and coal is of noncoking grade with grade ranging from 'A' to 'E'. Petrographic study of coal shows that total vitrinite ranges from 53.27 to 79.76" %, total liptinite ranges from 6.99 to 11.43" %, total inertinite ranges from 0.42 to 3.49" % and total shale with mineral matter ranges from 11.31 to 38.94" %. Rank wise the coal can be categorized as sub-bituminous type. The study recommendation is yet to be implemented.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Coal

Study Title

Regional Geochemical Mapping in the Ophiolite Belt in Parts of Mon, Tuensang and Kiphire Districts of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2018

Objective

Create geochemical database of the region with special emphasis on Ophiolite belt using multi-elemental analysis.

Study Recommendation

Detailed studies to be carried out for understanding the toxic presence of F and Hg elements in grid nos. 83N4/002/S/13 and 83O/1/070/S/14.

Analysis and Outcome

The geochemical mapping is done to for the exploration of minerals in small area. The current study was aimed at preparing the same in different parts of Nagaland such as Mon, Tuensang and Kiphire. The report of the study recommended essential points required to achieve the objectives. The report identified that the recommended detailed studies for investigating the presence of Fe and Hg was yet to achieved. Therefore, the analysis concluded that the recommendation were partially implemented [160].

Implementable recommendations:

- Detailed studies for investigating the presence of Fe and Hg

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Report on Preliminary Exploration for Chromium, Nickel, Copper and Associated Base Metal in Naga Hills Ophiolite, Phek District, Nagaland (G3)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2018

Objective

Locate mineralized zones of chromium, nickel, copper and associated base metals in ultramafic and mafic rocks of Naga Hills Ophiolite.

Study Recommendation

- The magnetic survey has delineated four magnetic anomaly zone of almost N-S orientation, with anomaly ranging from -1809 to 2174 nT at the probable depth of 16.3- 27.4m.
- The anomaly comprises irregular highs, lows and asymmetrical bipolar nature with no strike continuity, suggesting dissemination and pods-like mineralization. These anomalies are observed over the ultramafic cumulate.

Analysis and Outcome

The present study was aimed at locating different mineral zones in Naga Hills. Such study is useful in identifying the deposition of economic minerals. The report of the study suggested several recommendations for the same. The analysis of the report identified that four magnetic anomaly zone were present in almost N-S orientation which comprised of irregular highs and lows. These anomalies were asymmetrically bipolar. The analysis identified that the report recommended dissemination and pods like mineralization. There current condition of the above recommendations is that it is not yet completed. Therefore, the analysis of the report concluded that the recommendation was partially implemented [149].

Implementable recommendations:

- Dissemination
- Pods like mineralization

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Reconnoitering Survey for Chromium and Associated Base Metal in Naga Hill Ophiolite, Tuensang District, Nagaland(G-4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2017

Objective

Delineate the mineralisation zones comprising chromium and associated base metal in ultramafic and mafic rocks of NHO.

Study Recommendation

Geophysical survey (Magnetic, SP/IP) along with detailed mapping and close grid sampling should be conducted along the strike of the limonitised zone which is trending along NNE-SSW direction from Wui village towards Khenjong village. This will help to identify the target areas for chromite and associated base metals mineralisation, which can be taken up for detailed investigations in future.

Analysis and Outcome

The current study was aimed at delineating the mineralization zone of chromium and other base metal. This kind of study is useful in investigating the availability of minerals. The report of the study revealed high magnetic anomalies along limonitized zone. Hence, the report recommended detailed mapping and close grid sampling in the same. Such recommendation is useful in identification of chromite reserves. The analysis of the report concluded that the recommendations of the report were implemented well [164].

Implementable recommendations:

- Development of infrastructure in low susceptibility slope zone
- The shifting of settlement from high susceptible zone to low susceptible zone
- Detailed geotechnical study

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Detailed Corridor Mapping Along Dimapur-Kohima, Merapani-Wokha and Mariani-Changtongya Across Frontal Fold Thrust Belt of Naga-Arakan Yoma Suture of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2016

Objective

Ascertain the detailed lithostratigraphy and tectonic relations between different lithological units across Schuppen Belt of Naga-Arakan Yoma Suture with an attempt (a) to unfold the structural deformation and (b) to decipher the provenance of the Tertiary sediments.

Study Recommendation

- Traverse mapping (Corridor mapping) across Inner Fold Belt is recommended to be carried out to correlate with the findings of other geological domains viz Schuppen Belt and Ophiolite Belt and get a consolidated picture of their stratigraphy and understand the structural deformation.
- Detail study for coal investigation is recommended in Jenam and Renji formations of Barail Group of rocks as number of coal lenses/beds (10cm-60cm thick) had been observed in these formations during the traverse mapping.

Analysis and Outcome

The current study was aimed at investigating the lithostratigraphy and tectonic relationship between different lithological unit of Schuppen belt. It was also intended to reveal the structural deformation of tertiary sediments. This kind of study is useful in establishing the base for future tectonic and lithological investigation. The report of the study recommended a transverse mapping so that a correlation could be established between the finding of others geological domain, Schuppen Belt, and Ophiolite Belt. The investigation of coal in the Jenam and Renji formation was also recommended. The analysis of the report concluded that the recommendations were implemented well. Currently, these recommended points have been achieved completely.

Implementable recommendations:

- Transverse mapping across the inner fold
- Investigation of coal in the Jenam and Renji formation

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Specialised Thematic Mapping in and Around Noklarpungro in the Naga Hills Ophiolite Belt of Nagaland to Elucidate Tectonics – Metamorphic Evolution of Ultramafic – Mafic Rocks

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2016

Objective

- Delineate detailed structural characteristics of the belt
- Characterize the high-pressure metamorphism of accretionary zone of NHO,
- Characterization of high-grade rocks
- Establish the metamorphic history of supra-subduction.

Study Recommendation

- More detailed sampling and petrographic studies can be carried out to characterize the scaling properties of thrust traces of the belt, to delineate the mélangé forming processes of the belt and to understand the mechanism of exhumation of deep seated rocks.
- U-Pb dating of zircon in plagiogranite and verdelite in gabbro can be carried out to attain the formational age of ophiolitic rocks.
- Isotope geochemistry of ultramafic rocks can be carried out to understand their evolution and related processes.

Analysis and Outcome

The objective of the current study was delineation of structural characteristics of Ophiolite Belt of Naga Hills, characterizing rocks of high grade and establishing metamorphic history. Such kind of study is useful in understanding the lithostratigraphy of the Belt [165]. The report of the study corroborated that recommended petrographic studies and delineating the formation of mélangé process were considered seriously and have been completed. The U-Pb dating of zircon was also initiated but not achieved completely [88]. The isotope geochemistry of ultramafic rock is also yet to be achieved. The analysis of the report concluded that the recommendations of the report were partially implemented.

Implementable recommendations:

- Transverse mapping across the inner fold
- Investigation of coal in the Jenam and Renji formation

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Geological Report on Exploration for MIMI-Pyakatsu Limestone Block MIMI Limestone Belt, Kiphire District, Nagaland

Implementing Institution

Mineral Exploration Corporation Limited

Project Location/Completion Year

Nagaland, 2014

Objective

- Delineate the promising limestone bands with the help of detailed geological mapping and surveying.
- Drill boreholes at 400-600m strike interval and up to 100m vertical depth.
- Estimate category-wise in-situ geological resources and limestone quality.

Study Recommendation

- Most of the captive mines of all the cement plants of Eastern India have either complex or intricate limestone deposits. Hence Mimi-Pyakatsu limestone block shall give a thrust for cement industry.
- The investigations carried out so far in these block is on wider grid and the resources have been placed under 332 and 333 category of UNFC.
- It is necessary to explore the block sufficiently with optimum pitting and drilling in order to assess the limestone potential.

Analysis and Outcome

The exploration for Cement grade limestone was taken up in Mimi- Pyakatsu block and DGM, Nagaland has completed the field operations between 2011 and 2014 which had included exploratory drilling [April-2011 to June-2013], geological mapping and sampling completed in February-2014. A total of 5 boreholes involving 531.50m on a wider grid pattern were accomplished. The chemical analysis was done at MECL Laboratory, Nagpur. The exploration block consists predominantly of limestone, with occasional band of quartzite's of Tertiary Formations. The general strike of the limestone is NE-SW with moderate steep dip of 60°-80° towards northwest. All the boreholes have intersected limestone; the limestone continue and persists even beyond the closed depth of the boreholes. The core recovery is satisfactory. The critical appraisal of the available data suggests that the limestone is of chemical grade and suitable for cement manufacture. The deleterious constituents are below the specified limits. The chemical analytical data considered for reserve estimation can be taken as reliable. In view of the occurrences of limestone horizon as moderate to steep dip with lesser structural disturbances near Pyakatsu peak, the limestone deposit may be classified as "simple" type. The recommendation of the study was fully implemented.

Study Title

Interim Report on Geochemical Mapping in the Ophiolite Belt in Parts of Phek District, Nagaland in Toposheet No. 83K/10 (in Part) & 14

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2014

Objective

Study and assess the degree of elemental dispersion from the stream sediments in the Indo-Myanmar mountainous region and correlate the pattern with local geology and tectonics.

Study Recommendation

- Stream sediment (S): that reflects the average geo-genic composition of a catchment basin.
- Regolith (R): upper horizon/ top soil (0-25cm) without the top organic layer (<2mm). It reflects variations in geo-genic compositions of the uppermost layers of the earth's crust.
- Soil (C): a 25 cm layer within a depth range of 55 cm to 200 cm: Comparison of a soil and regolith would give information about environmental changes affecting anthropogenic contamination of the top layer (R).
- Stream water (filtered and unfiltered) (W): reflecting interplay in the geosphere. At the same time it is the main source of drinking water.
- Duplicate Sample (D) – The stream sediment samples were collected random from the same spot and processed, for checking the variation due to anthropogenic error

Analysis and Outcome

The main objective of the current report was studying and assessing the level of dispersion of sediments from the stream into the Indo-Myanmar mountainous region and correlating its pattern with the geology and tectonics of the local region. Such kind of study is useful in establishing the geological connection [168]. The interim report of this study revealed several important suggestions. It suggested that the sediment of the stream reflected the average geogenic composition same as the composition of catchment areas. The regolith also revealed the variation in geogenic composition with the uppermost layer crust. The report recommended to compare the 25 cm soil layer with regolith and investigating the stream water.

Implementable recommendations:

- Analysis and comparison of 25 cm layer of soil with regolith
- Water quality assessment
- Analysis of water quality of stream

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Interim Report on Regional Geochemical Mapping in the Ophiolite Belt in Parts of Mon, Tuensang & Kiphire Districts of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2014

Objective

Create geochemical database of the region with special emphasis on Ophiolite belt using multi-elemental analysis.

Study Recommendation

- Stream sediment (S): that reflects the average geo-genic composition of a catchment basin.
- Regolith (R): upper horizon/ top soil (0-25cm) without the top organic layer (<2mm). It reflects variations in geo-genic compositions of the uppermost layers of the earth's crust.
- Soil (C): a 25 cm layer within a depth range of 55 cm to 200 cm: Comparison of a soil and regolith would give information about environmental changes affecting anthropogenic contamination of the top layer (R).
- Stream water (filtered and unfiltered) (W): reflecting interplay in the geo-sphere. At the same time it is the main source of drinking water.
- Duplicate Sample (D) – The stream sediment samples were collected random from the same spot and processed, for checking the variation due to anthropogenic error.

Analysis and Outcome

The current report was aimed at creating geochemical database specially emphasized on Ophiolite Belt. This kind of study is useful in creating a geochemical database of the region. The interim report of the study revealed several essential recommendations [168]. It recommended to analyse a 25 cm layer of soil and its comparison with regolith for investigating the environmental changes. It also suggested to check the quality of stream water. The analysis concluded that the recommendations made by interim report were implemented well.

Implementable recommendations:

- Analysis and comparison of 25 cm layer of soil with regolith
- Water quality assessment
- Analysis of water quality for investigating the variation due to anthropogenic error

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)

Study Title

Final Report on Systematic Geological Mapping in Parts of Zunheboto, Mon, Kiphire, Tuensang and Phek Districts, Nagaland on 1:50,000 Scale

Implementing Institution

Geological Survey of India, State Unit:
Manipur-Nagaland

Project Location/Completion Year

Nagaland, 2013

Objective

Prepare geological map (1:50,000 scale) of these unmapped areas during the field seasons 2010-12 and 2012-13

Study Recommendation

- Very generalized map based on earlier work. KT boundary as shown should be checked thoroughly as it is reported below the Disang Formation. The gradational contact along K-T boundary may be thoroughly checked.
- The RSAS data may be consulted. Keeping in view the difficult terrain conditions and limitation there, it is suggested to make use of IRS ID LISS-III data for wider coverage. Traverse planning has to be done carefully.
- The fossils collected may be sent for identification.

Analysis and Outcome

The current project was aimed at preparing the geological map of unmapped areas on 1:50,000 scale. This kind of study of preparing the geological map is useful in corroborating the resources present on the earth. The report of the study revealed that the recommended investigation of KT boundary was considered on priority basis. It was also recommended to consult the RSAS data, and using IRS, ID, LISS-III data. In addition, the collected fossils were also recommended to identify. It was found that the recommendations were essential and have been implemented well [169].

Implementable recommendations:

- Investigation of KT boundary
- Consulting the RSAS data, and using IRS, ID, LISS-III data.
- Identification of collected fossils

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)



Study Title

Magnetostratigraphy and Palaeomagnetism of the Tertiary Rocks of Corridor 7 (Sector B), Nagaland

Implementing Institution

Nagaland University

Project Location/Completion Year

Nagaland, 2010

Objective

- Determination of the age of the sediments
- Construction of the stratigraphic sequence of the rocks
- Determination of the paleomagnetic properties of the basalt, Upper Disang, and Laisong sediments
- Construction of the magnetic polarity stratigraphy of the Upper Disang and Laisong formations and determination of sediment accumulation rates
- Determination of the petrogenesis and tectonic setup of the basalt
- Determination of the depositional environment, provenance, tectonic setting, weathering history, and paleoclimate of the Upper Disang sediments

Study Recommendation

Recommendation has not been outlined in this report

Analysis and Outcome

The area of investigation includes Dimapur, Kohima, and Phek Districts of Nagaland. Extensive geological fieldwork has been conducted in a major part of these districts. Three hundred and thirty seven (337) oriented samples have been collected from the area. Sixty three (63) thin sections have been prepared. Thirty five (35) samples were sent for geochemical analyses. Major structures are being mapped. Extensive data dealing with petrography and geochemistry of the sediments of the Inner Fold Belt and basalts of the Ophiolite Complex have been compiled. Instruments have been installed at Kohima.

Seven sets of core samples have been examined for magnetic susceptibility using an MS2 Meter / MS2B Sensor at Kohima. The samples have been analyzed for NRM after every step of demagnetization using a Dual Speed Magnetometer (JR6). An Alternating Field Demagnetizer (LD3A of Agico) and a Thermal Demagnetizer (MMTD of Molspin) are used to demagnetize the samples. Two vertical profile sections (VPS) have been constructed. One section of 234 m thickness lies within the Upper Disang Group of Lower Eocene age in the Inner Fold Belt at Leshimi in Phek District. The other section, 760 m in thickness, is confined to the Surma Group of rocks of Lower Miocene age that lies within the Belt of Schuppen in Dimapur District. This was purely an academic study, the objectives of which have been fulfilled

Study Title

Conservation, Long-Term Ecological Monitoring, GIS, DBMS, Natural Resources Accounting Methods and Chemical Profiling

Implementing Institution

ICAR-National Research Centre for Orchids,
Pakyong, Sikkim

Project Location/Completion Year

Sikkim, 2020

Objective

- Conservation, sustainable use of orchids resources of Sikkim Himalayan region.
- Long-term Ecological/ Environmental monitoring of orchids & assessment of threats to biodiversity and Extent of IKP documentation & strengthened.
- Carry out survey and GIS mapping of orchids population of Sikkim Himalaya.
- Develop Orchid biodiversity database of Darjeeling and Sikkim Himalayas.
- Assessment of natural population of Orchids in Sikkim Himalayan region by accounting methods and field testing.

Study Recommendation

- Creation of Database of orchid diversity of Sikkim.
- Population studies of *Cymbidium whiteae* King & Pantl. in North Sikkim, localized population distribution.
- Site specific studies of *Lecanorchis sikkimensis* N.Pearce & P.J.Cribb in Sikkim.
- Documentation of artcraft based on *Cymbidium* leaves an ITK (Indigenous Technical Knowledge) based approach for the indigenous people of Sikkim.

Analysis and Outcome

The study was divided into two main parts namely Conservation, sustainable use of orchid's resources of Sikkim Himalayan Region and Long-term Ecological/Environmental monitoring of orchids & assessment of threats to biodiversity and Extent of IKP documentation & strengthened. Some of the outcome of the study were viz., Establishment of an information baseline for in situ conservation for orchids. Completed priority setting for target species. ITK (Indigenous Technical Knowledge) and species survey of Kartok area, Parkha, Rai gaon, Tokchi, Dungalakra in East Sikkim, and Dzongu region in North Sikkim. A focus study was also carried out on the population, distribution, mapping and conservation status of *Cymbidium whiteae* classified as RET (Rare Endangered Threatened) species. The study also initiated the standardization of mass multiplication protocol, In-vitro seed inoculation of 08 species in different media and *Paphiopedilum venustum*, *Denis ophrydi*, *Cymbidium aloifolium* and *Calanthe sylvatica* were cultured successfully. The objective and the recommendations of the study were successfully implemented.



Study Title

Social Impact Assessment Study of Teesta IV Project

Implementing Institution

Administrative Staff College of India

Project Location/Completion Year

Sikkim, 2018

Objective

- Identifying the project affected communities and collecting their baseline data.
- Providing space for participatory processes and facilitating community discussions about the acceptability of the likely impacts and the proposed benefits.
- Comprehensively studying of the likely significant negative/positive impacts
- Developing a Social Impact Mitigation Plan (SIMP) that incorporates the benefits, mitigation measures, monitoring arrangements and institutional arrangements.

Study Recommendation

- Commitment by the State Government to institutionalize the LADF and constitute the LADC for its effective implementation in the ten affected panchayats.
- Commitment by the District Administration to constitute various committees with the participation of affected communities as recommended by the Study (with suitable modifications as deemed appropriate).
- Commitment by NHPC to strengthen the project ESMC and implement other institutional arrangements proposed by the Study.
- Commitment by NHPC to finance and support implementation of the recommended mitigation measures in the SIMP in letter and spirit.

Analysis and Outcome

The Study recognizes that indigenous communities directly affected by project development, require special consideration, over and above those provided to other affected families within the social assessment framework. This is applicable for the Lepchas of Dzongu who consider themselves most vulnerable sections of the community and have been resisting the project (except the affected landowners of Dzongu area) during the SIA Study process. The projects, located within or near indigenous communities, will need to proactively consult the communities impacted by the project. The prevailing conflict-ridden environment, high level of mistrust owing to poor legacy of project implementation etc. may be possible reasons for skepticism of the community. This may also have been propelled by the misunderstanding that the benefits of the project will only flow to the affected landowners (who are supporting the project). While landowners are the primary stakeholders, the objective of the SIA/SIMP was to ensure the well being of the entire community and holistic development of the ten affected GPUs. The recommendations for a benefit sharing mechanism, through committed expenditure under CSR, LADF and SIMP, have been solely made with this objective. The project for construction of Teesta Stage IV Hydro Electric Project is still awaiting clearance [171].

Study Title

Biostratigraphy, Palaeobiogeography and Sedimentology of the Tethyan Sequence of North Sikkim Himalaya, Sikkim and its Geological Evolution (on Expedition Basis)

Implementing Institution

Geological Survey of India, State Unit: Sikkim

Project Location/Completion Year

Sikkim, 2016

Objective

- The objectives of the study are to develop the palaeobiogeographic evolution of the Tethyan Sequence of Sikkim Himalaya.
- To collect and study the associated fossils and & geochronological study of Tethyan Sequence.

Study Recommendation

- A similar Tethyan sedimentary sequence is exposed in the northwest region of Sikkim Himalaya which can be studied in detail and can be correlated with the current study as well as with rest of the Himalayas.
- The Rb-Sr and Sm-Nd methods were applied to fine-grained sedimentary rock samples in order to have provenance information's. The Sm-Nd, although being
- considered as a new technique when applied to sedimentary rocks is an important parameter to the determination of potentials source rocks.

Analysis and Outcome

The analysis and interpretation of chemical data of CCGC rocks, shows that all the granites and gneisses are silica oversaturated with normative corundum and peraluminous in nature. All these rocks were found formed from melt of crustal origin and emplaced under syn-collisional, orogenic and within plate settings. Everest Pelite Formation is very exposed north east of Choma-Yummo and consists of a sedimentary and meta-sedimentary sequence this formation has been reported for the first time from this area.

The South Tibetan detachment system (STDS) is a well exposed ductile- brittle shear zone (STDS) and related mylonites have marked the contact between Tethyan Sedimentary sequence (TSS) on the hanging wall and Central Crystalline Gneissic Complex (CCGC) on the footwall. Biostratigraphy of Tethyan Sedimentary Sequence of the study area is build on the present study which records following taxa for the first time from the Lachi and Chho- Lahmho Formation - Phestia Sp., Bellerophon Sp; Kashmirites Sp. The age of the analysed zircons from one sample indicate two major populations at 28Ma and at 450Ma. This age of 28 Ma indicate that the STDS in this part of the Himalaya cannot be older than ages measured on the Miocene leucogranite bodies. The recommendation of the study is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Final Report on Investigation of Basemetal in Dikling-Pirikmartam Area, East District, Sikkim (G4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2016

Objective

To assess the basemetal and gold potential of the area lying to the West of Duglakhola.

Study Recommendation

- As the extent of the Mineralisation is mainly associated with quartz veins and that too of very small and discontinuous nature, also as the results of the chemical analytical results do not give any significant values, it is recommended that no further detailed investigation is required.
- The mineralisation in both types of occurrences is impersistent and has little economic viability

Analysis and Outcome

The present study mapped an area of 60 sq km around Martam, Rumtek, Chubba, Raigaon and Lingdum, East Sikkim, located in the SOI toposheet nos. 78A/11 & 12, was mapped on 1:12,500 scale with special emphasis on the basemetal potentiality of the area. Prominent mineralisation in the form of dissemination of pyrite, chalcopyrite etc was observed at two places namely Lingdum near to Rey Khola and Raigaon.

Mineralisation appears to be localized and sporadic and seen associated with the quartz veins within the host rocks. At Lingdum, the mineralisation occurs along the foliation plane in the chlorite-sericite mica schist traversed by quartz veins. The exposure is approximately 5 m in length. They occur as massive, light yellow in colour. At Raigaon, mineralisation was observed within the quartz veins present in the phyllite of the Daling Group. These quartz veins traverse mainly along the foliation plane though one or two veins cut across it. They are irregular and lensoidal in shape. These occurrences cover about 10 m in length. The analytical results from the chemical samples do not give any significant values for base metals as well as for Au and Ag. The recommendation of the study is fully implemented.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines, Government of India

Study Title

Final Report on the Specialised Thematic Mapping in the Area Between Dentam and Yuksom in Parts of West and South Districts, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2016

Objective

- Geological Mapping of the study area with special emphasis on Lingtse Granite Gneiss.
- Study of contact relationship between Chungthang Formation and Lingtse Granite Gneiss and status of MCT in the area.
- To resolve the basement status of Chungthang Formation.
- Geochronological study of Chungthang Formation and Lingtse Granite Gneiss.

Study Recommendation

- The complexity of the geology of the study area needs to be relooked over considering the variation in the positioning of the MCT or the MCT Zone by various workers.
- Two schools of thoughts of MCT one as a single tectonic and metamorphic boundary, the other as the structurally higher MCT1 and lower MCT2 needs to be considered.
- The concept of MCT1 and MCT2 having a large spatial width will mask the concept of large scale mapping in this part of the study area.

Analysis and Outcome

The study was carried out in two consecutive years in parts of SOI T.S. nos. 78A/3, 4, 7 & 8 over an area of 440 sq. km on 1:25000 scale that include 180 sq. km in 78A/3, 20 sq. km each in 78A/4 & 8 and 220 sq km in 78A/7 in parts of Hathidunga-Dentam-Ravangala-Dhupidanda-Narkhola-Yuksom-Phamtam areas in West and South districts of Sikkim (Plate I & II). The tectono-stratigraphy of the mapped area comprises Chungthang Formation and Darjeeling Gneiss of Central Crystalline Gneissic Complex (CCGC), Lingtse Granite Gneiss (LGG), Daling Group represented by Gorubathan Formation and intrusives. Amphibolites are the main basic intrusive body seen within the study area and they show concordant relationship with the major foliation/gneissosity of the metasedimentaries.

Petrographic studies of the CCGC units show high grade metamorphic mineral assemblages. Gneissic texture and the strong schistose texture are representative of the alternating mica domains and quartzofeldspathic domains in such rocks. Quartz grains show deformation bands, undulose extinction and lobate-serrate grain boundaries. All lithologies in the area show complex deformation. Regional trend of dominant foliation and mylonitic foliation of the area is NE-SW with moderate to steep dips towards NW. The major lineation of the area is moderately plunging towards the NNW to N direction.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines



Study Title

Final Report on Investigation of the Dolomite and Limestone Around Namchi, Nayabazar and Bijanbari Areas of South Sikkim and West Sikkim District, Sikkim (G4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2015

Objective

Identify target zone for limestone and dolomite in the proposed area. An area of 50 sq km was mapped in 1:12,500 scale

Study Recommendation

The dolomites present in the area can also be used for neutralizing the acidity of the soil. The locals use the rock for construction as building blocks and as roads metal in road construction. Since the majority of the samples do not give encouraging results, further investigation in the area may not be continued.

Analysis and Outcome

In pursuance of the Field Season programme 2014-15, an area of 50 sq km falling in the SOI toposheet nos. 78A/7&8 was mapped on 1:12,500 scale around Reshi BazarTatapani-Mangalbaria-Subuk-Kewzing, West and South Sikkim, with special emphasis on the limestone and dolomite occurrences. The dolomites present in the study area is composed of low to medium CaO and MgO content with an average SiO₂ value of 15.17%, moreover they give high loss on ignition value (LOI). No limestone was observed during the course of the field work in the study area.

Dolomites are hard & compact, steel grey in colour and gives low acid reaction. They are often characterised by elephant skin weathering and at Tatapani Gompa, crocodile skin weathering was also observed. They show differential weathering at some places due to presence of siliceous bands as impurities. Stromatolites of the genus Collenia showing small domal structures were observed at Tatapani Gompa area. Both massive and flaggy dolomites are present in the study area. Results of the whole rock analysis shows a maximum value of 30.44% and minimum of 14.73% for CaO with an average of 25.14% and MgO with a maximum of 20.54% and 11.75% as minimum with an average of 16.43%. Most of the samples show high SiO₂ values with an average of 15.17%. All the dolomite show high Loss on Ignition (LOI) values with an average of 38.11%.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Final Report on Preliminary Study for the Base Metals and Associated Gold in Extension Areas of Dikchu Basemetal Prospect, East District, Sikkim (G4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2014

Objective

To explore the possibility of extension of the deposit in addition to the already explored resource

Study Recommendation

The garnetiferous mica schist is the host rock of Cu-mineralisation in Lingdok-Phodong areas. The terrain is covered by landslides, and thick soil cover and the mineralization is observed only at few places and due to the poor concentration of various minerals, as is proven by various analysis. It is recommended that no further investigation for tracing the extension of Dikchu deposit should be taken up.

Analysis and Outcome

The investigation was taken up to establish the continuity of the Dikchu lode, East Sikkim. Large scale mapping of 125 sq. km on 1:12,500 scale was carried out and geochemical samples (bed rock, PTS, stream sediment samples) were collected from different mineralized outcrops. 52 cu. meters of pitting and trenching samples were also collected from various promising areas within the area mapped. The rocks of the area represents various grades of metamorphism from very low grade green schist facies to as high as amphibolite facies gradually increasing in grade from west to east. The garnetiferous quartz biotite schist is host for the Cu-mineralisation horizon in the study area. The pyrite and chalcopyrite occurs as veins, stringers and disseminations of and in oxidized portions, malachite and limonite.

Though the evidence of base metal mineralization is scattered over the present area, no significant strike continuity could be detected. The mineralization was found as impersistent lenses, veins and stringers, distributed over the areas apparently widely separated from each other.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines



Study Title

Study of Lingtse Gneiss in Sikkim Himalaya for Elucidating the Role of Proterozoic Granitoids in Himalayan Orogeny

Implementing Institution

Geological Survey of India, State Unit: Sikkim

Project Location/Completion Year

Sikkim, 2014

Objective

- Identification of shadow zones in the Lingtse gneiss mylonites and study of geochemical variations in the weakly mylonitised and strongly mylonitised Lingtse Gneiss to decipher the changes in geochemical characters during mylonitisation.
- To resolve the Basement status of Lingtse Gneiss.
- Correlation of Proterozoic Granitoids in Himalaya.

Study Recommendation

- Based on the current findings it was proposed to take an item of systematic geological mapping for the study and Stratigraphic correlation of the western patch of Lingtse granite gneiss (LGG) of west Sikkim to understand the tectono-stratigraphy of the region and subsequently the geological history and tectonothermal evolution.
- The first ever reported insitu occurrence of Orbicular Tourmaline Granite (OTG) in Himalayas may be studied in detail and correlated with other occurrences of the world in the same tectonic-setting e.g. Alps.

Analysis and Outcome

Specialized Thematic Mapping had been carried out and an area of 450 sq km (225 sq km each year) was covered. The main litho units encountered during mapping are Lingtse Granite Gneiss (LGG), Phyllite and Garnet-Staurolite-Mica-Schist of Daling Group and Biotite Gneiss of Central Crystalline Gneissic Complex (CCGC). LGG is a sheet like body of coarse to medium grained, foliated to strongly lineated granite mylonite. The main constituent minerals are quartz, K-feldspar, biotite, muscovite and opaques. The most characteristic feature of LGG is the presence of stretching lineation. This is defined by stretched quartz and feldspar grains. Biotite flakes are also aligned parallel to the stretching direction. Petrographic study reveals that the rock mainly consists of quartz, k-feldspar, biotite and muscovite. Evidences of deformation have been noticed and are manifested by the development of mylonitic fabric. Due to high degree of deformation granitic texture of the rock is completely destroyed.

The tectono-magmatic character of the Lingtse Granite Gneiss is specified dominantly as syn-collision granitoids phase. During Himalayan Orogeny it may come as thrust wedge and now rests over Daling Group of rocks. Presently, the Lingtse Granite Gneiss represents the lower part of a thrust sheet and it is not a part of the Daling Group. The Daling Group rests below the thrust sheet and the Lingtse Granite Gneiss ; which occurs as long elliptical out crops on Daling Group and are interpreted (known from field evidences) as NE to E dipping thrust surface, implying that these bodies occur as thrust bound wedges or tectonic 'horses' of the gneissic basement (easterncontact). The study recommendation was partially implemented.

Agencies responsible for implementation

- Geological Survey of India

Study Title

Agartala City Urban Development Project – Maharaja Bir Bikram College Lake Revitalization in Agartala City Part A- Initial Environmental Examination

Implementing Institution

Project Management Unit, Agartala Smart City Limited, Government of Tripura

Project Location/Completion Year

Tripura, 2020

Objective

The prime objective of the project is to strengthen ecotourism in city with a redesigned waterfront at Maharaja Bir Bikram (MBB) College. The lake zone is ideally situated to be developed as an important tourist zone, with emphasis on ecotourism.

Study Recommendation

- Occupational noise exposure. The standard is a combination of noise exposure levels and duration that no worker exposure shall equal or exceed.
- The Rules specify activities which are harmful and prohibited in the wetlands such as industrialization, construction, dumping of untreated waste and effluents, and clamation. The Central Government may permit any of the prohibited activities on the recommendation of Central Wetlands Regulatory Authority.
- A total of 70 twin litter bins (80 liters) are recommended to be placed along road side.

Analysis and Outcome

The citizens of the Agartala will be the major beneficiaries. The subproject is primarily designed to improve environmental quality and living conditions of Agartala town by developing MBB College Lake as a major recreational center. The proposed subproject is unlikely to cause significant adverse impacts on either the environment or the human health and safety. The potential impacts that are associated with design, construction and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures. Based on the findings of the IEE, there are no significant impacts and the classification of the subproject as Category "B" is confirmed. No further special study or detailed environmental impact assessment (EIA) needs to be undertaken to comply with ADB SPS (2009) or GOI EIA Notification (2006).

The recommendation of the study are feasible, State Government is taking measures to implement the recommendation. Coordination among the stakeholders is required to implement the recommendation.



Study Title

District Survey Report: Khowai District, Tripura

Implementing Institution

Greenminds Environmental Research Pvt. Ltd.

Project Location/Completion Year

Tripura, 2019

Objective

To assess the status of brick earth mining and other mining in Khowai District, Tripura

Study Recommendation

- The brick kiln owners themselves contract with the owners of private lands or holdings to make it better for the farmers to improve their cultivation.
- Conduct feasibility study by which economic viability of brick earth mining is assessed or judged.
- Huge mining of ordinary earth at a time will impose an adverse effect upon the environment regionally. So, quantification of ordinary earth mining is to be avoided as per generated situation, just to trigger the brick earth mining activity.

Analysis and Outcome

Mining activity as a whole is seen to have significant adverse impacts on environment. It is, therefore, necessary that the mining of minor minerals is subjected to simpler but strict regulatory regime and carried out only under an approved framework of mining plan, which should provide for reclamation and rehabilitation of the mined out areas.

Brick earth mining comes under Category B2. For Category B2 mining, mining area is up to 5 hectares. So the considered area is small and mostly confined to agricultural fields. Mostly local people are employed in this activity. There will be minimum adverse effect of this activity on the drainage system.

Besides to generate a number of direct employments, indirect employment will also be generated in this area by this activity. This is also a source to generate revenue to the Government. It can be concluded from the above facts that the mining of brick earth from this area will not have any adverse impacts but would help in improving the socioeconomic condition of the surrounding villages. All the recommendation provided by the study is highly implementable.

Agencies responsible for Implementation:

- Brick Manufacturers
- Department of Industries & Commerce, Government of Tripura

Study Title

Extraction of Sand from Gomti River, Tripura

Implementing Institution

Techno Environ Engineers

Project Location/Completion Year

Tripura, 2016

Objective

- Describe the ecological conditions of the study area more vividly.
- Prepare habitat-wise vegetation profile.
- Prepare the floristic checklist of the study area.
- Prepare a checklist of the faunal composition of the study area.
- Estimate the primary and secondary productivity of the water bodies of that area.

Study Recommendation

- Increased funding for nearby people to improve social infrastructure and cultural maintenance programmes.
- All safety provisions have to be ensured to negate any likely impacts on social environment due to associated hazards.

Analysis and Outcome

The study is an environmental impact assessment of a sand mining project in a cluster of lands in the Gomati River bed under the Udaipur Subdivision of Tripura. The project has been proposed for the extraction of sand by opencast manual extraction method.

Due to heavy rainfall annually, a large amount of river bed materials had been deposited at Gomati River, which has widened the course of the river and is also responsible for cutting of nearby agricultural and forest land causing heavy degradation and loss of soil and vegetation along the river course. Keeping in view the environmental consideration for the ecosystem of the river, it is essential to remove this material from the river bed.

The project has benefitted in meeting the huge demand of construction material like coarse and fine aggregate required in building construction and infrastructure works, road material for construction and maintenance of roads/highway; elastic ballast material for rail tracks in the state of Tripura as the naturally available materials of river bed quarry site have been found suitable from techno-economic consideration. The mining project also provided direct and indirect employment to skilled, semi-skilled, and unskilled labourers.



Study Title

Project Report on Proposed Exploration & Development Activities in Tichna PML Block Tripura

Implementing Institution

Oil and Natural Gas Corporation

Project Location/Completion Year

Tripura, 2015

Objective

The objective of the report is to provide detailed information about the project to seek Wildlife/Forest/Environmental Clearance from the concerned authorities.

Study Recommendation

As the drilling wells are falling in the Wildlife sanctuary, it was advised to obtain permission from the National Board for Wildlife before environmental clearance.

Analysis and Outcome

Tichna Field is situated in the western most part of Tripura state. The structure is surrounded by gas bearing Rokhia structure in NW, Gojalia in SE and Baramura in the E & NE and to the west borders Bangladesh. The surface topography of Tichna Gas Field is manifested in the form of gently raising ridges and shallow valleys covered with vegetation. Almost the entire structure falls within the Trishna WLS and due to that exploration and exploitation of hydrocarbon could not be carried out. Due to non-availability of Forest & Environmental clearance, the hydrocarbon potential of Tichna area remained locked. In view of the setup of OTPC (ONGC Tripura Power Corporation), the need of gas from this structure is very crucial for supply of gas to power plant. The process of diversion of 1.32 hectares of forest land for location TIAC within the WLS started way back in February 2000. In May 2005, the State Board for wildlife approved for diversion of 15Ha of Tichna Wild Life Sanctuary land for 10 exploration activities of ONGC. As per advice of MoE&F, ONGC submitted proposals of all the ten locations in the new format on 10.08.2007 but clearance is awaited till date.

Agencies Responsible for implementation:

- Forest Department of Tripura
- ONGC Tripura Power Corporation

Study Title

Progress Report on Specialised Thematic Mapping in Tripura-Mizoram Fold Belt in Parts of South Tripura and Dhalai Districts, Tripura

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Tripura, 2014

Objective

- Lithofacies analysis for lithostratigraphic classification of the Surma Group.
- To establish the provenance, tectonic setup, depositional environment, palaeocurrent and palaeoclimatic conditions of the Surma group of rocks.

Study Recommendation

No detailed studies have been taken up so far on these reported gas seepages, and detailed studies may be proposed to know their nature and their potentiality. Well indurated sandstone band noted within the Bhuban Formation towards north of Babusai may further be investigated to know its lateral continuity for use as road metal and construction material.

Analysis and Outcome

The present study carried out specialized thematic mapping on 1:25,000 scale. Out of which, 220 Sq. km have been covered during the first field season programme (FSP) i.e. 2013-14 which falls between the latitude 23°30'N to 23°38'N and longitudes 91°40'E to 91°50'E of SOI Toposheet Nos. 79M/10 and 79M/14. Atharamura Anticlinal range and the complementary synclinal valleys between Amarpur and Gandachhara exposes Upper Bhuban Member and Bokabil Formation of the Surma Group. Petrographic and geochemical evidence suggests that these Surma sediments were predominantly derived from acidic and low grade metamorphic source rocks. Though a minor contribution from mafic/ultramafic as indicated by high Cr/Ni values cannot be ruled out.

Bhuban sediments are relatively less weathered than the Bokabils. Palaeocurrent data indicate north or northeastern part of the study as their provenance whereby the sediments were deposited in the fast shallowing southerly deepening Surma Sea. The Surma sediments were deposited in a shallow marine to tidal environment where oxic environment prevailed. While the overlying Tipam and Dupitila sediments shows tidal to estuary, and floodplain to fluvial milieu respectively. This indicates gradual shallowing of the unstable Surma Basin along an active margin setting at the convergence of IndianMyanmar Plates.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Specialized Thematic Mapping in Parts of T.S. No. 84A/1 In Dhalai District, Tripura

Implementing Institution

Geological Survey of India, State Unit:
Tripura & Mizoram

Project Location/Completion Year

Tripura, 2013

Objective

- To prepare geological maps of the area on 1:25,000 scale,
- To build the stratigraphy and sedimentation history,
- To delineate the already reported occurrences of ignite and coal and lignite patches,
- To prepare facies map in terms of lithofacies analysis to work out the depositional environment.

Study Recommendation

It is recommended to identify and map Tipam sediments and Dupitila sediments by considering physiography and regional structures.

Analysis and Outcome

A total area of 100Sq. km in Dhalai district, Tripura state have been geologically mapped on 1:25,000 scale in parts of SOI Toposheet No. 84A/1. The mapped area comes under Manu-Chailengta synclinal valley which is flanked by Sakhan range in the east and Longtarai range on the west. The valley is highly dissected; small mounds and hummocks within the valley are mainly represented by unconsolidated and undeformed cross-bedded fluvial sediments of Tipam and Dupitila Group.

Upper Tipam and Dupitila cross-bedded sandstones are almost identical in the field is a difficult task, except where they coexist and re separated by unconformity. Such distinct unconformities are however very rare, owing to extensive erosion after deposition of Tipam sediments. In this scenario, unconformity alone does not serve the purpose of distinguishing Tipam from Dupitila. Besides sorting, dip of beds i.e., inclination, is an important criteria because Tipams are folded, while Dupitilas post-date folding. It needs mentioning that, flat bedded inliers of Upper Tipam sandstone can be easily confused with the undeformed cover of overlying Dupitila sandstone. Thus, both the physiography and structures are indispensable during geological mapping in such terrain.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

India: North-Eastern Region Capital Cities Development Investment Program - Agartala Water Supply (Tr-2)- Initial Environmental Examination

Implementing Institution

State Investment Program Management and Implementation Unit (SIPMIU)

Project Location/Completion Year

Tripura, 2011

Objective

The objectives of the Initial Environmental Examination were to assess the program's environmental and social impacts and present safeguards to mitigate any potential significant impacts.

Study Recommendation

- This Initial Environmental Examination (IEE) has been prepared for the Agartala City Water Supply Subproject, specifically for the construction of 7 groundwater treatment plants (GWTPs); construction of 14 new overhead service reservoirs (SRs) and rehabilitation of 3 old steel tanks; laying of approximately 59 km new rising mains; laying of approx. 200 km gravity distribution main at south part of Agartala including replacement of 32 km worn-out mains; providing 15,000 nos. household connection and construction of 200 nos. stand post and (vii) installation of bulk water meters on existing mains.
- An Environmental Management Plan (EMP) is proposed which includes mitigation measures for significant environmental impacts during implementation; environmental monitoring program, and the responsible entities for mitigation, monitoring, and reporting; public consultation and information disclosure; and grievance redress mechanism.

Analysis and Outcome

The study assessed the environmental impacts of all elements of the infrastructure proposed under the Agartala Water Supply Subproject. Potential negative impacts were identified in relation to both construction and operation of the improved infrastructure, but no impacts were identified as being due to either the project design or location. Mitigation measures have been developed in generic way to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the outline designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design. The subproject is unlikely to cause significant adverse impacts. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures. The recommendations of the study were fully implemented and incorporated in the project.



Study Title

Scoping and Feasibility Studies of Bamboo Plantation for Implementation of REDD+ Activities in the North Eastern States of India

Implementing Institution

Indian Council of Forestry Research and Education, ICFRE

Project Location/Completion Year

More than one state, 2020

Objective

To understand the potentialities of bamboo plantations in implementation of REDD+ activities.

Study Recommendation

- The study concludes that bamboo plantations have wide scope in implementation of REDD+ activities in the North Eastern states as bamboo species have potential to sequester atmospheric carbon dioxide at the faster rate besides providing the livelihood opportunities to the local communities.
- It also recommends for an appropriate policy to identify communities as an important place in encouraging forward and backward linkages and help in accelerating the growth of bamboo sector in India other than private investors. Capacity building of various stakeholders in management of micro-enterprise which includes nursery technologies for cultivation of various species to value addition bamboo processing and design technologies is required.
- Genetic interventions to obtain promising productive stock by both clonal origin and seed origin which flowers sporadically and provide ensured supply of quality seeds.

Analysis and Outcome

For the present study surveys were conducted in the Mamit and Aizawl districts of Mizoram for understanding the horizon of bamboo functions in terms of its scope and feasibility in implementation of REDD+ activities. In NE states of India, as per three categories of forest cover, the open forest category covers 67771 sq km and contributes 40.53% in total forest cover of NE states of India. The scrub (forest land <10% canopy density) is 3155 sq km. The degraded area has shown a cumulative increase of 0.53 million hectare of degradation in seven sister states between two time periods (2003-05 and 2011-13) as per Desertification and Land Degradation Atlas of India, 2016. This brings a good opportunity to increase the area under bamboo plantations. Among NE States of India, four states viz Assam, Mizoram, Nagaland and Tripura have formulated their state bamboo policies in 2019, 2002, 2004, 2001 respectively for development and enhancement of bamboo plantations.

The utilization of bamboo resources along with its sustainable development using scientific management practices is encouraged in all the state policies. This is well aligned with REDD+ mechanism to address the drivers of deforestation and forest degradation at the same time provide green employment with enhanced green skills. On the basis of scoping and feasibility studies, the study concluded that bamboo plantations have wide scope in implementation of REDD+ activities in the North Eastern states as bamboo species have potential to sequester atmospheric carbon dioxide at the faster rate besides providing the livelihood opportunities to the local communities.

Agencies responsible for implementation:

- State Biodiversity Boards
- Ministry of Environment and Climate Change

Study Title

Report on Geophysical Mapping in Toposheet Nos. 78N/12 AND 78O/1 Covering Parts of Kamrup District of Assam and West Khasi Hills District of Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2019

Objective

To generate the baseline geoscientific data. In view of the significant geological importance of OGP areas, the geophysical mapping has been taken up in OGP coverage area on priority basis.

Study Recommendation

- The geophysical survey has brought out characteristic gravity and magnetic responses over various geological litho-units in the area with significant contour patterns.
- Gravity survey shows the overall negative Bouguer gravity anomaly in the area with the total variation of 33.86 mGal and 25.34 mGal in the Toposheets No. 78 N/12 & 78 O/1 respectively.
- Relatively high gravity values are observed over the exposed Gneissic rock, whereas low gravity is observed over the quaternary formation.

Analysis and Outcome

The study outcome shows the total field magnetic anomaly map a total variation of 1230.7 nT and 9991 nT in Toposheets No. 78 N/12 & 78 O/1 respectively. The significantly high magnetic anomaly in Toposheet No 78 O/1 is due to the presence of Banded Magnetite Quartzite and basic Amphibolite, Moderate to high magnetic anomalies over exposed rock of Porphyritic Granite and Gneissic rocks, whereas low magnetic anomalies over the quaternary formations. The prominent high analytic signal of magnetic anomaly in and around south of Hahim and Malang area in toposheet 78 O/1 may be attributed to the presence of high magnetic material with significantly high contrast.

The Euler depth solutions of gravity and magnetic data indicates the shallower nature of contacts in the area with the maximum number of solutions lies in the depth ranges less than 1000m. The spectral analysis of gravity data of the Toposheet 78 N/12 reveals presence of two subsurface interfaces based on the density, the shallower and deeper interfaces at a depth of 130 0m and 2090m respectively. Similarly, result of the spectral analysis of gravity data of toposheet 78O/1 reveals two interfaces, shallower at a depth of 1260 m and deeper at a depth 3200 m. The spectral analysis of magnetic data of the Toposheets 78 N/12 & O/1 reveals only one subsurface interface at a depth of 1430m and 1190m respectively.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines



Study Title

Specialised Thematic Mapping in and Around New Tusom – Chingai to Elucidate the Tectono-Metamorphic History in Naga Hills Ophiolite Belt of Nagaland-Manipur and to Delineate the Associated Mineralization

Implementing Institution

Geological Survey of India, State Unit:
Manipur – Nagaland

Project Location/Completion Year

More than one state, 2019

Objective

- The present mapping programme on 1:25,000 scale was taken up with an objective to have better insight into the structural evolution of the NHOB characterization of metamorphic rocks and to delineate the associated mineralization.
- The study will provide information on tectonic features and petro-geochemical processes involved during the subduction processes.

Study Recommendation

- Detailed work on granulitic/amphibolitic rocks that make up the metamorphic sole of the thrust along with the associate rocks may be taken up to bring out geo-thermometric and geo-barometric details of the zone and to accumulate knowledge pertaining to the history of subduction and the maximum depth attained by the exhumed subducted blocks.
- Geochemical mapping has been carried out on larger grids during F.S 14-15 (4x4 km and 8x8 km respectively). However, more detailed geochemical mapping with closer grid spacing of at least on 1x1 sq. km may be taken up with a view to delineate mineralized zones in detail.

Analysis and Outcome

The present study carried out a specialized thematic mapping (1:25K scale) in the Naga-Manipur Hill Ophiolite Belt (NHOB) in and around New Tusom to Chingai, a total area of 440 sq km was covered during field season 2017-2018 and 2018-2019. Metamorphic sole as tectonic slices occur within the mafic-ultramafic units represented by garnet bearing granulite and amphibolites facies. Garnet bearing granulite facies consist of garnet (almandine-grossular) along with intrusions of rutile, apatite, sodic plagioclase and occasional zonation with calcic plagioclase. The inclusion of earlier mineral phases i.e. rutile, apatite and sodic plagioclase indicate prograde metamorphism during subduction process. In contrast, the garnet symplectite texture of fibrous hornblende and albite indicate retrograde metamorphism during exhumation.

The olistostromal facies of upper Disang Formation is considered to have formed in marginal trenches when tectonic disruption took place along the continental margin. It is the dividing threshold facies between the distal shelf sediment to the west and the deep sea sediment to the east. This facies probably represents the outline of the continental margin during Eocene. The Jopi Formation overlies unconformably the Upper Disang Formation near Khongai hamlet.

Agencies responsible for implementation:

- Geological Survey of India

Study Title

Interim Report on Geochemical Mapping in Toposheet No. 78N/12 Of Kamrup and Kamrup (Metro), Darang Districts, Assam & Khasi Hills Districts, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

To generate geochemical database of Degree Sheet 78N of Assam and Meghalaya States using multi elemental analysis.

Study Recommendation

- LREE is showing high value ranges in Patasil Reserved Forest (composite sample Nos. 101,102, 103, 104, 115 and 116), Guwahati university hill (composite stream sediment sample Nos. 099 and 100) in the eastern part of the toposheet.
- These values showing in the pink/grey porphyritic granite, quartzo-feldspathic_x0002_gneiss of Neo-proterozoic to paleo proterozoic granitoid. The anomalous high values recorded as against the background values (Table-6.3.1) are LREE La (380.88 ppm), Ce (653.80 ppm), Pr (81.16 ppm), Nd (266.60 ppm), Eu (35.22 ppm), Sm (43.16 ppm) and Gd (45.28 ppm).
- This porphyritic granite occurring mainly in the eastern part of the study area may be probed to ascertain the cause of the anomaly and to investigate any potential source of LREE. Further investigation for potential source of REE in this area is also encouraged.

Analysis and Outcome

A geochemical mapping was taken up in Toposheet No.78N/12 in 1:50,000 scale which is falling in Kamrup, Kamrup (Metro), Darang districts, Assam and Khasi hills district Meghalaya. One Hundred and Seventy One (171) numbers of Stream Sediment/slope-washin 2x2 grid, eighteen (18) Soil sample (R&C) in 5x5 grid, five (05) XRD, five (05) petrographic and nine(09) stream water samples in 5x5 grid were collected for different analyses and submitted the same samples for the chemical analysis as per NGCM SOP.

High concentration of LREE observed in the study area confined to the grey granites, quartzo-feldspathic-gneiss and porphyritic granites rocks in Patasil Reserved Forest, Guwahati university hill, Kamakya hill in the eastern part of the toposheet. The pH value of water samples ranges from 6.4 to 6.9 and are falling within the permissible limit of 6.5 to 8.5 prescribed for drinking water by BIS (2012). Based on the geochemistry of the water samples, all the water is considered as fresh and suitable for drinking and irrigation purposes except the water from Bolamari, Hajo Suta nadi of A1 quadrant due to the presence of Arsenic value more than the permissible limit of 3.46.

Agencies responsible for implementation

- Geological Survey of India
- Ministry of Mines
- Water Resources Department, Government of Assam



Study Title

Interim Report on Geochemical Mapping in Toposheet No.83c/10 in Karbi Anglong District, Assam and East Jaintia Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

- To generate geochemical baseline data of 68 elements.
- To search mineral deposits
- To create geochemical map of different elements for the entire country.
- To establish valid environmental baseline for planning long-term development. Scope of the present work is to prepare Geological, Geomorphological, Drainage, Relief, Landuse and Geochemical anomaly maps for mineral targeting as well as health, agricultural concerns and environmental aspects.

Study Recommendation

- Stream sediment (S): That reflects the average geo-genic composition of a catchment basin.
- R-Horizon: Upper horizon/ top soil (0-25cm) without the top organic layer (<2mm). It reflects variations in geo-genic compositions of the uppermost layers of the earth's crust.
- C- Horizon: A 25 cm layer within a depth range of 55 cm to 200 cm. Comparison of a C-horizon and regolith would give information about environmental changes affecting anthropogenic contamination of the top layer (R).
- Stream water (W): Reflecting interplay in the geo-sphere and at the same time it is the main source of drinking water.
- Heavy minerals (H): It is defined as minerals having a higher density than quartz, the most common rock-forming soil mineral with a density of 2.65 g/cm³.

Analysis and Outcome

The present study carried out geochemical mapping covering an area of 698 sq. km in parts of T.S No 83C/10 during FS 2017-18. Chemical representative samples for stream sediments were collected from 3rd, 2nd and 1st order streams strictly following the NGCM SOP guidelines. Therefore a total no. of 182 composite stream sediment sample, 09 composite duplicate stream sediment samples, 09 water samples and 18 soil sample (09 each from R and C-Horizon), 09 nos. heavy mineral samples at 5km x 5km grid, 05 nos. XRD samples and 05 nos. of petrography samples were collected. Total 182 samples of composite stream sediments sample, 09 R-horizon & 09 C-horizon soil sample, 09 waters samples and 09 duplicate samples has been sent to chemical division, NER, Shillong and analytical results of package A and H has been received.

Highest value of Zircon (2386 ppm) was observed in NE part of toposheet near Mokoilum village over Myllem Granite. Some of the notable values are Cr (297 ppm), Rb (506 ppm), Th (199 ppm), Ba (1444 ppm). In the study area the pH of most of the water samples varies from 6.4 to 7, which shows that water is acidic to neutral in nature. In general, the surface and shallow groundwater is mainly acidic, soft with less mineral content. The anomalous value in stream sediment samples which were collected from Mawriyap and Sarucha villages in northern parts of toposheet has a Total Rare Earth Elements, TREE ranges between 55 ppm and 3621 ppm. This area can be taken as G4 item for REE investigation.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines

Study Title

Preparation of Palaeontological Catalogue of North Eastern Region

Implementing Institution

Indian Red Cross Society (IRCS)

Project Location/Completion Year

More than one state, 2017

Objective

The main objective of this project is the systematic documentation with field checks of the reported fossil occurrences in the northeastern region and preparation of a catalogue containing all the fossil groups.

Study Recommendation

- This report after the circulation may be taken up for publication in the form of a "Pictorial Catalogue of fossils of Northeastern Region" under the catalogue series of Geological Survey of India.
- To improve the quality of photographs of the fossils, an effort can be made to photograph the fossils from the respective repositories.

Analysis and Outcome

The present work is an attempt to prepare a pictorial catalogue of fossil remains by incorporating all available details, such as their taxonomic status, brief description, locality, horizon, age, along with publication details and repository which have been reported by various workers in the form of GSI unpublished reports or in the referred journals. It will be useful to the present and future workers, who can now have access to the required data on fossil occurrences of NER at one place. The recommendation of the study is partially implemented.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Report on Gravity-Magnetic Mapping in Parts of Darrang, Kamrup Nagaon Districts of Assam and Ri-Bhoi District of Meghalaya Covering Toposheets 78N/15 & 78N/16

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2016

Objective

The objective of the survey was Gravity and Magnetic mapping in 1:50K scale to determine the subsurface geological features and to generate gravity and magnetic maps.

Study Recommendation

A significant high intensity magnetic anomaly associated with high gravity zone has been delineated 1.5 km northwest of Burnihat, Ri-Bhoi district of Meghalaya. The area seems to be important from mineralisation point of view. Based on the geophysical results and geological evidences of the anomaly, a detailed geological and geophysical investigation is recommended to ascertain the mineralisation potential of the zone.

Analysis and Outcome

The qualitative interpretation of gravity-magnetic data has brought out several gravity and magnetic discontinuities and body axes, related to subsurface structural features like lineament/fault/fracture/shear/lithological contacts. A total variation of -54mGal has been observed in the area with maximum value of -44 mGal near Kumarkungi in the southern part and minimum of -98 mGal near Goriapara in the north eastern portion. The gravity and magnetic anomaly maps clearly brought out prominent high gravity anomalous zone associated with high intensity magnetic signatures over Assam-Meghalaya massif in southern part. A prominent NE-SW trending lineament with discontinuity has been clearly brought out by both magnetic and gravity maps over Brahmaputra River. The significant low gravity zone with steep gravity gradient towards north of the study area indicates that basement is deepening towards north and is well corroborated by the Euler depth solutions of gravity and magnetic data.

Agencies responsible for implementation:

- Geological Survey of India
- Ministry of Mines

Study Title

Interim Report on Geochemical Mapping in Toposheet No 83C/02 in Parts of Jaintia Hills District, Meghalaya and Karbi Anglong District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2013

Objective

To generate geochemical baseline data for use in mineral exploration, environmental management, agriculture, forestry, landuse and many aspects of human and animal health and other societal concerns.

Study Recommendation

The study recommends detailed further study where:

- High values of Cr, Cu Co, Ni and Zr recorded in serpentinite , gneissic and porphyritic granite rocks needs further detail study.
- The high values of HREE (Tb, Dy, Ho, Er, Tm, and Yb) are recorded in gneissic rock along the southeastern margin.
- The high alkalinity nature of water recorded in Umtung area is unsuitable for drinking purposes.

Analysis and Outcome

For the present study a total of 364 stream sediments (SSS) comprising 182 composite samples were collected covering an area of 680 sq. km in 83C/2. Composite stream sediments (CSS) were prepared by mixing samples from two to three cells that constitute 4 sq km grid. A total of 9 regolith and C-horizon soil samples were collected on each 5' x 5' grids. Stream water samples were also collected from 9 sites each covering an average of 80 sq km area. The distribution patterns of elements of Cr, Cu portray that the high values are on Serpentinite rock, Co, Ni of high values present on quartzite rock, Vanadium concentration high on gneissic rock and Zr having high values present in porphyritic granite rock. Analytical results of package W(A) for both pre-monsoon and post-monsoon have been received and data processed. Barring one water samples with high pH and high TH the other parameters lie well below the BIS and WHO limits suggesting that they are suitable for drinking, irrigation and industrial purposes.

Agencies responsible for implementation:

- Geological Survey of India



Study Title

Exploration of Native Flora and In-vitro Study to Assess their Efficiency in Removal of Water Pollutants

Implementing Institution

Tezpur University

Project Location/Completion Year

Arunachal Pradesh, 2013

Objective

- To assess the selected non-toxic herbs (aquatic and terrestrial) for remediation of heavy metals and arsenic
- To remedify if heavy metals and arsenic from water using selected species
- To apply potential plants for the treatment of waste water
- To create a database of the potential herbs

Study Recommendation

- The study recommended some plants (herbs) to purify water in three watersheds: Tenga, Shergaon and Pinjoli to remove heavy metals, namely lead, arsenic and cadmium.
- The same may also be used by industries for treatment of waste water from industries.
- Water boards and civic bodies may use also the same to purify or treat waterbodies.
- Further research has been encouraged with the plants identified.
- The creation of a plant database has been suggested.

Analysis and Outcome

The recommendation of the study has been fully achieved. Assessment of 19 selected samples of non-toxic herbs (aquatic and terrestrial) for remediation of heavy metals and arsenic from three watersheds of Tenga, Pinjoli and Shergaon of Arunachal Pradesh of Eastern Himalaya have been fully achieved. Experiments regarding the remediation of heavy metals from water using selected species have been carried out fully and such herbs were identified. Such potential herbs have also been applied for the treatment of wastewater. Creation of database of the potential herbs was carried out by NERIWALM.

Study Title

Preliminary Investigation of Brine Seepage in Tirap District, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2013

Objective

To carry out detail sampling and geological investigation of the brine water and seepage. The item also includes geochemical analyses of samples to know the characteristics of the brine waters, surface waters and soil samples. It also includes geological mapping on 1:50000 scale.

Study Recommendation

- Depth of the wells are very shallow and its reserve is very poor. The value of Na and Cl is too high but it will not be economically viable to manufacture salt from these wells because of its poor reserve.
- Due to its low reserve, saline water cannot be used even as preservatives, commercially.

Analysis and Outcome

The present study carried out a detailed sampling of brine and surface water and analysed the characteristics of brine water. A number of brine wells are present in Tirap district of Arunachal Pradesh, located in the Southeastern part of Arunachal Pradesh. The studied area is bounded by Latitude N27°00'-N27° 2', and Longitude E95° 25'-E95° 35' in Survey of India Toposheet Nos 83M/8 and 83M/12. Geologically the area comprises tertiary sediments and the rock of the area belongs to Disang Group and Barail Group.

A total of 17 numbers of wells are present in the area and majority of the wells are located in Disang Group. Major ion analyses were carried out and plotted in Pipers Tri-linear diagram to identify the hydrogeological facies of the waters. The brine waters are rich in Na and Cl and their values range from 942.8 ppm to 4142.6 ppm and 1278 ppm to 26830 ppm. Apart from Na and Cl, other major cations and anions are Mg, Ca and K and SO_4^{2-} , HCO_3^- and NO_3^- , respectively. These brine wells were used by the locales to produce salts and preserve foods. The depth of water in the wells are very shallow and it varies from 1.2 m to 5 m. The objective of the study and recommendation were fully implemented.



Study Title

Assessment of Ambient Air Quality in the Vicinity of Well Baghjan 5, Oil India Limited, Duliajan, Assam

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2020

Objective

- To measure the levels of PM_{2.5}, SP₂, NO_x, methane (CH₄), non-methane hydrocarbons (NMHC), total hydrocarbons (TH), and total volatile organic compounds (TVOCs) at a radius of 0.5 km, 1 km, 1.5 km and 2 km from the impact well.
- To measure the equivalent sound pressure levels (dB) at different locations from the wellhead.
- To submit a report on the monitoring carried out along with recommendations to address the impacts on the ambient environment.

Study Recommendation

- The noise level from the operational site needs to be addressed at sensitive receptor locations. Suitable green belt can be implemented in the operational area to cut down the noise level to the desired levels.
- A feasibility study needs to be carried to work out the thickness of green belt desired for reduction of noise levels below ecologically sensitive/silent zone standard prescribed by CPCB.

Analysis and Outcome

The monitoring carried out at different locations in the vicinity of fire at gas well head that particulate matter (PM_{2.5}) and gaseous pollutant concentrations at all the four locations throughout the entire monitoring period were well within the limits prescribed by CPCB. However, the noise levels measured at all the locations during the entire course of the monitoring were found to be exceeding the daytime ecologically sensitive/silent zone standard prescribed by CPCB. As recommended the noise level from the operational site was addressed at sensitive receptor locations. Suitable green belt was also implemented in the operational area to cut down the noise level to the desired levels. Hence the recommendation of the study is fully implemented.

Study Title

Bioremediation Services of Contaminated Soil and Waterbodies due to Oil Spillage Resulting from Blowout of Well Number BGN#5

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2020

Objective

To treat oily soil and contaminated water bodies resulting from blow out of well number BGN#5 near Baghjan village by applying this microbial consortium developed by R&D Oil India Limited, Duliajan, Assam

Study Recommendation

Recommendation has not been outlined in the report.

Analysis and Outcome

The bioremediation of oily soil was initiated in the month of June, 2020 at well number BGN#5, Baghjan, Oil India Limited, Duliajan, Assam. A total of 1200 m³ of oily soil was undertaken for bioremediation of this project. First, the oil was recovered from water bodies and transported to put on land area within 25 km where in-situ bioremediation was on. The oily soil samples, oily water samples and bore well water sample had been collected from the bioremediation site, were checked for solvent extractable total petroleum hydrocarbon (TPH) and other necessary parameters. Biodegradation process was carried out in four zones. It was found that after completion of the bioremediation job, the TPH content in the soil/treatment on land was less than 0.5% and TPH in water was less than 100 ppm, which is in conformity with statutory norms. The study objective was fully achieved.



Study Title

Distribution and Enrichment of Heavy Metals Among Sediments, Water and Aquatic Plants and Modeling its Ecological Impact on Wetland Ecosystem of the Brahmaputra Valley

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2016

Objective

- To determine the concentrations of some heavy metals (Pb, Cd, Hg, Cu, Cr, Zn, Mn %t.; in water, bed sediment and in different parts of the aquatic macrophytes collected from different wetlands system of the Brahmaputra valley.
- To study physico-chemical characteristics of water and sediments in terms of pH, total alkalinity, dissolved solids, Chloride, nitrate, phosphate, organic carbon etc. to collect baseline information on ecological conditions during pre and post-monsoon seasons
- To determine the potential for metal accumulation of different naturally growing wetland plants collected from metal contaminated sites.
- To evaluate the significant difference in the concentration of different studied metals with respect to different wetlands using statistical tools.
- To assess the relationship and interdependency of heavy metals (Cu, Zn, As, Pb, Cr, Mn, Cd) in macrophytes, sediment, and water samples, during pre and post-monsoon seasons.
- To see the enrichment, sediments, bioavailability and pollution level of heavy metals in sediments
- To propose an ecological model to relates the transport, distribution and speciation of heavy metals and their toxicity, and the effect of environmental variability on metal toxicity.

Study Recommendation

Pollution status of the wetlands of different districts of the Brahmaputra valley of Assam with respect to heavy metals was detected.

Analysis and Outcome

Wetlands are areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. The wetlands are rich in flora and fauna. The heavy metal pollution in wetlands can be a potential cause of decreasing biodiversity [48]. The study was focused on determining the level of heavy metal pollution in water, sediments, and various macrophytes of different wetland systems of Brahmaputra valley which can be done via physicochemical analysis. The purpose was to collect the baseline information of the pre- and post-monsoon season. The plant growing in different wetlands were also checked for their potential to accumulate heavy metals. The report of the study recommended to check the level of heavy metal pollution in the wetlands of different district of Assam which is very important to conserve the wetlands as well as for the biodiversity. The recommendations of the current study were implemented well.

Implementable recommendations:

- Level of heavy metal pollution in the wetlands of different districts of Assam

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board (CPCB)
- State Pollution Control Board (CPCB)

Study Title

Physicochemical Characterization of Aerosol and Source Apportionment in the Mid-Brahmaputra Plain in Assam: A Modeling Approach

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2015

Objective

- Physicochemical characterization of atmospheric aerosols of central Assam region with the major initiatives viz., morphological studies and size distribution, estimation of mass density and number, elemental composition, Ionic composition, organic and inorganic carbon
- Spatial and seasonal variability of aerosols mass and number density and composition. Influence of biomass burning and monsoon on the aerosol characteristics would also be looked into.
- Rainwater characterization over the year. Enumeration of relationship between rainwater chemistry and aerosols.
- Modelling- Source apportionment by CMB and PCA models and Model estimation of visibility impairment on the basis of mass scattering and absorption efficiencies

Study Recommendation

Recommendation has not been outlined in the report.

Analysis and Outcome

The project is an attempt to understand the aerosol characteristics of mid-Brahmaputra plain. Since there was no such systematic study reported from this region explaining the possible major contributing sources of aerosol, this study was envisaged primarily to address basic issues of aerosol properties and their source apportionment in the Tezpur region of mid-Brahmaputra valley. The study had found that biomass burning, vehicular emission, coal burning, street dust, construction dust, suspended oil/crustal matter, etc. are the main contributors of atmospheric aerosol i.e., combustion - 56%; street dust 16%; construction dust 13% and crustal matter 15%. Biomass-burning aerosols affect the radiation budget. Dry beds of the river Brahmaputra is also an important source of aerosol of the region. Long-range transport of aerosol has an effect on local aerosol properties and the rain. Polluting sources of the NER is unique compared to major cities of India, but there are limited research studies on aerosols in North-East India. To arrive at a national status of aerosols, data from northeast region of India cannot be ignored.

The outcome of the apportioned study would add up to the national status of aerosol that would be useful to researchers and planners. As per the study team, the outcome of the study is fully implemented and resulted in a significant positive impact. It is also noted that the impact of the study will increase and generalized to a great extent in other regions as well.



Study Title

Physiochemical Characterization of Aerosol and Source Apportionment in the Mid-Brahmaputra Plain in Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2015

Objective

- To understand the aerosol properties and their source apportionment in the Tezpur region of mid-Brahmaputra valley.
- To study correlation between air quality and rainwater of the region.

Study Recommendation

- The chemical mass balance (CMB) model estimates explain that biomass burning, road dust and vehicular emissions are the major contributors of atmospheric aerosol over mid-Brahmaputra region.
- The relation between mass concentration of PM10 and pH of rainwater showed negative correlation.

Analysis and Outcome

Aerosols are extremely small solid particles, or very small liquid droplets, suspended in the atmosphere. About 90 percent of aerosols have natural origins. For example, volcanoes, for example, eject huge columns of ash into the air, as well as sulfur dioxide and other gases, yielding sulfates. Forest fires send partially burned organic carbon aloft. Certain plants produce gases that react with other substances in the air to yield aerosols, such as the "smoke" in the Great Smoky Mountains of the United States. Likewise in the ocean, some types of microalgae produce a sulfurous gas called dimethylsulfide that can be converted into sulfates in the atmosphere [56]. The remaining 10 percent of aerosols are considered anthropogenic, and they come from a variety of sources. Though less abundant than natural forms, anthropogenic aerosols can dominate the air downwind of urban and industrial areas. Fossil fuel combustion produces large amounts of sulfur dioxide, which reacts with water vapor and other gases in the atmosphere to create sulfate aerosols. Biomass burning, a common method of clearing land and consuming farm waste, yields smoke that's comprised mainly of organic carbon and black carbon. The objective of the current study was physico-chemical characterization of aerosol and source apportionment in the Mid-Brahmaputra plain in Assam. The identification of correlation between the air quality and rainwater was also one of the important objectives of this study. The final report of the study recommended that biomass burning, road dust and vehicular emissions are the major contributors of atmospheric aerosol over mid-Brahmaputra region which are needed to be controlled. It further recommended that the concentration of PM10 and pH of rainwater were negatively correlated. These recommendations should be implemented on priority basis.

Implementable recommendations:

- Regular monitoring and control of biomass burning, road dust and vehicular emissions

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board

Study Title

State of Environment, Assam Ambient Air and Water Quality, 2014

Implementing Institution

Pollution Control Board, Assam

Project Location/Completion Year

Assam, 2015

Objective

- To determine the status and trends of ambient air quality.
- To evaluate water quality trends, assess nature and extent of pollution control needed, etc.

Study Recommendation

Recommendation has not been outlined in the report.

Analysis and Outcome

The state of environment describes the present condition of the air, water, soil, etc. The study aimed to determine the status and trends of ambient air quality, evaluation of water quality and the level of pollution and extent of pollution control needed. The presence of contaminants such as mist, photochemical and sulphurous smog, particulate matter, and all the gases beyond their permissible limit affect the health to a great extent. Similarly, the contamination of water with various heavy metal ions, nutrients, and salts beyond their permissible limit is hazardous to human health. Therefore, there is an urgent need to monitor the level of pollution in ambient air and water. The present report is missing the recommendations. The possible recommendations might be creating awareness to use public transport, and the plantation program at large scale. The other recommendations are to impose strict environmental laws against the industries releasing various pollutants into the environment. The creation of awareness among the community can also be a potential step to regulate the domestic pollution. The recommendations of the report were partially implemented. A similar study of air quality of Kaziranga National Park in Assam was done by Handique in 2015 [52]. Bora and Goswami have studied water quality index in Kolang River, Assam (Bora and Goswami, 2017 [53]).

Implementable recommendations:

- Creating awareness to use public transport
- Plantation program at large scale
- Strict environmental laws against the industries releasing various pollutants in the environment
- Creation of awareness among the community

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board



Study Title

Study of Arsenic Contamination in Water and Soil in Parts of Nagaon and Marigaon Districts, Assam

Implementing Institution

Geological Survey of India, State Unit: Assam,
Guwahati

Project Location/Completion Year

Assam, 2015

Objective

- The objective was to map the arsenic (As) distribution pattern in ground water by studying the existing tube wells to delineate arsenic-high and arsenic-low ground water zones. During the year, a total area of 2382 sq km area has been covered with spot analysis of 1100nos in different localities following 2x2 Km (appx.) grid pattern.
- During the study a total of 121nos surface water and 251nos ground water samples have also been collected. Soil samples (C-horizon) from 33 localities and 6no. of bed rock samples (BRS) have also been collected and submitted to the chemical division for analysis of major oxide, trace element, As and Se.

Study Recommendation

- The utilization of surface storage system like ponds, streams, rivers, dug wells have to rejuvenate or the shallow tube wells can be used judiciously because they contain significantly lower values of arsenic as observed during the present investigation.
- It is recommended that water from stream, pond and rivers should be the first preference followed by shallow tube wells rather than choosing for deeper tube wells.
- Both shallow and deep tube well in Older and Newer Alluvium should be examined before utilising for drinking purposes.
- People awareness programme should be arranged to motivate people not to use drinking water from unknown sources particularly from untested tube wells. Rain water harvesting may also be an alternate source of potable water in the areas under study.

Analysis and Outcome

Arsenic is a metalloid which is very toxic in nature. It is found in arsenate and arsenite form. The inorganic form of arsenic is carcinogenic in nature. Toxicity of arsenic causes very several diseases. The immediate symptoms of acute arsenic poisoning include vomiting, abdominal pain and diarrhea [58]. These are followed by numbness and tingling of the extremities, muscle cramping and death, in extreme cases. The long-term effect of arsenic is observed in the skin in the form of pigmentation, skin lesions, hard patches on the palms and soles of the feet. The major source of arsenic poisoning is natural which is stored in bedrock. Arsenic poisoning is increasing because of bedrock exposure with atmospheric oxygen. Therefore, identification of pollution sources and its mitigation is very important. The objective of the current study was mapping of arsenic (As) distribution pattern in ground water by studying the existing tube wells to delineate arsenic-high and arsenic-low ground water zones. The report of the study recommended to use surface water body like ponds, streams, rivers, dug wells etc. because of containing lower values of arsenic. Therefore, the report forced to rejuvenate such system. It was observed that the recommendations of the study were partially implemented. The report recommended to examine the shallow and deep tube well in newer and older alluvium soil. An awareness program was also recommended to aware the people about rainwater harvesting and not to use the drinking water from unknown sources.

Implementable recommendations:

- Use and rejuvenate the surface water body like ponds, streams, rivers, dug wells etc., to avoid arsenic poisoning.
- Examination of the shallow and deep tube well in newer and older alluvium soil

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board
- Ministry of Water Resources, River Development and Ganga Rejuvenation



Study Title

Final Report on the Study of Arsenic Contamination in Water and Soil in Parts of Jorhat District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2013

Objective

- To map the arsenic distribution pattern in ground water, recorded from the existing tube wells in the high arsenic incidences areas, to delineate in detail the arsenic high and low ground water zones in specific areas with reports of arsenic.
- To study the difference in the sub surface mineralogy of the zones with contrasting arsenic values in ground water for specifically identifying the arsenic traps and the nature of arsenic fixation in them.,
- To evaluate the geological and geochemical processes responsible for high arsenic values in aquifer sediments and its subsequent entry in the ground water sediments.
- To prepare the inventory of affected populace and suggest remedial measures, awareness campaign in the public and local administration.

Study Recommendation

- The best way to avoid arsenic poisoning is not to drink water that contains arsenic. Surface water like water of ponds, known as pukhuri, tanks and rivers may be used as alternate source of drinking water. But surface water sources have to be treated to remove disease-causing micro organism.
- There is a need for integrated research to understand complex process of arsenic release mechanisms and its mobilisation in aquifers in Brahmaputra basin.
- Drilling and sub-surface study and arsenic specification may be required in the arsenic high zone area in order to know the exact sources and causes of high arsenic contamination in ground water and absence of no report of health hazard in the district due to arsenite.
- Under the 'Fundamental and Multidisciplinary Geosciences and Special Studies' more emphasis should also be given to the collaborative/joint venture work with medico professionals reporting the cases regularly for common/routine diseases and may not be able to link with 'problems due to Arsenic'.
- Means of vegetation/plantation/crop cultivation may be promoted to decrease the presence of arsenic salts. Rain water may be made to enter into groundwater by new technology to flush out the arsenic rich salts in high arsenic zone.

Analysis and Outcome

Arsenic is a metalloid which is very toxic in nature. It is found in arsenate and arsenite form. The inorganic form of arsenic is carcinogenic in nature. Toxicity of arsenic causes very several diseases. The immediate symptoms of acute arsenic poisoning include vomiting, abdominal pain and diarrhea. These are followed by numbness and tingling of the extremities, muscle cramping and death, in extreme cases [77]. The long term effect of arsenic is observed in the skin in the form of pigmentation, skin lesions, hard patches on the palms and soles of the feet. The objective of the current study was aimed at identification of arsenic contamination zones and apply possible measures to mitigate its hazardous effects. The report of the current study recommended to avoid contaminated water with arsenic, using surface water bodies, initiating integrated research to investigate the arsenic contamination and its mobilization. The analysis of the report identified that the recommendations of the study were considered on high priority to curb arsenic poisoning. At present, all the recommendations are implemented as suggested by the report. Moreover, such studies must be continued to avoid arsenic poisoning [78].

Implementable recommendations:

- Avoid using contaminated water with arsenic
- Use of water from surface water bodies
- Integrated research to understand complex process of arsenic release mechanisms
- Collaborative work with medico professionals
- Entry of rainwater into ground water

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board
- Ministry of Water Resources, River Development and Ganga Rejuvenation



Study Title

Integrated Arsenic and Iron Removal From Contaminated Ground Water

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2011

Objective

To develop a low cost and easy to use Arsenic-Iron removing process and design systems for domestic and community use.

Study Recommendation

- The study recommends for field trial of the technique both at domestic and large scale levels.
- To develop an automated online arsenic and iron removal system.
- Further R&D work can be done on management of the arsenic rich solid iron sludge produced by the technique.
- Popularize method developed, Arsiron Nilogon.

Analysis and Outcome

The current project was a highly successful one drawing accolades from Department of Science and Technology, Government of India. Under the project an arsenic removal method 'Arsiron Nilogon' was developed [80]. Arsiron Nilogon is a filtration technique which has already been granted a patent, it uses three common and safe chemicals, namely baking soda, potassium permanganate and ferric chloride in specified quantities. The filtration process can be done in individual homes with the help of two buckets and a sand-gravel filter or scaled up for community usage. The small quantities of chemicals used and the easily available fixed assets like household buckets and plastic water tanks enable the process extremely economical. Calculations show that the total recurring cost is only about 1 paisa (Rs 0.01) per litre of treated water so a family can get arsenic-free drinking water for a week (200 litre) at the cost of Rs 2.00. Hence, [81]. Arsiron Nilogon is an ideal arsenic and iron filtration technique that can be afforded by the poorest of the poor. It is envisioned that the study impact will increase overtime, better coordination among various government departments for effective implementation will be highly useful.

Study Title

Inventory of Emissions of Air from Various Industrial Sources in Tripura

Implementing Institution

National Environmental Engineering
Research Institute, NEERI

Project Location/Completion Year

Tripura, 2015

Objective

Study and report the Inventory of Emissions in Air and water environment from various Industrial sources in the state of Tripura based on secondary data.

Study Recommendation

The study was limited to air emission only. The secondary data needs to be made available for the study on industrial use of water.

Analysis and Outcome

The study reports the inventory of emissions in air and water environment from various industrial sources in the state of Tripura based on secondary data. Main parameters, considered were Oxides of Sulfur (SO_x), Oxides of Nitrogen (NO_x), respirable Particulate Matter (PM₁₀), Suspended Particulate Matters (SPM) and Non Methane Volatile Organic Compounds (NMVOCs). The study was limited to air emission only as secondary data on industrial use of water was not available. The present study attempted to produce an inventory of emissions specifically from twelve hundred and ninety four (1294) industries excluding pathology labs situated in the state of Tripura and identifying the major contributing factors based on secondary data. Brick kilns were found to be the predominant contributing factor of the pollutants in all the industrial districts of the state. Category of industry wise total emission distribution is depicted shows red category industries have the major role to emit SO_x, NO_x, PM₁₀ and SPM in whole Tripura and major amount of NM-VOCs are emitted from green category industries. West Tripura emits maximum amount of pollutants and this district is followed by South Tripura, North Tripura and Dhalai district. The emission from other four districts i.e. Sepahijala, Khowai, Unakoti and Gomati were found to be negligible.

Agencies responsible for implementation:

- Tripura Industrial Development Corporation
- Tripura State Pollution Control Board
- Central Pollution Control Board



Study Title

Development of Baseline Data with Respect to Air, Water, Soil Quality as well as Noise Up to Block Level in Four Districts of the State of Tripura

Implementing Institution

National Environmental Engineering
Research Institute, NEERI

Project Location/Completion Year

Tripura, 2014

Objective

To assess present environmental quality status at block level in four districts of Tripura with baseline data generation in respect of ambient air, water, soil quality as well as noise by collection of samples for the various parameters.

Study Recommendation

- There is immense potential of further development for this state which will not be possible without industrialization, improve quality of life and urbanization. In view of much required practice of sustainable development; growth and progress should not come at the cost of environmental degradation.
- In order to perceive the concept of the sustainable development the first step is to identify the current status of the various environmental components by generating baseline data for them. The baseline data will be the foundation for the policy decision and pathway of future development.

Analysis and Outcome

Tripura has witnessed a significant increase in the number of industries and also in the number of vehicles from last few years. As a result, there has been a significant change in the quality of environment. For this study primary data (air, water, soil and noise samples) have been collected from each 45 blocks of eight districts of Tripura and the samples have been analyzed as per standard protocols, district wise result obtained for all the blocks for various indicative parameters for different environmental compartments. Present status of ambient air quality shows that the average PM10 or RSPM concentration in all districts other than the West Tripura district are within the CPCB standard of PM10 level. The highest PM10 level was observed for West Tripura district followed by Gomati and Sepahijala. Highest level of benzene have been observed in Gomati district followed by Khowai, North Tripura and West Tripura Districts. The uncontrolled emissions from the brick kilns may be responsible for higher level of benzene in this area. The overall vehicular frequency in the state of Tripura is not significant. Present status of surface and ground water quality indicates shows high iron level in the ground water in majority of the blocks throughout the state. In few blocks manganese was also observed to be higher than the permissible limit for drinking water quality as per BIS standard. Present status of soil quality shows that in general the soil in various blocks of Tripura is slightly acidic to neutral in nature.

Agencies responsible for implementation:

- Tripura State Pollution Control Board

Study Title

Geo-Environmental Status of Haora River

Implementing Institution

Tezpur University

Project Location/Completion Year

Tripura, 2011

Objective

To investigate the Geo-Environmental Status of Haora River

Study Recommendation

- Deforestation should immediately be stopped in the upper catchment of the river.
- Lifting of uncontrolled and excess amount of water from the river should be stopped.
- Unscientific collection of sediment from the river bed should be stopped.
- Excavation of sediment from the valley side areas as well from surrounding flood plains should be controlled to regulate the unnatural shifting of the river course.
- Brick fields from the river side should be shifted to at least 1km away from the river course.
- Resettlement buildings and infrastructures from the river valley.
- Waste treatment plants should be constructed to monitor waste water before releasing into the river.
- Dumping of solid waste; use chemical fertilizers and pesticides in the agricultural fields along the river course; dispose of toxic substances into the river should be stopped.
- Mass awareness programme should be organized to educate the people of the importance of rivers

Analysis and Outcome

This study was undertaken to assess the present Geo-environmental status of the Haora river in Tripura, under the initiative and financial assistance of Tripura State Pollution Control Board. The river flows through Agartala and is the major river which flows in the Sadar subdivision of the Western District of Tripura. The river possesses a basin area of about 457.97 sq km. The present study involves the analysis of the hydrological condition of river from Chandrasadhubari to downstream. A number of cross sections have been drawn from Chandrasadhubari (where the river crosses the NH 44 and meeting with one of its important tributary Bardwal) to Agartala at different critical points near the NH 44 and some important confluences with its important tributaries. The recommendations of the study are fully addressed under the Howrah River Front Development Project Phase I – II a Special Purpose Vehicle, Agartala Smart City Limited (ASCL), under the Government of Tripura ^[182].



Study Title

Final Report on Biodigester Toilets for Improved Sanitation Facilities in Schools in Nazira Block, Sivasagar District, Assam Under ONGC TERI Biotech Limited's (OTBL's) CSR Initiative

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2020

Objective

Installation of biodigester toilets for improved sanitation facilities in schools in Nazira Block, Sivasagar district, Assam

Study Recommendation

- Campaign for the students to inculcate the habit of keeping the toilets and premises clean,
- Awareness programme to sensitize the student and creating awareness among the student and teacher.
- Awareness on operation and maintenance of the toilet clean at school level.

Analysis and Outcome

Ten schools were selected based on the feasibility study conducted in 15 schools for the construction of toilet at schools in Nazira block, Sivasagar district, Assam under the CSR initiative of OTBL programme. Design of the toilets were prepared, and construction works completed in all the 10 schools. Sensitization and awareness generation programmes were conducted in the schools. Constructions of toilets in all the 20 schools have been completed. The objective and recommendation of the study were successfully implemented.

Study Title

Sustainable Utilization of Solid Waste as a Source of Plant Nutrient in Rice Based Agroecosystem of North-East India

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2015

Objective

- To convert the solid waste into organic manure for better nutrition to crop plants through vermicomposting technology.
- To study the changes in soil health due to application of vermicomposted products from solid wastes.
- To demonstrate the efficiency of vermicompost in reducing the use of inorganic fertilizer in agricultural fields of Assam (surrounding areas of Tezpur).
- To establish vermicomposting technology as a tool for sustainable use of solid waste in rice-based cropping system of this part of North-East India.

Study Recommendation

- The samples are alkaline in nature with the presence of organic matter in municipal solid waste.
- High EC of the samples reveals the lower level of salinity in the TSW, which is an essential character for bio-composting.
- Status of availability of all the three major nutrients in TSW viz., N, P, and K were also found to be on higher side.
- Total concentration of metals viz. Fe, Cu, Mn, Zn, Cr and Ni, were noticeably high and thus is a matter of serious concern which warrants further intensive study focusing on stabilization of these elements within permissible limits.



Analysis and Outcome

Solid waste is the unwanted or useless solid materials generated from human activities in residential, industrial, or commercial areas. The increased population has increased the formation of solid waste from various sources such as households, gardens, agricultural fields, industries, etc. The solid waste generated from the agriculture sector and household can be used as manure after decomposition. The study was based on conversion of solid waste into organic manure via vermicomposting. The change in soil health was observed after utilization of vermicompost. The identification of efficiency of vermicompost than inorganic manure was also one of the objectives. The development of vermicompost technology for the future sustainable use of solid waste was also targeted. The study found that the concentration of Fe, Cu, Mn, Zn, Cr and Ni, was noticeably high. Therefore, the report recommended an intensive study focusing on the stabilization of these elements within permissible limits. The recommendations of the present study are partially implemented.

Implementable recommendations:

- Maintaining lower salinity in solid waste
- Stabilization of these elements within permissible limits

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board
- Ministry of Water Resources, River Development and Ganga Rejuvenation

Study Title

Integrated Watershed Management Project WJH - IWMP – X

Implementing Institution

Soil & Water Conservation Department, Govt of Meghalaya

Project Location/Completion Year

Meghalaya, 2014

Objective

Management of the micro-watersheds namely (i) Amlympiang (ii) Amkahoh Situated in Nongtalang, Sohka Shnong, Sohka Mission and Sohka Phlang villages. The total area of the micro-watershed is 2867 Ha with 2630 hectares to be treated under the Integrated Watershed Management Programme (IWMP) which falls under the High Priority category as per the prioritization of watersheds by the North East Space Application Centre (NESAC).

Study Recommendation

- A Watershed Committee to be formed in each villages
- Villagers to extend all possible help for implementing the Integrated Watershed Management Programme (IWMP).
- Share the common profit for the villages including the weaker section, women and the landless

Analysis and Outcome

The general topography of the area is an undulating often covered with grassy banks of enormous size dotted with pine trees individually or in small groups. The ground is generally gentle sloping with slopes varying from 10 percent to 60 percent. The area is mainly drained by Umngot River.

The study implemented sustainable land use practices and water management practices to protect and improve the quality of the water and other natural resources within a watershed. The recommendation of the study was fully implemented. The study resulted in minimizing the effects of waste and degraded lands. It also addressed the problem of acute shortage of potable water in the villages. Overall the study led to the development of land, agro-forestry, and agro-horticulture thereby increasing the livelihood and agricultural product and also enhance the ground water table in the watershed area.



Study Title

India: North Eastern Region Capital Cities Development Investment Program – Shillong Solid Waste Management Subproject

Implementing Institution

State Investment Program Management and Implementation Unit (SIPMIU)

Project Location/Completion Year

Meghalaya, 2011

Objective

- Upgrade the existing SWM services to make them scientific and more efficient and to adopt sanitary landfilling for ultimate disposal as per Municipal Solid Waste (Management and Handling) Rule (MSW Rules) (2000) in the interests of health and economic well-being of the people of Shillong.
- Provide the long term (till 2041) solution of the problem of solid waste management by way of modernization of the system through modern household and community bins for separate collection of biodegradable and non- biodegradable wastes, and recyclables, closed body transportation of garbage, dressing sanitary landfill site with bull dozers and compacting with land compactor, supplying Personnel Protective Equipment (PPE) to the laborers and rag pickers to protect their health.
- Besides, generation of revenue by better collection of user charges through effective creation of community awareness and selling of compost and recyclables.

Study Recommendation

- The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed for the Shillong Solid Waste Management Subproject.
- Potential negative impacts were identified in relation to construction and operation of the improved infrastructure, but no impacts were identified as being due to either the subproject design or location.

Analysis and Outcome

The study was carried out to address the inadequate solid waste infrastructure in Shillong for the needs of the growing population. There are too few collection points and people deposit their solid waste on open grounds where it creates unhealthy environment and produces health hazard. Although the municipality collects the waste from these areas periodically, the service is not systematic [155]. Similarly for the final disposal of the waste generated by the city, although there is a 100 TPD compost plant in operation, there is no systematic and scientific way for the final disposal of the rejects from the compost plant. All the recommendation of the study is fully implemented.

Study Title

State-specific Action Plan for Water Sector: Arunachal Pradesh

Implementing Institution

TERI School of Advanced Studies

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

- To assess and evaluate the impact of climate change on water availability of both surface and groundwater resources at the sub-basin level
- To provide technological options for sustainable water resources planning and management

Study Recommendation

Interventive measures have been suggested for each sector.

- Flood control: construction of embankment, spurs and guide bunds, etc.
- Urban development: urban transport and urban mapping; building sewerage line and stormwater drainage in 26 urban settlements; connecting all the unconnected 2741 habitations.
- Water resources: Focus is on Rooftop rainwater harvesting schemes, source protection, gully plugging, check dam, catchment area protection, contour trenching, impounding reservoirs, and artificial recharge.
- Health: Controlling vector-borne disease research, mosquito control measures, an improvement of access to and use of services

Analysis and Outcome

The present study assessed the need to define problems related to all the aspects of water resources specific to Arunachal Pradesh. The study also identified probable solutions and evaluation of alternatives covering the impact of climate change, cost-benefit analysis, technological gaps, and policy framework including legal and institutional linkages for optimization of water resource utilization as conservation holds utmost importance. Further it assessed and evaluated the impact of climate change on water availability of both surface and groundwater resources at the sub-basin level to provide technological options for sustainable water resources planning and management.

The status of implementation of the recommendation is not known. The study will have high impact in terms of climate change mitigation and adaptation in water sector of Arunachal Pradesh. The Arunachal Pradesh government on 18 August 2021 announced a 26-year road map to minimize and mitigate the impact of climate change [38]. The plan titled 'Climate Change Management Mission-2047' sets goals for water conservation and management of habitat, agriculture, forest, energy, health, transport, waste, and disasters in the next two decades[39].

Agencies responsible for implementation:

- Department of Environment and Forests, Government of Arunachal Pradesh



Study Title

Estimating sediment and water yield from hills of Guwahati city

Implementing Institution

Indian Institute of Technology, Guwahati

Project Location/Completion Year

Assam, 2017

Objective

To estimate the sediment and water yield from the hilly watersheds of Guwahati City to help adopting management measure

Study Recommendation

- Considering the need of management requirements hills of Guwahati have been delineated into 612 watersheds.
- Peak discharge has been calculated using Rational Method for the year 2011 and 2015 for a return period of 100 years, 50 years and 25 years. Considering further development in the hill and the impact of climate change, use of 25 year return period is recommended.
- Sediment loss from the catchment has been calculated for 2 values of Rainfall Erosivity factor (R). One represents a high return period in the order of 50 years and another for a return period in the order of 2 years. For practical purposes, 2 year return period value can be used.
- As the hill slopes are very steep and the distance to foot hill is very less, delivery factor has not been considered for this estimation of sediment loss.
- For convenience of practical application, watersheds are divided into some classes based on degree of degradation.

Analysis and Outcome

The area of land which drains water into a specific waterbody is called watershed. It drains water from rainfall and snow fall into river, stream, and nearby other water bodies such as pond, lake, pools, etc. Watershed play an important role in water conservation. Watersheds are also the source of huge sediments. Therefore the management of watershed has become an urgent need of the current situation. Watershed management is a term that describes the use of land, forest, and water resources in ways that do not harm the plants and animals living there [46]. The present study was focused on the estimation of sediments and water yield form the hilly watersheds of Guwahati city for adopting the management measures. There was a specific recommendation given in the present study for classifying watersheds into different classes based on the degree of degradation. The recommendation of the study is partially implemented. The report of the study investigated a 25 year return period by considering the impact of climate change. The sediment loss study was calculated for 2 values of rainfall Erosivity factor of which one represented high return period in the order of 50 years and another for a return period in the order of 2 years. Another possible and potential recommendation of the present study may be the management of watershed.

Implementable recommendations:

- Potential measure for the management of watershed.
- Dividing watershed into some classes based on degree of degradation.

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Ministry of Water Resources, River Development

Study Title

Impact of Developmental Interventions on Algal Diversity in Deepor Beel– a Ramsar Site

Implementing Institution

Gauhati University

Project Location/Completion Year

Assam, 2015

Objective

- To inventorise and document the existing algal diversity in and around Deepor beel.
- To study the periodicity and seasonal dynamics of algal population in Deepor beel.
- To assess the physico-chemical constituents of water in Deepor beel in relation to developmental interventions.
- To assess the impact of developmental interventions on algal diversity.

Study Recommendation

- As the area under the Wildlife Sanctuary was comparatively cleaner, the Sanctuary boundary may be extended.
- As the biggest threat to the beel is the municipal corporation's garbage dumping station, it may be removed from the place.
- Biomonitoring with the Palmer's algal pollution indicators may be initiated in each and every corner of the beel on a regular basis.

Analysis and Outcome

A Ramsar Site is a wetland site designated to be of international importance under the Ramsar Convention which was signed in 1971. The Ramsar sites are home to vulnerable, endangered, and critically endangered species. It supports various plants and animals population to support biological diversity. More than 20,000 water birds have been reported to be present in Ramsar sites. The various anthropogenic activities have led to the loss of Ramsar sites, mostly due to land-use patterns and other developmental interventions. Deepor beel is a permanent freshwater lake in the former channel of Brahmaputra river [54]. It has great biological importance. There is no other stormwater storage basin except this, hence it becomes more important. It acts as a staging site for the migratory birds where largest concentrations of aquatic birds are found in winter. The objective of the present study was to assess the physico-chemical properties of water and the impact of developmental interventions on algal diversity in Deepor beel. After the study, the report recommended to extend the boundary of the sanctuary. The municipal corporation's garbage was the biggest threat to the beel which was recommended to be removed from the site. The biomonitoring of algal pollution in the beel was also recommended on a regular basis. All the recommendations of the report were implemented well.

Implementable recommendations:

- Extend the boundary of the sanctuary
- Removal of garbage for the site
- Biomonitoring of algal pollution

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board



Study Title

Promoting Best Practices in Water, Sanitation and Hygiene

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2015

Objective

- Assess the present situation of water, sanitation and hygiene practices in Assam.
- Disseminate scientific knowledge on water, sanitation, hygiene and nutrition amongst the community members.
- Establish water resource center within the school premises to create awareness on WaSH practices among students.
- Awareness generation and capacity building of the identified stakeholders through workshops, trainings, by local folklore, art, culture and development of resource kit including films, e modules, posters on the issue of concern.

Study Recommendation

- The community members should be made aware of various government schemes on water and sanitation.
- It is important to establish linkages between community members and government officials for problems such as collection of waste from site and regular supply of water from the public water supply.

Analysis and Outcome

Water scarcity, poor sanitation, inferior drinking water quality, and lack of awareness on proper hygiene and sanitation practices are issues that hamper the social, economic and psychological development of an individual and as well as the community on the whole. The project was implemented in two villages – Tatimara and Thakurkuchi in the Chandrapur region of Kamrup district of Assam. Through its training and capacity building component, the project provided an opportunity to the community members to gain knowledge on the best practices related to water, sanitation, and hygiene through the use of Information, Education and Communication (IEC) material. A Water Resource Centre was also established to function as a storehouse of information and material on WaSH issues for awareness generation and promotion of best WaSH practices in the community. Some of the major achievements of the project were Earth Day Awareness Campaign; Painting Competition on Earth Day; Discussion Forum on Menstrual Hygiene for Girls; Development of Hand Washing Time Table; Collection and analysis of data on prevalence of vector and water-borne diseases. The recommendation of the study was fully implemented.

Study Title

Study of Arsenic Contamination in Water and Soil in Parts of Toposheet Nos. 83b/12 & 16 in Parts of Nagaon and Marigaon Districts, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2014

Objective

- To map arsenic distribution pattern in ground water, from existing tube wells and also to delineate the arsenic-high and arsenic-low ground water zones in specific areas with reports of arsenic.
- To monitor a few selected tube wells in areas of high arsenic zones.
- To prepare the inventory of affected populace and suggest remedial measures.

Study Recommendation

- In the area, it has been noticed that despite contamination of groundwater with arsenic varying from 25 ppb to 100 ppb, no impact could be seen on the local populace. Possible reasons can be occurrence of arsenate or arsenic in pentavalent form in the groundwater which causes no impact.
- Detailed study is required to further investigate this cause by carrying out arsenic speciation studies through ion chromatograph to detect the occurrence of arsenate and arsenites in groundwater.
- Since the surface water sources are devoid of arsenic as well as fluoride contamination, the surface water can be well utilized for drinking purposes. Both shallow and deep aquifers located on the Newer Alluvium should be examined before utilising for drinking purposes. Low arsenic zone areas should be well utilised for drinking purposes.
- People awareness programme should be arranged door to door to motivate people not to use drinking water from unknown sources particularly from tube wells. Rain water harvesting may also be an alternate source of potable water in the areas under study.



Analysis and Outcome

Arsenic is one of the metalloids which is naturally present in the rock. The erosion of such rock increases its concentration in the natural water bodies. It enters into water bodies by anthropogenic sources also. Its permissible limit in drinking water is 10 ppb. The contamination of arsenic in groundwater is brought by the exposure of bedrock with atmospheric oxygen. The water contaminated with arsenic cause a disastrous impact on human health. Therefore, identification of its distribution pattern is very important. The objective of the current study was to mapping of the pattern of arsenic distribution in ground water from the existing tube wells. Monitoring of tube wells in high arsenic zones and preparation of an inventory of the affected population and suggesting remedial were also its important objectives. Such kind of study will help in investigating the arsenic contaminated regions for safety purposes [67]. The absence of impact on the population in spite of concentration up to 100 ppb suggested the presence of arsenic in pentavalent form. The report suggested to do a detailed study to investigate the speciation of arsenic. It is recommended to use surface water and organizing awareness program. The analysis of the study concluded that the recommendations were essential and considered seriously [68]. All the recommendations were implemented well.

Implementable recommendations:

- Investigation of arsenic speciation
- Use of surface water in arsenic contaminated zone
- Rain water harvesting

Agencies responsible for implementation:

- Ministry of Water Resources, River Development and Ganga Rejuvenation
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board
- State Pollution Control Board

Study Title

Aamloga-Barasapur Soil Conservation and Water Distribution Project in Sonitpur District of Assam

Implementing Institution

WAPCOS Limited

Project Location/Completion Year

Assam, 2010

Objective

- Prevention of accelerated soil erosion and degradation thereby conservation of soil and water.
- Improvement of drainage system and irrigation facilities to the cultivable lands through construction of drop structures, earthen channels etc.
- Improvement of in-situ moisture conservation through construction of small agricultural field bunds in appropriate position.
- Poverty alleviation through Improvement of overall socio economic conditions.

Study Recommendation

Project achieved by successful implementation of the Aamloga-Barasapur Soil Conservation and Water Distribution Project in Tezpur sub-division, Sonitpur district of Assam under Soil Conservation Department. It was also observed that due to implementation of the project not only the agricultural activity in the project area has increased but also the socio-economic condition of the people has improved thereby creating a very good social impact.

Analysis and Outcome

Water is the most precious, life supporting natural resource present on the earth. It is essential not only for survival of life on earth but also for sustenance of environment. The sustainable use of land and water resources, conservation of water and soil, reduces the hazards to natural resource. In addition, it also improves the socio-economic condition of the people. The major objectives of the present study were the prevention of accelerated soil erosion followed by conservation of soil and water. This study is essential for the holistic development of environment [84]. The analysis of the report revealed that the objectives of the projects were achieved by successful implementation of soil conservation and water distribution project in Tezpur sub-division, sonitpur district of Assam under Soil Conservation Department. It was also observed that the implementations of the project, the agricultural activity and socio-economic condition of the people were uplifted. The analysis revealed that the recommendations of the projects were implemented completely.

Implementable recommendations:

- Construction of drop structures
- Improvement in the socio-economic condition of the people
- Soil conservation and water conservation

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)



Study Title

Report on the Feasibility Stage Geotechnical Investigation for Upper Khri Diversion Project, West Khasi Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2014

Objective

Provide geotechnical inputs by means of site geological studies at several project components and subsequent recommendations as per site requirements to the Project Authorities, as and when requested.

Study Recommendation

Rock mechanics tests such as Unconfined Compressive Strength (UCS), (IS:9143-1979, reaffirmed 2001) depending upon type of structure and load etc. may be carried out as per the requirement of the designers.

Analysis and Outcome

The main objective of the current project was offering geotechnical inputs via geological studies of site. Such kind of studies act as additional tool for carrying out geological studies properly. The report of the study recommended very essential point to achieve the target [150]. The analysis of the report identified that the recommended Unconfined Compressive Strength was carried out to meet out the objectives. Although the current status of the recommendation has been achieved but still, it must be continued for the future study for better results. The analysis of the report revealed that the recommendation was implemented.

Implementable recommendations:

- Carrying out Unconfined Compressive Strength test

Agencies responsible for implementation:

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Geological Survey of India (GSI)
- Department of Land Resources of Ministry of Rural Development

Study Title

Storm Water Drainage System for Gangtok, Sikkim

Implementing Institution

WAPCOS Limited

Project Location/Completion Year

Sikkim, 2012

Objective

To formulate a Master plan based on scientifically designed system of drains to provide safe and adequate passage for storm water in order to safeguard life and property of the town dwellers and prevent any fatal occurrence in future.

Study Recommendation

The project has been successfully implemented. The public and its properties both at micro and macro level have been safeguarded from any hazards of landslides and soil erosion in the future

Analysis and Outcome

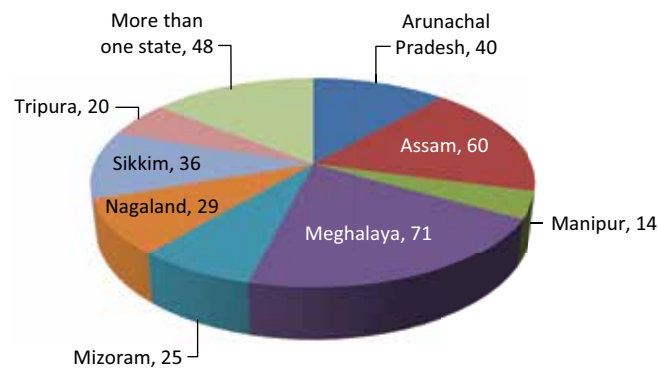
The purpose for which the above project was approved by the North Eastern Council (NEC) has been fully achieved by successful implementation of the item of works for Storm Water Drainage System for Gangtok, Sikkim (10 nos. of Jhora Training Work) under I&FC Department. It was also observed that due to implementation of this scheme the destruction to life and property due to frequent landslides during monsoon season has reduces thus creating a very good social impact.



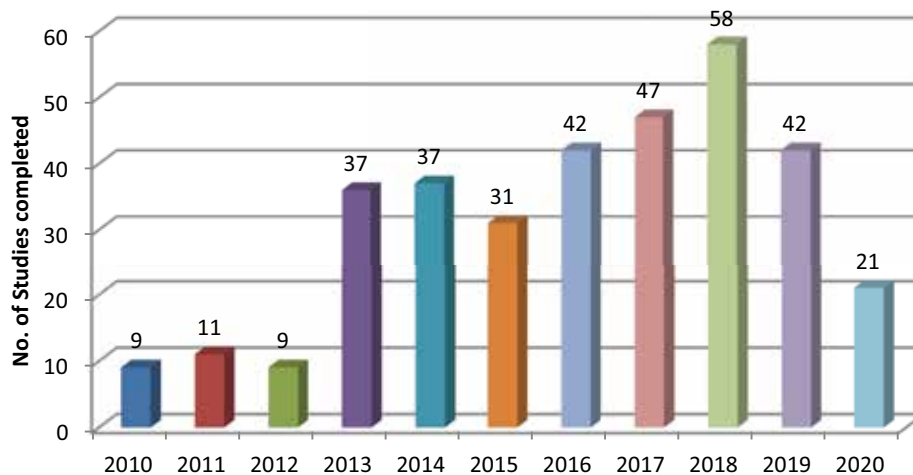
State-wise Summary

In the present study, 344 research studies have been collected and analysed. These research studies have been conducted during 2010 to 2020 in the North Eastern Region (NER) by the academic and research institutions. Based on the study reports collected, it has been observed that maximum number of studies were conducted in Meghalaya (71), followed by Assam (60), Arunachal Pradesh (40), Sikkim (36), Nagaland (29), Mizoram (25), Tripura (20), and Manipur (14). There were 48 studies that were carried out in more than one state. The maximum number of studies (58) in the environment sector were conducted in 2018.

There are several studies, which have been conducted in the environment sector like geological mapping for the natural resources, disaster management, arsenic poisoning, management of flood, development of urban infrastructure for upgrading the environment and improving the quality of life, upgrading sanitation in rural areas, the impact of climate change on precipitation, use of remote sensing for flood control measures, disaster caused by climate change, biodiversity distribution, forestry, natural resources, conservation of soil and water, etc. These studies played a great role in improving the potential of nature-based solutions, mitigating climate change, improving sanitation, conservation, etc.



Studies completed in Environment Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Environment Sector in NER during 2010 to 2020 (Year-wise)

Meghalaya

Meghalaya has conducted the maximum number of studies on the environment. The total number of studies conducted in Meghalaya was 71. It is rich in biodiversity having a huge number of species of mammals, birds, and plants. In addition, Meghalaya is also rich in mineral resources. There is an urgent need for the conservation of biodiversity-rich regions of Meghalaya. As per the recommendations, the study related to the exploration can identify mineral-rich zones in Garo, and Khasi Hills. The studies conducted here were related to the exploration of minerals, petrochemicals, environmental impact assessment (EIA), forest management, conservational activities like the characterization of community reserves, conservation values, mining, disaster-like landslide management, tectonic movement, etc. Except few, all the studies were successful in the past decade, which contributed and suggested potential points to upgrade the environment. The studies recommended several new areas of research related to the objectives and location of research being done, which will promote sustainable mining, urban infrastructure development, conservation and management of forests, etc.

Assam

Based on the collected study reports, there are 60 studies that focussed on the environment sector in Assam. Assam is one of the North-eastern states, which is rich in biodiversity and some regions of Assam are in the eco-sensitive zone. It is also very prone to flooding. Here the maximum number of studies are based on flood mitigation and flood management, which was followed by the conservational studies of biodiversity, ecosystem, arsenic poisoning, etc. Some studies were also carried out on geological mapping for investigation of earthquake-prone zone, mineral richness, and other geological studies. The reports of the studies on these projects recommended enhancing the potential to hold surface run-off so that the flood could be controlled. Such kind of study is very urgent to be continued in flood-prone regions like Assam because it is one of the important reasons for the loss of biodiversity. Therefore, such projects in the future should be done on a priority basis.

Arunachal Pradesh

Based on the collected study reports, from 2010 to 2020, the total number of environmental projects allocated to Arunachal Pradesh was 40 in which the maximum number of projects were allocated in 2016. There are numerous environmental issues related to the environment in Arunachal Pradesh due to rapid urbanization, industrialization, and intensive agricultural activities. Loss of biodiversity is one of the most devastating problems in Arunachal Pradesh. It is rich in mineral resources too.

The projects allocated were related to geotechnical studies, thematic mapping, landslides, ecosystem restoration, climate change mitigation, biodiversity conservation, etc. Based on recommendations made by the report, several initiatives have been taken to overcome the existing environmental problems in Arunachal Pradesh. As this region is rich in biodiversity, the conservational projects are needed to be done on an urgent basis. The geotechnical studies related to the stability of the slopes are of utmost importance for the development of infrastructures.

Sikkim

In the present collection of study report, since 2010, 36 environmental projects for exploring potential zones of mineralization, geotechnical studies for investigating the stability of the dam slope, etc., have been conducted in Sikkim. Among these projects, the projects on geotechnical studies were dominated because of the formation of several dams in the hilly areas of Sikkim. Maximum projects were allocated in 2016 for investigating the environmental impact assessment of developing projects like hydro energy in the hilly areas, impact of climate change, conservation of biodiversity, etc. Several important recommendations were made for these studies like geotechnical study for finding out the stability of the dams, identification of new locations for mineral exploration, conservation of biodiversity-rich areas, etc.

Based on the EIA report, several environmental management plans were also proposed to mitigate the impacts of developing projects on displacement, resettlement, and rehabilitation of human societies.



Manipur

As per the study report collected, since 2010, 14 environmental projects have been focused on Manipur, including thematic mapping for exploring potential zones of mineralization, photogeological mapping for mapping purposes, geotechnical studies for investigating the stability of the slope, and magnetic survey of chromite-bearing ultramafic rocks, etc. Among these projects, the projects on geotechnical studies were dominated because of the formation of several dams in the hilly areas of Manipur. Such projects were successful and exposed the existing environmental problems.

These studies recommended very important suggestions including systematic and detailed mapping of the proposed area, further investigation of the sub-surface nature of chromite bodies, etc. The studies of ecosystem restoration, biodiversity conservation, climate change, flood, etc., revealed that much work has to be done in the environmental sectors in Manipur. Therefore, in future, these projects would be appreciated in these regions.

Nagaland

As per the collected study reports, during 2010 to 2020, a total of 29 studies were conducted in Nagaland especially focussing on various kinds of mapping such as Macro-Scale (1:50,000) landslide susceptibility mapping for preparing landslide inventory database, geochemical mapping of Ophiolite belt for creating the database, corridor mapping establishing a detailed lithostratigraphy and tectonic relations between different lithological units across Schuppen Belt of Naga-Arakan Yoma Suture. Such studies helped much to develop the infrastructure, and expansion of towns which were suggested to be carried out in the low susceptibility slopes. The projects on locating the mineralization zones for chromium, copper, nickel, and other base material in ultramafic rocks also identified a good number of mineral zones. This Study resulted in several important recommendations such as an investigation of coal in Jenam and Renji formations of the Barail Group of rocks, a geophysical survey (Magnetic, SP/IP) along with detailed mapping and close grid sampling along the strike of the limonitized zone.

Studies related to seismic and landslide hazards were also very helpful to identify the level of risk, which could be used to mitigate the disaster and urban planning. The studies like seismic and landslide hazards should be carried out thoroughly in the hilly areas for early warning and mitigation. All the projects carried out were important and resulted in potential results. The recommended studies were also very important and must be carried out.

Mizoram

In the present study report collection, a total of 25 studies have been conducted by Mizoram since 2010 on the environment sector. Major kinds of studies were related to geological mapping for combating natural hazards such as landslides and earthquakes, and the development of infrastructure and towns. The outcome of these studies was very significant, which identified the locations of weak zones and thrust areas. There were very important recommendations for systematic and detailed mapping of the proposed area so that such zones can be identified completely. Therefore, a project related to such studies was suggested in the future also.

In addition, the studies related to environmental impact assessment, arsenic pollution, biodiversity, and mineral exploration were also carried out. These studies were very much successful to overcome the mentioned environmental issues. The mineral exploration study has identified several mineral-rich zones of limestone and sandstone. It was recommended to identify other such zones of the same minerals. Therefore, the study related to mineral exploration must be carried out in the future. Overall, all the projects allocated are very significant for the sustainable growth of the State.

Tripura

Tripura is the state which conducted minimum projects related to the environment. The total number of projects conducted by Tripura was 19. These projects allocated in the environment sector were related to thematic mapping, mineral exploration, conservation of biodiversity, seismic activity, development of infrastructure in such zones, landslide susceptibility mapping, etc. The outcome of these studies was very significant in achieving the targeted objectives. The outcomes have improved the development of basic infrastructures like a dam for hydropower generation in Tripura, which have great potential for electricity generation.

The landslide susceptibility mapping is encouraged to be carried out in future studies also. The thematic mapping of mineral-rich zones has identified the zones rich in glass sand, limestones, etc. The environmental impact assessment of several developing projects suggested sustainable development of hydroelectricity dams in the hilly areas of Tripura. The resettlement and rehabilitation of the population affected by the developing activity were also recommended to complete on a priority basis. The rapidly increasing population led to rapid urbanization, which was studied thoroughly and recommended several important suggestions to restore the ecosystem of the Tripura region. It was also suggested to conduct ecosystem restoration projects in the future also.

Overall Scenario

Majority of the past research studies were found to be on environmental aspects. Environmental studies conducted in the past, primarily focused on disasters both natural and anthropogenic, biodiversity and ecology, water resource management and environmental impact on human lifestyle. The disaster related studies inferred on the significance of early warning system and monitoring for flood, earthquake, abnormal rainfall pattern, etc. and pointed out associated complications given the unique topography of the region. However, recommendations highlighted need for robust scientific guidelines and framework with city architecture based on site-specific baseline data.

In NER, several issues were identified like expansion of township which is deteriorating the natural ecosystem and also inviting disastrous incidents like landslide. Therefore, the expansion should be done only in low susceptibility slopes. The future research and development should be focused on preparation of landslide susceptibility map which helps in assessment of Landslide hazard, urban planning and mitigation.

The NER are rich in mineral resources such as coal with high Sulphur and Mn Ni Cd, Cu, Pb, Fe, Mg, etc. For the identification of mineral, systematic geological mapping must be carried out. Mining of these minerals creates several environmental problems like deforestation, habitat loss, loss of biodiversity, soil erosion, damage of large scale landscape, and pollution. The report of the study recommended for sustainable use of coal and focus on clean energy development. The research and development should focus on the development of renewable energy.





6.7 HEALTH AND NUTRITION

Study Title

Optimization of Load-Carrying Capacity in Sherpa and Backpack Mode for Agricultural Workers (Male and Female) of Arunachal Pradesh

Implementing Institution

North Eastern Regional Institute of Science and Technology

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

- Conduct the maximum capacity test of selected subjects (male and female).
- Determine load-carrying capacity in various speeds and slopes.
- Evaluate perceived exertion rating through questionnaire.
- Suggest ergonomically improved basket for carrying load in the Sherpa mode.

Study Recommendation

- A lumbar-shaped pack will be more comfortable, as it helps distribute weight evenly.
- Apply the principle used in contoured chairs. Padded shoulder straps will put less pressure on the shoulders and will also help take pressure off the lower back.
- This design will help to provide support and evenly distribute the weight load on the back, causing less strain and problems. A padded hip belt will be provided for comfortably supporting the weight on the hips.

Analysis and Outcome

The outcomes of the study will benefit agricultural workers in the region, especially in improving physical tolerance while taking the head-supported load for day-to-day activities. The assessment of discomfort in carrying agricultural load is valuable information for determining the physical match between agricultural workers and their work. The effect of agricultural load needs to be considered while determining workload parameters in open field conditions. The outcome of the study will be useful for formulating strategies and government policies for the entire region.

More awareness and demonstration programmes on the benefits of an ergonomically improved basket for carrying load in the Sherpa and backpack modes need to be conducted for the agricultural workers. Further research is needed by involving more stakeholders to fully understand the impact on physiological and perceptual responses associated with the Sherpa and backpack modes of load-carrying technique. In addition, field exploration can be performed to compare the findings of laboratory outcomes with the real situation in the sector. Proper implementation of ergonomic interventions for carrying load will ultimately improve the economy of the region.

Agencies responsible for implementation:

- Department of Agriculture, Government of Arunachal Pradesh
- Ministry of Agriculture and Farmers Welfare, Government of India

Study Title

Health Related Demography of the Scheduled Caste Population in Kamrup District, Assam

Implementing Institution

Regional Ayurvedic Research Institute for
Gastro-Intestinal Disorders

Project Location/Completion Year

Assam, 2017

Objective

- Organize OPDs to provide health-care services to the neglected population of the covered area.
- Conduct health awareness camps in schools, temples, and gurudwaras.
- Carry out door-to-door surveys to create awareness about the objectives of the programme to the population covered.

Study Recommendation

- The main prevalent diseases were found during the survey: *Amlapitta, Vatavyadhi, Sandhi Suta, Sirahsula, Sandhivata, Twakroga, Kasa, and Pratisyaya*.
- It was found that most of the diseases are probably due to their living condition, environment diet, life style, and socio-economic status as well as lack of health awareness and non-availability/inaccessibility of primary health-care services.

Analysis and Outcome

An improvement in the socio-economic condition of the scheduled caste community can go a long way in the mitigation of the prevalent diseases among the community in the region. The results of the study have been applied in further studies in this area. Various policies and actions adopted have seen a positive outcome and have led to the improvement in the conditions of this deprived group. However, ignorance and social boundaries related to caste system have been barriers to improvement in the health-related issues of the community.

Health awareness measures and health-care services need to be improved considerably in the region. For significant progress in increasing the human development status of the scheduled castes, development organizations must continue to explore varying levels of incentives and pursue national social equality in the region.

Agencies responsible for implementation:

- Directorate of Welfare of Scheduled Castes, Government of Assam
- Department of Health and Family Welfare, Government of Assam
- Ministry of Health and Family Welfare, Government of India



Study Title

Understanding Sexual Health and Rights of Youth with Disabilities in Assam: A Study

Implementing Institution

Foundation for Social Transformation

Project Location/Completion Year

Assam, 2016

Objective

- Understand the sexual and reproductive health (SRH) needs of young people with disability (YwD) in Assam, India.
- Examine the sexual and reproductive health knowledge, experiences, and needs of young people with intellectual or physical disability.
- Identify barriers to accessing SRH information and services.
- Gauge the level of knowledge and preparedness of parents or caregivers of young people with disability on various sexual and reproductive health and rights (SRHR) and understand the challenges faced by teachers of young people with disability at the institutions and their training needs thereof.

Study Recommendation

- Sensitize people who interact with youth with disabilities.
- Including comprehensive sexuality education in the institution curriculum for 15+ years old youth with disabilities.
- Develop a training module on sexual health and sexual rights of youth with disability with a focus on sensitization for teachers, special education, NGO staff, and caregivers.
- Develop relevant communication aids for ease of information dissemination among the youth.

Analysis and Outcome

Connections between disability and sexuality are still not often articulated. The study is, therefore, significant for understanding the sexual and reproductive health needs of young people with disability in the state. The recommendations of the study have been partially implemented. Several disempowering and stigmatizing myths exist that contribute to large-scale human rights violations. It is important to disseminate the project learning and bring together different civil society organizations, academicians, doctors, lawyers, media persons, policy makers, parents, and students for a dialogue process and taking it forward.

The findings of the study suggest there is a dearth of information on sexual health and rights for people with disabilities. Adolescence issues of youth with disabilities require to be addressed in a manner that includes parents, educators, and caregivers who can deal with the youth in a more structured way. Widespread public education and awareness on sexual health for persons with disability are required to dispel misconceptions and instil respect in human rights related to sexual health. Monitoring is the key tool for mapping the effect of interventions, enabling periodic reviews and planning course corrections as required.

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Assam
- Ministry of Health and Family Welfare, Government of India

Study Title

Coverage Survey on Immunization 2014–15, Dhalai District, Tripura

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Assam, 2015

Objective

Assess the immunization coverage of children in the Dhalai district of Tripura.

Study Recommendation

It is seen that on an average only 58% of the children within a year had received full immunization and 33% were partially vaccinated. Of the eight blocks, Manu has recorded the lowest full immunization coverage, only 22%. Raishyabari and Chamanu also recorded very low full immunization—only 33% and 45%, respectively. Therefore, the districts and the state need to take corrective measures so that all the children can be fully immunized within a year.

Analysis and Outcome

From the study, it is noted that on an average only 58% of the children within a year had received full immunization and 33% were partially vaccinated. The main reason for non-immunization was place of immunization being too far. In this situation, the launch of Mission Indradhanush and then the Intensified Mission Indradhanush by the Government of India has resulted in a major boost for the district. Inter-sectoral convergence along with intensive planning and monitoring is the main feature of the mission.

With the ramped-up infrastructure, utilization of manpower, well-planned programmes, and better execution, the health workers succeeded in creating an immunization-friendly atmosphere and mindset. According to the data from April–June 2020, the immunization cycle of Dhalai district, almost 100% coverage was reached in the case of pregnant mothers of BCG immunization ^[185].

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Tripura
- Ministry of Health and Family Welfare, Government of India



Study Title

Longitudinal Analysis of Changes in Cytokine Profiles of Malaria Patients at Different Stages of Treatment and Disease Resolution

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2015

Objective

- Study the expression of cytokine gene and cytokine protein levels in the symptomology of *Plasmodium falciparum* malaria.
- Study the temporal changes in the level of the relevant cytokines with disease progression or regression following drug treatment.
- Compare the expression of the Foxp3 gene in complicated and uncomplicated malaria cases.

Study Recommendation

No specific recommendations. The following leads are given:

- TNF-alpha, IL-10, and TGF-beta discriminated between severe and uncomplicated malaria suggesting these cytokines to play a role in severe malaria pathogenesis.
- An over-exuberant pro-inflammatory cytokine response with decreased IL-10 levels in SM followed by an increase in levels with the resolution of parasitaemia hints at the possible modulation of host cytokine response by parasite factors.
- The study also suggests role of neutrophils with increased IL-8 and IL-1 beta levels in severe inflammation in malaria.

Analysis and Outcome

The ability to mount an effective innate immune response is crucial in limiting the initial phase of malaria infection. The involvement of parasite factors, geoclimatic and social factors, and the host's immunological response have been suggested to play a critical role in malaria pathogenesis.

The data presented in the study suggest failure of mechanisms that regulate the cytokine balance, as indicated by decreased IL-10 expression, which resulted in exaggerated inflammatory response in severe malaria. A significant role of neutrophils in disease severity was observed, which necessitates the importance to understand the host-pathogen interactions that would help design therapeutic interventions to provide optimal pathogen killing with minimal host damage.

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Assam
- Ministry of Health and Family Welfare, Government of India

Study Title

Assessment of Thrombolytic Potential and Anticancer Activity of Fibrinolytic Enzymes Purified from Russell's Viper Venom and Bacterial Isolates from NE India

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2014

Objective

- Purify and biochemically characterize fibrinolytic enzymes from protease-secreting bacteria isolated from the environment and fermented food samples from North-East India and from Russell's viper venom.
- Study the biophysical properties of the fibrinolytic enzymes and their derivatives.
- Characterize pharmacological properties and cytotoxicity of the purified fibrinolytic enzymes and their derivatives.
- Assess in-vitro thrombolytic activity, anticancer activity, gastrointestinal absorption, and toxicity of the fibrinolytic enzymes on mammalian cell lines

Study Recommendation

- Purification of direct-acting fibrinolytic enzymes from bacteria and snake venom, which surpass the in-vitro thrombolytic potential as well as anticoagulant activity of commercially available drugs such as plasmin and streptokinase, and warfarin and heparin, respectively. These enzymes are promising candidates for their therapeutic application and for the prevention and/or treatment of thrombosis.
- Purification of an anticoagulant, anticancer peptide from Russell's viper venom, which at a very low dose shows apoptotic activity against MCF-7 breast cancer cells. This molecule may be developed as peptide-based therapeutic agent for the treatment of cancer. In fact, this is the first report on the purification and characterization of the smallest peptide from snake venom showing dual inhibition against thrombin and FXa.

Analysis and Outcome

Fibrinolytic enzymes are promising candidates for their therapeutic application and for thrombolytic and cancer therapy. Advances in studies of these kinds of enzymes open up great opportunities in the health sector. The recommendations of the study have been partially considered in research studies. Utilizing fibrinolytic enzymes for anti-thrombosis therapy is promising. While different approaches have been used to reduce their side effects, efforts are still needed to overcome the problems associated with bleeding, haemorrhage, and allergic reactions. Further optimization of their production process is also needed in order to design safe and cost-effective drugs ^[186].

Researchers have discovered that using the fibrinolytic enzymes from snake venom can inhibit tumour growth and invasion by fibrin digestion, which creates a favourable condition for immunologic response by immune cells [187]. With specific reference to the region, there is still a need to integrate the research findings into clinical practice to improve the understanding of the action mechanisms of venom proteins in order to develop novel drugs and diagnostic reagents for better results that will further benefit humankind. It is important to continue searching for therapeutic drugs from natural resources, as well as investigate their mechanisms of action in cancer cells.

Agencies responsible for implementation:

- Department of Biotechnology, Government of India
- Ministry of Health and Family Welfare, Government of India



Study Title

Audit of Non-Structural Safety Aspects of 15 Hospitals in Assam

Implementing Institution

All-India Disaster Mitigation Institute (AIDMI)

Project Location/Completion Year

Assam, 2014

Objective

- Assess the vulnerability of hospitals/health facilities from non-structural elements.
- Assess the preparedness of hospitals/health facilities to prevent or minimize the loss of lives during emergencies and disasters in respective towns/districts.
- Recommend non-structural mitigation measures for each hospital/health facility to respond to the need of communities especially during emergencies.

Study Recommendation

- Educate hospitals staff about underlying risk factors.
- Design appropriate mitigation measures for the different hazards.
- Regularly train personnel on the implementation of the preparedness plans.
- Conduct mock drills to test the effectiveness of hospital preparedness to various threats.
- Include all hospitals in Assam in similar assessments and share the findings with all.
- Design a policy for safe hospitals and safe hospitals in emergencies.
- Design and implement state-level strategies to improve the safety in Indian states.
- Establish a dialogue on hospital safety between districts in order to foster experience and knowledge as well as sharing of best practices.
- The Assam State Disaster Management Authority would be the leading authority for the coordination of hospitals in Assam and implement a state-wide policy on safe hospitals and safe hospitals in emergencies.

Analysis and Outcome

The suggestions proposed in the study have been partially implemented in the states. The identified issues can be achieved by the proper implementation of guidelines and rules framed for the purpose of improving safety aspects of hospitals. *The National Disaster Management Guidelines—Hospital Safety* (2016) by the National Institute of Disaster Management lay down the guidelines for the design and safety of hospital buildings ^[188].

Non-structural safety aspects of hospitals need to be ensured by the state disaster management authority. The Assam State Disaster Management Plan ensures that all components of disaster management are addressed to facilitate planning, preparedness, operational, coordination, and community participation. In any disaster response, health facilities like hospitals are expected to play a central role ^[189]. This underscores the mitigation actions as laid down by the plan for significant hazard risks: implement non-structural mitigation activities for building such hospitals and critical infrastructure so as to improve safety; undertake massive training and certification of professionals and construction workers on safe construction practices and retrofitting; undertake structural and non-structural seismic retrofitting of key lifeline/critical infrastructure, including hospitals.

Agencies responsible for implementation:

- Assam State Disaster Management Authority, Government of Assam
- National Institute of Disaster Management, Ministry of Home Affairs, Government of India

Study Title

Modification of Workplace in Rice Mill to Reduce Dust Exposure to the Workers

Implementing Institution

North Eastern Regional Institute of Science and Technology

Project Location/Completion Year

Assam, 2014

Objective

- Develop the working model of dust-free feeding-cum-sieving in laboratory.
- Modify the workplace of feeding and sieving sections in rice mills to reduce dust concentration.
- Compare the dust concentration of rice mills before and after modification.

Study Recommendation

- The feeding section should be combined with an enclosed sieving section.
- Similar modification should be carried out in at least two more mills.
- Awareness programmes should be organized for mill workers about diseases associated with dust.

Analysis and Outcome

Exposure to dust is a major problem in traditional rice mills of Assam. The occupational diseases owing to dust exposure among workers in agricultural industries depend on the constitution and concentration of dust, duration of exposure, and variation in personal immunity. As modifications at feeding and sieving sections of a rice mill are critical for controlling dust exposure, the recommendations of this study have been applied and some mill owners have accepted the proposed modification subject to certain conditions.

In the study, feeding and sieving sections of rice mill were modified by incorporating a hood on the existing sieve with an air-sucking system. Significant reduction in dust concentration was observed. Further, the effect of modification at the sieving and feeding section was also observed at the polishing and packaging system as dust was propagating to these sections mainly from the feeding and sieving section only. The developed system is feasible and cost effective for traditional rice mills of Assam [191]. The technology can be replicated for other similar industry also.

Agencies responsible for implementation:

- Department of Science and Technology, Government of India
- Council of Scientific and Industrial Research, Government of India
- Department of Agriculture and Horticulture, Government of Assam



Study Title

Assessment of Effectiveness of Village Health Sanitation and Nutrition Committee in Assam

Implementing Institution

Gauhati University

Project Location/Completion Year

Assam, 2013

Objective

- Know the effectiveness of VHSNC.
- Examine the role of ASHA and organization of VHNDs.
- Analyse the quality of services given to mother and other beneficiaries during VHND.
- Examine the involvement of the anganwadi workers, ANM, MPW, LHV, etc. in the functioning of VHSNCs.
- Study the other issues related to improvement in the VHSNCs and involvement of other line departments.

Study Recommendation

- All VHSNCs should be patient friendly.
- Orientation/training needs to be given to the members of the VHSNCs so that they become clear about their roles and can work in tandem with the other villagers for smooth functioning of VHSNCs.
- ASHA facilitators must be made responsible for effective functioning of VHSNCs in their areas.
- For the distribution of funds among the BPL beneficiaries to install sanitary latrines, the VHSNCs should select the appropriate person in discussion with all members present in the meeting so as to avoid discrepancy.
- Attendance of pregnant women in VHSNC meeting is very poor. Fruitful motivation is required to bring them to the meeting. Only 25% pregnant women are visited by members other than ASHA.

Analysis and Outcome

The Village Health Sanitation and Nutrition Committee (VHSNC) is an integral element of the National Rural Health Mission. The recommendations of the study have been considered for subsequent planning activities by the central and state agencies. For implementing the recommendations of the study, participation of different stakeholders in the committee functions, especially people from disadvantaged communities, is critical. The VHSNC has a vital role in decentralized health planning and monitoring. The functioning and regulation of VHSNCs need to be improved considerably for more effective actions on issues related to health and its social determinants at the village level.

A study shows that only around 17% of the VHSNCs had conducted regular monthly meetings in the assessed year [194]. There should be a tool that facilitates in planning and implementation according to village-specific health plan, and community monitoring of health services at the village level. A properly coordinated and regularly supervised and monitoring system along with a strict accountability mechanism should help in improving the current scenario of the VHSNCs.

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Assam
- Ministry of Health and Family Welfare, Government of India

Study Title

Analysis of OPRM1 and DAT1 as Possible Candidate Genes for Drug Addiction: A Population Based Association Study in the Indian Population from Manipur

Implementing Institution

Manipur University

Project Location/Completion Year

Manipur, 2015

Objective

- Examine the prevalence of different polymorphisms of DAT1 and OPRM1 genes in the addicts and healthy controls from Manipur.
- Investigate whether there is any differences in the distribution of the genotypes and alleles in the addicts and the ethnically matched controls of Manipur.
- Screen both the genes for any novel mutations in this population and see whether it is associated with the addictive behaviour.

Study Recommendation

The functional status of the markers that have shown positive effect needs to be investigated further to generate a consensus on the risks of these markers.

Analysis and Outcome

The present study is limited by sample size. A similar study needs to be carried out with larger samples, and replication in other ethnic populations is necessary before concluding or ruling out the involvement of these genes. Further, considering the fact that substance dependence is a complex, polygenic disorder involving environmental and genetic factors, the studied polymorphisms convey only relatively small account of information. Therefore, studies that investigate the involvement of more polymorphisms of these genes as well as other genes and environmental factors that play significant roles towards substance dependence need to be undertaken to fully comprehend the genetic inputs.

Several other studies have reported the association of markers with substance-use disorders. Such studies may pave the way for patient stratification, novel prevention, targeted intervention, and treatment strategies for curbing drug addiction. Research demonstrates that individuals with genetic predisposition for addiction to one class of drugs are likely to abuse other drugs as well. From a molecular perspective, variations in genes that encode specific proteins for receptors, transporters or signalling proteins involved directly or indirectly with reward pathway are likely to have an influence in addiction due to specific changes brought about in the protein themselves or their expression or both ^[202].

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Manipur
- Department of Social Justice and Empowerment, Government of India



Study Title

Support to Traditional Healers for Strengthening and Capacity Building

Implementing Institution

Bio-Resources Development Centre

Project Location/Completion Year

Meghalaya, 2012

Objective

- Profile traditional healers in the state.
- Identify the constraints and problems of traditional healers.
- Engage in training and capacity building.
- Provide processing tools and kits.
- Promote herbal gardens.

Study Recommendation

- Training and capacity building on agro-techniques for medicinal plants (ex situ and in situ) nursery raising.
- Financial assistance for polyhouse and net houses to maintain the germplasm and to function as seed bank for medicinal plants and herbs.

Analysis and Outcome

A major outcome of the study was the empowerment of the local health practitioners/traditional healers with knowledge pertaining to various health issues. Capacity development and sensitization programmes have improved the practices of traditional medicine preparation and packaging and enabled them to improve the quality of their practices. The acquirement of skills sets has led the primary health workers to serve the rural community better.

In a bid to promote health tourism in Meghalaya, the state government has initiated the Mebaai Tribal Health and Wellness Centre, which provides indigenous holistic health therapy [205]. Effective coordination among all stakeholders, including self-help groups, will go a long way to strengthen the traditional healers of the state. Though there is high awareness and utilization of traditional medicine in the state, more efforts are required by the public sector to support and engage with the healers.

Agencies responsible for implementation:

- Ministry of Tribal Affairs, Government of India
- Ministry of AYUSH, Government of India
- Meghalaya State Medicinal Plants Board
- Health and Family Welfare Department, Government of Meghalaya

Study Title

Evaluation of National Rural Health Mission (NRHM) in Meghalaya

Implementing Institution

AMC Research Group Pvt Ltd

Project Location/Completion Year

Meghalaya, 2011

Objective

Assess the impact of the National Rural Health Mission (NRHM) initiatives in the intervention districts of Meghalaya.

Study Recommendation

- Orientation programmes on the utilization of untied funds.
- Substantial improvement in health infrastructure in CHCs, PHCs, and sub-centres.
- Awareness generation activities like health camps, street plays, door-to-door health campaign, etc.
- Recruitment of medical and para-medical staffs.
- Proper auditing process (both internal and external) on the utilization of RKS funds.
- Training and concrete supervision on the functioning of ASHAs.
- Specific drugs for cardiovascular, diabetics, vaccines for animal bites, etc.
- Well-equipped ambulances on call to transport the pregnant mothers and other serious patients in border and remote areas.
- Government doctors should be restrained from private practices.
- Promotion of health education in schools.
- Proper disposal of biomedical waste in health facilities.
- Blood banks need to be set up at CHCs, by organizing blood donation camps.

Analysis and Outcome

The monitoring framework of the NRHM seeks to involve local communities in planning and implementing programmes with a framework that allows them to assess progress against agreed benchmarks. The recommendations of the study have been implemented in subsequent programmes by state agencies and development institutions. Public research institutes, community-based organizations, and NGOs, along with health department functionaries, are involved in awareness and training programmes among the key stakeholders and target community.

Projects under the World Bank's Environmental and Social Management Framework have aimed at strengthening the public health system in the state. This includes the development of a plan for improving the management and disposal of all biomedical wastes generated by both government and private health facilities, in collaboration with the state pollution control board and municipalities, to enable ownership of the process and outcomes among the providers and users. Mechanisms have been developed for additional ambulance/resource for referral transport to support the health-care facilities in transporting patients ^[206].

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Meghalaya
- Ministry of Health and Family Welfare, Government of India



Study Title

Identification and Development of DNA Methylation Biomarkers for Stomach Cancer Prevalent in Mizoram, India

Implementing Institution

North-Eastern Hill University

Project Location/Completion Year

Mizoram, 2016

Objective

- Identify targets of CpG island hypermethylation in stomach cancer prevalent in Mizoram.
- Confirm the methylation status of the genes generated; develop quantitative methylation-specific PCR (Q-MSP) assays for the CpG island confirmed.
- Check if the expression pattern of these genes correlates with their methylation status.

Study Recommendation

- The gene PPP1R16B can be considered as a potential candidate for stomach cancer, which can be developed into quantitative methylation-sensitive PCR-based assays with high analytical sensitivity, specificity, and reproducibility, which can be routinely applied to DNA samples from biopsies, archival tissues, and bodily fluids.
- Such “new markers” will have a high potential to increase the ability of clinicians to take necessary decisions for the line of treatment early enough before there is substantial increase in tumour burden.

Analysis and Outcome

DNA methylation is one of the major forms of epigenetic modification, which plays a significant role in gastric carcinogenesis. Some of the hypermethylated genes initially identified by genome-wide screening, including the novel genes (FEXF2, FGF12, GDF7, KCNQ5, and PPP1R16B) reported in this study for stomach cancer in Mizoram, have been confirmed by a separate set of experiments using the MassArray Epityper Assay. The results of the study demonstrate predicting the possibility of developing stomach cancer and correlate the percentage of methylation of the particular gene/s and stomach cancer. More such studies are required to be undertaken, which will aid in tracing tumour progression and the outcome of treatment.

The “biomarkers” identified in this study need to be used for a broader study in a bigger group so that they can be used in better disease management by early detection of stomach cancer. Although biological researchers have shown a lot of new findings in regard to biomarkers of stomach cancer, only conventional biomarkers are still employed in clinical use ^[212]. More in-depth understanding of epigenetic mechanisms holds great potential for cancer prevention, detection, and therapy.

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Mizoram
- Ministry of Health and Family Welfare, Government of India

Study Title

A Report on Cancer Burden in North Eastern States of India

Implementing Institution

National Centre for Disease Informatics and Research

Project Location/Completion Year

More than one state, 2017

Objective

- Provide pooled analysis of the incidence of cancer in North-East India in comparison to the rest of India.
- Provide a direction to all stakeholders to plan such initiatives.

Study Recommendation

- Strengthen cancer registration through the implementation of cancer notification in every state.
- Translate research evidence to relevant policies and programmes.
- Create awareness on prevention, management, and outcome of cancer in the community.
- Strengthen human resource and infrastructure for early detection, treatment, and palliative care facilities.
- Need to tackle major risk factors, such as tobacco, alcohol, and indoor air pollution.
- Promote appropriate research programmes for cancer prevention and control.
- Develop comprehensive cancer control programmes.
- Encourage engagement between researchers and programme managers.

Analysis and Outcome

The recommendations of the study have been implemented in the ensuing studies and programmes. The North-Eastern Region has the highest incidence of cancer in India and is also burdened by the higher prevalence of risk factors and inadequate cancer treatment facilities. Due to inadequate infrastructure, people are compelled to seek treatment outside the region. There is an urgent need to develop a comprehensive cancer control programme. To achieve this goal, a multilevel, multidisciplinary, and multidimensional approach might prove helpful to control the situation to some extent.

The National Cancer Registry Programme has played a vital role towards mapping the cancer burden in the region over several years. The region is a thrust area for the ICMR to augment research to address cancer prevention and control activities. The scientific evidence generated from the registries has led to strengthening of the health infrastructure in the region and will provide the guidance for future policy decisions. The major areas for research include in-depth aetiological research, health system research, operational research, research for developing cancer programmes, and programmes for implementation and monitoring of research.

Agencies responsible for implementation:

- Ministry of Health and Family Welfare, Government of India
- Indian Council of Medical Research, Government of India



Study Title

Comparative Metagenome of Human Gut of North and North-Eastern Region of India

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2017

Objective

Generate a comprehensive catalogue of microbes found in healthy human guts from North Indian and North-East Indian population using high-throughput 16S rRNA sequencing of metagenome isolated from faecal samples.

Study Recommendation

- Develop a database, which should be available at the DBT website.
- The developed database of human gut genome from both populations will get uploaded at the DBT website besides submission at the NCBI GenBank/EMBL (public platform) gene bank.

Analysis and Outcome

This is the first study on the comparative metagenome of gut microbial populations with different age from vegetarian and non-vegetarian diets of both North Indian and North-East Indian populations. The study presents a relative higher abundance of *Bacteroidetes* and *Proteobacteria* phylum and lower abundance of *Firmicutes* phylum in the gut microbiota of north-eastern population. A lower abundance of *Lactobacillaceae* was observed in the north-eastern population as compared with the north Indian population. However, in the analysis of short chain fatty acids (SCFAs) in the faecal samples by both gas chromatography and nuclear magnetic resonance, no significant difference was observed in the composition of acetate, butyrate, and propionate between population groups of different ages and diets. The study showed a paradigm shift in the gut microbiota of these dietary differentiated peoples (north and north-eastern population), since there is a vast variation in the dietary intake of these two extreme parts of our country.

This area of study requires more in-depth research before major fundamental breakthroughs can be translated to general applications for the public.

Agencies responsible for implementation:

- Department of Biotechnology, Government of India
- Ministry of Health and Family Welfare, Government of India

Study Title

Studies on Genetic and Epigenetic Alterations in Head and Neck Cancer Prevalent in the North Eastern Region of India

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2016

Objective

- Study the differentially methylated genes in cancer and control tissues and identify the genes that are methylated by AP-PCR.
- Methylation analysis of candidate genes by methylation-specific PCR.
- Study the polymorphism of genes involved in xenobiotics and alcohol metabolism by PCR.
- Analyse the expression of methylated genes by immune histochemistry.
- Correlate the methylation, polymorphism, and gene expression levels with different clinical-pathological stages of head and neck cancers.

Study Recommendation

- Understand the genetic and epigenetic alterations in patients from a particular population would help in better understanding of the disease prognosis and will be useful in predicting the severity of the disease.
- This polymorphic status of the genes and HPV status might serve as possible predictive biomarkers for the early detection of HNC.

Analysis and Outcome

The polymorphic and DNA methylation status of particular genes in specific populations will provide insight into the development of personalized effective therapeutic regimens based on the principle of pharmacogenomics for the better management of disease severity and treatment. Gene-gene and gene-environment interactions between the genetic polymorphism and prospective lifestyle risk factor in specific populations would be instrumental in determining the preventable lifestyle factors to reduce the burden of head and neck cancer.

A comprehensive effort is needed to identify the cause of such a high prevalence of cancer and generate awareness and treatment options suited to meet this challenge. The results obtained in this study will provide improved understanding of the disease. The discovery of many “novel” genes that are epigenetically regulated in the development of oropharyngeal cancer can open up new avenues of biomarker discovery in the population of the North-Eastern Region of India and also in the aetiology of the disease in other populations.

Agencies responsible for implementation:

- Ministry of Health and Family Welfare, Government of India
- Indian Council of Medical Research, Government of India



Study Title

Women Who Use Drugs in North-East India

Implementing Institution

United Nations Office on Drugs and Crime

Project Location/Completion Year

More than one state, 2015

Objective

- Describe the demographic characteristics and drug-use pattern of women in North-East India.
- Explore drug injection and HIV-related injection risk behaviours.
- Assess their sexual behaviour.
- Evaluate their medical history, incidents of overdose, and reproductive health.
- Describe their experience of violence.
- Explore service utilization and related challenges.

Study Recommendation

- Allocate exclusive financial and human resources for services targeting women who use drugs and collecting systematic data on them periodically, in order to help devise appropriate interventions.
- Income-generation interventions and social protection measures targeting women who use drugs, particularly for those engaged in sex work and selling drugs, are important.
- Women-centric targeted interventions (TIs) need to be expanded in high HIV burden states and immediately established in low HIV burden states.
- A top priority is establishing OST clinics in the north-eastern states to provide opioid substitution to pregnant women dependent on opioids, and to advocate OST for all women who are dependent on opioids irrespective of the mode of administration.
- Periodic screening for hepatitis B and C and mental health problems needs to be carried out among women who use drugs. They need to be educated on reproductive and child health (RCH) services.
- Designing and implementing interventions that target women who use drugs and engage in sex work are necessary in order to reduce HIV vulnerability and risks.
- The development and implementation of evidence-based interventions that incorporate prevention of violence, and target women who use drugs, are likely to promote better health outcomes.
- Advocacy with law enforcement, religious leaders, and community opinion leaders will be beneficial in reducing violence and sexual abuse against women.
- Building, strengthening, and sustaining the capacity of various categories of service providers working with women who use drugs are essential to develop an effective, efficient, and sustainable response.

Analysis and Outcome

The recommendations of the study have been implemented partly by the government bodies in coordination with various local associations and NGOs. In September 2020, the Directorate of Social Welfare, Government of Meghalaya, released the Meghalaya Drug Abuse Prevention Policy, 2020, [222] and launched the State Nasha Mukta Bharat Campaign. Campaign and awareness programmes are being conducted across states addressing the issues raised in the study. A multidisciplinary approach is required to address the concerns of women who use drugs.

Being a cross-sectional field of study, temporal relationships between variables cannot be established. Sensitive data related to drug-use and sexual behaviours in this study are self-reported and social acceptability bias needs to be considered while interpreting the study findings. More studies need to be undertaken covering certain biological data to overcome limitations in the interpretations when it comes to risk behaviours and adverse health consequences of women who use drugs.

Agencies responsible for implementation:

- Ministry of Women and Child Development, Government of India
- Ministry of Social Justice and Empowerment, Government of India
- Ministry of Health and Family Welfare, Government of India
- State governments of NER states



Study Title

Assessment of Village Health Sanitation and Nutrition Committee in Manipur, Meghalaya, and Tripura

Implementing Institution

Regional Resource Centre for North Eastern States, Ministry of Health and Family Welfare, Government of India, Guwahati

Project Location/Completion Year

More than one state, 2011

Objective

- Understand the role and various activities/contributions of VHSNCs and community involvement.
- Know the fund utilization and purpose of utilization, and community actions.
- Understand the monitoring/supportive supervision mechanism of VHSNCs.
- Know the challenges being faced and the existing mechanism of addressing them.

Study Recommendation

- Whether the newly proposed number of VHSNCs is approved or not, the Thoubal district needs to have additional ASHAs as it is not recommended for one ASHA to be the signatory holder/member secretary of more than one VHSNC.
- However, as states have not proposed an additional number of ASHAs in PIP 2011–12, the only option left is reducing the number of VHSNCs in Thoubal, and make one ASHA member secretary of one VHSNC only. Therefore, states/districts need to intervene on this issue.

Analysis and Outcome

A meaningful impact has been observed in the region due to the implementation of the recommendations of the study. Village Health Sanitation Committees have been a key initiative to achieve decentralization and empowerment of local people to achieve the goals of the National Rural Health Mission (NRHM). The assessment of Village Health Sanitation and Nutrition committees is particularly helpful in understanding their performance, identifying gaps/challenges and the existing mechanism to address them, and suggesting possible action points for further strengthening.

A recent review of the National Health Mission has suggested that training should be undertaken for VHSNCs at state and district levels, with trainers specializing in social mobilization. Greater state support is also required for village health planning, monitoring of community health services, and local collective action for health promotion. This will enhance the participatory nature of Village Health Sanitation Committees ^[225]. Well-designed annual health plans could be integrated into block- and district-level health plans, thereby strengthening the decentralized health planning process recommended by India's national guidelines.

Agencies responsible for implementation:

- Ministry of Health and Family Welfare, Government of India
- Ministry of Women and Child Development, Government of India
- State governments of NER states

Study Title

Assam State Report, NMHS, 2015–16

Implementing Institution

Lokopriya Gopinath Bordoloi Regional
Institute of Mental Health

Project Location/Completion Year

Assam, 2017

Objective

- Estimate the treatment gap and disability attributed to mental disorder.
- Conduct a mental health system assessment over several domains, using objectively verifiable indicators to understand the mental health-care delivery in the state.
- Develop a state-specific factsheet to serve as baseline for objective evaluation of progress over time.

Study Recommendation

- A comprehensive state mental health policy must be developed that addresses all aspects of mental health problems like suicide, severe and common mental health disorders, child mental health, psychosocial rehabilitation, stigma, and others. The policy should lay a road map for ease of accessibility to mental health care, early diagnosis and management of mental disorders, enable recovery.
- The state mental health policy should be accompanied by a comprehensive, timeline-driven state mental health action plan. This should contain a detailed workable plan addressing the activity components, roles and responsibilities of every stakeholder, timelines, budgetary provisions, and monitoring mechanisms.
- Psychiatry exposure and training at the undergraduate level should be revamped.
- Sensitization and training of primary health-care providers with focus on identification and first-level management of psychiatric illness.



Analysis and Outcome

Tapping into the mental health systems available, the survey has highlighted deficiencies in many public mental health domains, which have scope for improvement. With the lack of a state-specific data on mental health problems, this state report serves as baseline information for subsequent development of mental health systems in the state. The recommendations of the study have been partly implemented, and the results will be useful for designing a comprehensive state mental health policy, in line with national policies.

Technology adaptation to make a user-friendly mechanism is important in order to answer the question regarding mental health and hygiene immediately. Community awareness campaign and training of health workers will go a long way for empowering the community on mental health. As the study notes that the mental health system in the state is poorly organized, fragmented, and uncoordinated to address these problems, there is a need for a strong public health approach and a well-functioning mental health system within the larger health system. Mental health service must be integrated and coordinated with the primary health care with effective monitoring. Information on mental health care across the state should be strengthened since a major limitation in the survey methodology was the non-availability of information from the private sector involved in mental health-care activities. Presently, eight districts of Assam are covered in the District Mental Health Programme ^[183]. The remaining districts also need to be included to strengthen state-level implementation of the state and national plans and policies in the sector.

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Assam
- Ministry of Health and Family Welfare, Government of India

Study Title

Out-of-Pocket Expenditure in Jorhat and Kamrup Districts

Implementing Institution

Omeo Kumar Das Institute of Social Change and Development

Project Location/Completion Year

Assam, 2014

Objective

- Understand the household health status/episode of sickness or illness.
- Understand the health-care utilization pattern among the sick.
- Understand the health-care expenditure towards health insurance, payments related to health status/episode of sickness or illness as stated in objective.
- Analyse the health-care-related expenditures.
- Estimate the average medical and non-medical health-care-related expenditures, households facing catastrophic health expenditures, and impoverishment.

Study Recommendation

- The survey findings reveal that despite the expansion in the coverage of the health-care facilities in both the districts, people continue to face insecurity in respect of health expenditure.
- The burden of meeting treatment costs from the sale of assets continues to be fairly high in both the districts.
- The inpatient services in public health-care facilities need to be augmented to cater to the needs of the people.
- A major cause of high expenditure among the households had been due to drugs and diagnostics even while availing services from government hospitals.

Analysis and Outcome

Out-of-pocket expenditure is regressive in nature, because lower-income groups pay disproportionately more from their income compared with higher-income groups. The findings of the survey have been considered in framing programmes aimed at decreasing the out-of-pocket expenditure in the region. The burden of meeting health-care treatment cost from the sale of assets continues to be fairly high in both the districts. Therefore, it is necessary to decrease the out-of-pocket spending by allocating more revenues to the health-care sector. The out-of-pocket expenditure of Assam is found to be higher than the North-Eastern Region average and the all-India average ^[192].

It is necessary to decrease the out-of-pocket spending by allocating more revenues by the state to the health-care sector. This will help people get better quality health care and also protect them from securing their wealth and subsistence income. To overcome negative repercussion on the health and wealth of the people, the public spending on health-care needs to be augmented. Insurance coverage like Rashtriya Swasthya Bima Yojana should be introduced among the households in a big way. Leveraging digital technology can also help real-time mapping of the health-care deficit areas and identifying the gaps in access to ensure universal health coverage.

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Assam
- Ministry of Health and Family Welfare, Government of India



Study Title

Coverage Evaluation Survey 2012–13

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Assam, 2013

Objective

- Assess the coverage of immunization of children.
- Assess the availability and utilization of maternal health-care services in Assam.
- Find out if any improvement has taken place regarding immunization coverage and maternal health-care services over the last Coverage Evaluation Survey (2011–12).

Study Recommendation

- Increase facilities equipped for perinatal care (designated as “delivery point”) by 100%.
- Increase the proportion of all births in government and accredited private institutions at the annual rate of 5.6% from the baseline of 61%.
- Increase the proportion of pregnant women receiving antenatal care at the annual rate of 6% from the baseline of 53%.
- Increase the proportion of mothers and newborns receiving post-natal care at the annual rate of 7.5% from the baseline of 45%.
- Increase the proportion of deliveries conducted by skilled birth attendants at the annual rate of 2% from the baseline of 76%.
- Increase exclusive breast-feeding rates at the annual rate of 9.6% from the baseline of 36%.
- Reduce the prevalence of under-five children

Analysis and Outcome

Enhancing awareness about the different health-care schemes provided by the state and central governments has been critical to improve the immunization and maternal health-care services in the region. According to the NITI Aayog’s health index, Assam is categorized as “achievers” in terms of the overall and incremental performance ^[195] The *Sample Registration System Bulletin* notes significant decline in maternal mortality ratio (MMR) in Assam ^[196].

Public–private partnerships (PPPs) may be encouraged in the region. ASHA village health workers should take initiative steps to bring more awareness among the masses and can play a very vital role in communicating between the masses and the public health system. The different forms of print, electronic, and social media may play a proactive role for increasing the awareness level about different health facilities provided by the government among the beneficiaries.

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Assam
- Ministry of Health and Family Welfare, Government of India

Study Title

Evaluation of Boat Clinics in Assam

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Assam, 2013

Objective

- Assess the functional status of boat clinics in terms of availability and functionality of boats; availability and functionality of equipment/diagnostic equipment; and availability of drugs.
- Assess the availability and composition of human resources and training status and their outcome.
- Assess the operational plan of boat clinics, which includes coverage area—whether the boat clinic is covering areas as per the route plan or not.
- Assess the type of services provided in terms of curative services, reproductive and child health services.
- Assess the IEC activities conducted by boat clinics.
- Assess the level of awareness among the beneficiaries about the services provided.
- Assess the satisfaction of clients regarding the services of boat clinics.

Study Recommendation

- The boats should start their journey towards the islands (char) at a uniform time so that the health camps can be started early and the time on patient care can be increased for all the districts. The damaged boats must be repaired on an urgent basis.
- There should be a back-up boat to provide uninterrupted service when any district unit boat is under repair. All the staff and crew members of the boats must be insured and provided with life jackets. Teams should be stationed at the sub-district level (as close to the ghats as feasible) to increase the time for patient care as many boat clinic units were providing only 2–2.5 camp hours of service.
- There should be training of pharmacists on inventory management and record keeping. Separate drug kits should be provided by the state NRHM according to the morbidity pattern.
- Screening of non-communicable diseases should be added to the service package. Laboratory services need to be further strengthened by utilizing the supplied instruments and equipment. Test reports should be delivered on the same day before departure from the camp site.

Analysis and Outcome

The recommendations of the study have been partially implemented. Boat clinics in Assam have become the primary access to health care for almost three million inhabitants of the 2500 saporis (river islands) where construction of permanent structures for health care is almost impossible due to recurring flooding events. During the Covid-19 pandemic, the boat clinics pitched in by carrying out door-to-door community surveillance in the river islands.

The National Health Mission is providing health services to the communities residing in the remote river islands of the River Brahmaputra in 13 districts of Assam with 15 boat clinic units. According to the website of the National Health Mission, these are now being envisaged to provide comprehensive primary health care in riverine areas and are staffed by appropriately trained health-care staff [197]. Boat clinics are instrumental in providing health services, including reproductive and child care, curative care, family planning services, basic laboratory services, etc. The monitoring process of the boat clinics' performance needs to be institutionalized.

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Assam
- Ministry of Health and Family Welfare, Government of India



Study Title

Report on the Impact Assessment Study on Service Delivery of Mobile Medical Unit (MMU) in the State of Assam

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Assam, 2013

Objective

- Study the structure and functioning of mobile medical units (MMUs) in the state.
- Assess the health care and services provided by MMUs, such as maternal and child health, family planning, basic OPD services, diagnostic facilities, IEC, etc.
- Assess the financial implications of MMUs.
- Assess the impact of health care provided by MMUs on the beneficiaries.

Study Recommendation

- There was no proper storage room for the drugs, and most of the time the drugs were kept in the vehicles.
- Some districts kept their drugs in the NRHM office store room or at medical officer's or pharmacist's residence.
- The requirement of drug storage rooms was one of the important recommendations of the MMU teams during the evaluation. There was no proper management for the disposal of expired drugs.

Analysis and Outcome

The study notes that monitoring, supervision, and review of mobile medical units (MMUs) are grossly inadequate at the district and state levels. Based on the recommendations of various reports and in consultation with the states, the Ministry of Health and Family Welfare has developed the *Operational Guidelines for Mobile Medical Units*. The guidelines make provisions for the inclusion of a wide range of stakeholders in the operation of MMUs ^[198].

According to the website of the National Health Mission Assam, all districts in the state are presently equipped and functional with MMUs being administered by the Hindustan Latex Family Planning Promotion Trust since 2017. Twenty-eight districts are covered by MMUs. Initially, 80 MMUs were introduced to cover 320 tea gardens of Assam to provide comprehensive primary health-care service to the people of the tea garden area, which has now increased to 445 tea gardens within a span of 3 years since its inception. Fifty MMUs are providing comprehensive primary health-care services in the different villages and interior areas of non-tea garden districts ^[199].

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Assam
- Ministry of Health and Family Welfare, Government of India

Study Title

Evaluation of Public Private Partnership Run Health Facilities in Meghalaya

Implementing Institution

Regional Resource Centre for North Eastern States, Ministry of Health and Family Welfare, Government of India, Guwahati

Project Location/Completion Year

Meghalaya, 2018

Objective

Assess the performances of the PPP-run health facilities (PHC/CHCs) of Meghalaya.

Study Recommendation

- The report recommends defined clauses in the MoU for the modalities of implementation, service provision, manpower, lab tests, and funding.
- It also recommends for improvement in programmes and services such as organizing refresher and training courses at regular intervals, skill development, biomedical waste management, etc.
- Regular supply of chemical and other medical equipment; strengthening of community interventions using ASHA and VHSNC; repair or improvement or upgradation of facilities or centres.

Analysis and Outcome

Public-private partnership (PPP) has emerged as one of the important strategies for health sector reforms in the state. Initiatives have been taken by the National Rural Health Mission and the National Health Mission, Government of Meghalaya, to undertake different PPPs in meeting the growing needs for health services.

The most successful initiative under the PPP route has been the handing over of the less-performing community health centres and primary health centres to non-government organizations, who operate them to provide promotive, preventive, and curative health-care services and specialize in reproductive and child health-care activities. The PPP could be extended to AYUSH-integrated health facilities and wellness centres also ^[203].

The Meghalaya Cabinet has approved the Meghalaya Public-Private Partnership (PPP) Policy, 2021, with a new concept—community PPP policy. The state has also notified the State Health Policy 2021, which envisions rights-based framework in providing health care for citizens, especially for the poor and marginalized ^[204]. The state will explore innovative models for preventive health care, similar to the Megha Health Insurance Scheme (MHIS), which covers curative care. The state will encourage PPPs in which public health institutions will collaborate with private-sector institutions to cover preventive care. The policy will allow for private insurance companies to enter the positive health-care market on a trial basis.

Agencies responsible for implementation:

- National Health Mission, Government of Meghalaya
- Health and Family Welfare Department, Government of Meghalaya



Study Title

Draft Evaluation Report on PPP for Health Care Delivery in Meghalaya

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Meghalaya, 2011

Objective

Understand the effectiveness of the PPP model for health-care service delivery in the state.

Study Recommendation

- A 3–5 year maintenance contract is recommended with annual review and penalty/incentive clause. Service guarantees should be as per the Indian Public Health Standards. The government staff working with the private party may be treated on “deputation”, and appropriate service conditions may apply.
- A limit of 20–25% of the annual budget should be put in place for the special purchases of drugs and consumables.
- A lump-sum budget may be paid, based on the actual costing, which may include salary, maintenance, mobility support, and drugs and consumables.
- For quality control, ISO or related certification may be applied. A patient grievance redressal system is necessary at the facility level, with an appellate at the district (CMO/DHS) level.
- The state might look at establishing a state-level PPP cell staffed with experts, which may also act as the grievance redressal forum. Procedures for arbitration need to be laid down unambiguously

Analysis and Outcome

Public–private partnership (PPP) has emerged as one of the important strategies for health sector reforms in Meghalaya. Initiatives have been taken by the National Rural Health Mission and the Health and Family Welfare Department, Government of Meghalaya, to undertake different PPPs in meeting the growing needs for health services. Marked improvement has been noticed in most of the facilities and the functioning of the health centres in terms of service delivery following the takeover by NGOs. Improvements took the form of infrastructural corrections, better maintenance of buildings, improved staff availability, and better supply of essential drugs and equipment.

The Meghalaya Cabinet has approved the Meghalaya Public–Private Partnership (PPP) Policy, 2021, with a new concept—community PPP policy. The State Health Policy 2021 envisages rights-based framework in providing health care for citizens, especially for the poor and marginalized. The state will explore innovative models for preventive health care similar to the Mega Health Insurance Scheme (MHIS), which covers curative care. The state will encourage collaboration between public health institutions and private-sector institutions to cover preventive care. The policy will allow for private insurance companies to enter the positive health-care market on a trial basis ^[204].

Agencies responsible for implementation:

- National Health Mission, Government of Meghalaya
- Health and Family Welfare Department, Government of Meghalaya

Study Title

Improving Comprehensive Abortion Care Services in Meghalaya: A State Government: Ipas partnership

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Meghalaya, 2011

Objective

- Understand the present status of infrastructure, availability of trained providers, and other infrastructure like essential equipment and drug availability.
- Assess the knowledge and attitudes among the providers for providing Comprehensive Abortion Care (CAC) services at the public health facilities.

Study Recommendation

- The state should immediately aim for training at least one provider from each CHC and selected PHCs so that women have access to safe abortion services at the block level.
- The state should undertake demand-generation schemes through outreach activities or IEC to make the community aware of facts about abortion as well as to inform them about the availability of abortion services at public health facilities in their vicinity.
- The state should encourage all district and sub-district hospitals to ensure second trimester abortion.
- The study also recommends undertaking activities like Values Clarification Workshop to improve the attitude among providers towards abortion service provision.
- Post-training follow-up of the trained providers should be done to ensure that they initiate abortion services with required technical, logistic, or other forms of support at appropriate time to ensure their performance as expected.

Analysis and Outcome

This is one of the first studies in Meghalaya to explore the preparedness of the public health facilities to initiate the process of Comprehensive Abortion Care (CAC) services in the state. The provision of safe abortion services is one of the objectives of the state government's Directorate of Health Services, Maternal Child Health and Family Welfare. CAC is an integral component of maternal health interventions as part of the National Health Mission.

Studies have called for greater coordination among the government, medical agencies, and social institutions. With better management under PPP, previously non-operational health facilities located in difficult-to-access and underserved areas can deliver health-care services. Comprehensive service delivery interventions, including ensuring availability of skilled providers and contraceptive commodities, offering clinical mentoring for providers, identifying and addressing provider bias, and improving provider counselling skills can increase post-abortion contraceptive acceptance and reduce unintended pregnancy ^[207].

The findings of this study need to be viewed in light of methodological limitations. Results cannot be generalized to the whole of Meghalaya as the study scope is restricted to only the public-sector facilities. Private facilities, too, provide/have the potential to provide MTP services.

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Meghalaya



Study Title

Sustenance of Kayakalp Initiative in Mizoram

Implementing Institution

Regional Resource Centre for North Eastern States, Ministry of Health and Family Welfare, Government of India, Guwahati

Project Location/Completion Year

Mizoram, 2020

Objective

Validate the Kayakalp achievements and also to further enhance improvement in a holistic way.

Study Recommendation

- Recruit medical officers and other staff.
- Relocate unutilized medical equipment.
- Repair and maintain buildings.
- Implement a condemnation policy in identified PHCs.
- Maintain water supply systems.
- Maintain a housekeeping checklist.
- Properly handle biomedical and other recyclable wastes.
- Construct an isolation ward in the Suangpuilawn PHC and all PHCs in the Mamit district.
- Issue an order for the formation of an Infection Control Committee in DH Mamit, CHC Kawrthah, and PHCs in Mamit district, Phuaibuang and Khawruhlian PHCs.

Analysis and Outcome

According to the ranking by the NITI Aayog on Sustainable Development Goals (SDGs), Mizoram ranks fourth in SDG3—Good Health and Well-being [210]. Kayakalp aspires to inculcate the culture of cleanliness for gaining the trust and confidence of communities in public health facilities. The recommendations of the study for improving various aspects of the initiative are being implemented. According to the Kayakalp guideline, each best health facility receives a cash award along with a citation. Also, a commendation award will be given to those districts scoring above 70%. These cash incentives are expected to be utilized as a source for maintaining clean and hygienic practices in the facility and will also serve as an important source for the Swachhta drive and also the ongoing Kayakalp activities.

Keeping in mind the need for sustenance, quarterly monitoring visits have been planned in the district hospitals. According to the website of the Health and Family Welfare Department, Government of Mizoram, under the programme, all the state government health facilities are assessed and reviewed as per the guidelines and checklists of the National Quality Assurance Standards (NQAS) Assessors Guidebook. So far, one district hospital, i.e. Aizawl East District Hospital (Civil Hospital, Aizawl), has achieved NQAS Certification [211].

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Mizoram
- Ministry of Health and Family Welfare, Government of India

Study Title

Environment Management Plan for Nagaland Multi-Sectoral Health Project (NMHP) (P149340)

Implementing Institution

Department of Health and Family Welfare,
Government of Nagaland

Project Location/Completion Year

Nagaland, 2014

Objective

Improve health services and increase their utilization by communities in targeted locations in Nagaland.

Study Recommendation

- Common BMW disposal facilities to be developed at the district headquarter level involving municipal bodies. A committee involving representation from the DH&FW, Municipal Corporations, and NPCB may be set up for the monitoring of BMWM at the state level.
- A scientific study to be conducted to find a suitable mechanism of biomedical waste management at different levels of health-care facilities (suitable to local situation and quantum of biomedical waste).
- All the health personnel and staffs of municipal bodies involved (or to be involved) in biomedical waste management need to be trained properly. Members of the community groups also need to be sensitized with the risk involved and importance of biomedical waste management.

Analysis and Outcome

The Nagaland state government and development organizations have undertaken projects and activities to implement the study's recommendations. The Nagaland Health Project with support from the World Bank aims to improve the management and delivery of health services and increase their utilization by communities in the targeted locations of Nagaland. Other such programmes have been undertaken by the state, districts, and municipal bodies. The state government has framed the Nagaland Integrated Waste Management Policy 2019, which targets efficient management and proper disposal of waste and educate the people to segregate biodegradable, recyclable, and inert wastes at source [213].

Biomedical waste management is one of the key sub-components identified to improve medical waste management under the Nagaland Health Project. Presently, there is no common biomedical waste treatment facility in Nagaland. It is critical to undertake a systematic assessment of the quantum of biomedical wastes generated at each health facility and devise customized options for biomedical waste management (for solid and liquid biomedical waste).

Agencies responsible for implementation:

- Directorate of Health and Family Welfare, Government of Nagaland
- Nagaland Pollution Control Board, Government of Nagaland



Study Title

A Report on Monitoring of Important Components of NHM Programme Implementation in East District, Sikkim

Implementing Institution

Population Research Centre, Institute of Economic Growth, Delhi

Project Location/Completion Year

Sikkim, 2018

Objective

- Monitor the status of the physical infrastructure of health facilities under the NHM programme.
- Understand the availability and efficiency of human resource.
- Understand the gap between the demand and supply of health service delivery under the NHM programme.
- Assess the functionality of equipment as well as the supply of essential drugs, consumables, etc.
- Analyse and ascertain the implementation and performance of different scheme under NHM, such as JSSK, NRC, RBSK, ARSH, etc.
- Analyse other important components, namely, service delivery, record maintenance, biomedical waste management, referral transports system, IEC material, disease control programme, etc.
- Assess the availability of finance for the NHM activities in the district.

Study Recommendation

- Health facilities that essentially stand non-functional with respect to various NHM activities must be identified and worked on or dropped off with respect to requirement and effectiveness; this includes SCs and PHCs. This, in turn, entails regular monitoring and supervision and makes certain optimal utilization of resources.
- Training with respect to reporting HMIS data is mandatory and important. In order to ensure smooth functioning of the activities, staff shortage must be resolved. Also access to essential drugs must be highlighted by the district, and supply should match the demand side as per the block requirements.
- Formulate and strengthen the District Quality Assurance Committee, considering the wide scope of improvement that exists with regards to infection control practices.
- Delay in fund allocation must be resolved so as to ensure smooth proceedings in all the health components under the NHM.

Analysis and Outcome

According to NITI Aayog's North Eastern Region District SDG Index Report and Dashboard 2021-22, East Sikkim is one of the top performing districts in the North-Eastern Region in terms of meeting SDG3 goals pertaining to good health and well-being [214]. There has been improvement in infrastructures, capacity building, manpower placement, and delivery of comprehensive services through primary health sub-centres, primary health centres, and community health centres. The State Programme Implementation Plan spells out the strategies to be deployed, budgetary requirements, and health outcomes aimed under the National Health Mission (NHM). To improve the health-care delivery, increase in the OPD and IPD services through better facilitation and coordination of public health systems has been a contribution of the NHM.

The Accredited Social Health Activist (ASHA) workers have been a key link between peripheral health system and people at grassroots level. Imparting training on digital literacy and financial support to them need to be augmented.

Agencies responsible for implementation:

- Department of Health Care and Family Welfare, Government of Sikkim
- Ministry of Health and Family Welfare, Government of India

Study Title

Monitoring of Important Components of NHM Programme Implementation in North District, Sikkim

Implementing Institution

Population Research Centre, Institute of Economic Growth, Delhi

Project Location/Completion Year

Sikkim, 2018

Objective

- Monitor the status of the physical infrastructure of health facilities under the NHM programme.
- Understand the availability and efficiency of human resource.
- Understand the gap between the demand and supply of health service delivery under the NHM programme.
- Assess the functionality of equipment and the supply of essential drugs, consumables, etc.
- Analyse and ascertain the implementation and performance of different schemes under the NHM such as JSSK, NRC, RBSK, ARSH, etc.

Study Recommendation

- Health facilities that essentially stand non-functional with respect to various NHM activities must be identified and worked on or dropped off with respect to requirement and effectiveness, including SCs and PHCs. This, in turn, entails regular monitoring and supervision and makes certain optimal utilization of resources.
- Formulate and strengthen the District Quality Assurance Committee, considering the wide scope of improvement that exists with regards to infection control practices.
- Delay in fund allocation must be resolved so as to ensure smooth proceedings in all the health components under the NHM.

Analysis and Outcome

According to NITI Aayog's North Eastern Region District SDG Index Report and Dashboard 2021-22, North Sikkim is one of the top performing districts in the North-Eastern Region in terms of meeting the SDG3 goals pertaining to good health and well-being [214]. The National Health Mission (NHM) has been a successful undertaking in the district, which focusses on community-based comprehensive health care to all. The district hospital has taken distinctive measures to prevent maternal deaths by immediately admitting the beneficiaries as the first step of treatment policy undertaken.

Access to health facilities remains a challenge in the district due to the condition of the roads in the region. Owing to the high altitude, the district is subjected to natural calamities very frequently, making a challenge for health facilities to cater to the needs of beneficiaries as well as beneficiaries to reach out to access health services. Regular monitoring and supervision of resources need to be conducted for ensuring optimal utilization of resources and smooth implementation of the programme.

Agencies responsible for implementation:

- Department of Health Care and Family Welfare, Government of Sikkim
- Ministry of Health and Family Welfare, Government of India



Study Title

Monitoring and Evaluation of National Health Mission/ Programme Implementation Plan in Sikkim district of South

Implementing Institution

Institute of Economic Growth

Project Location/Completion Year

Sikkim, 2016

Objective

Monitor and evaluate various schemes under the National Rural Health Mission by the Ministry of Health and Family Welfare.

Study Recommendation

- Make new deployment to smoothen the functioning of the system.
- Maintain proper records of cash payments made under the JSY.
- There were issues of power supply in the District Hospital Singtam. The PHC has been converted to CHC, but a lot needs to be done in terms of providing sufficient staff, proper infrastructure, etc. to make it function as a CHC.
- There was no computerized inventory management for the available drugs, and also the drugs supplied to the district were of short expiry; hence, we recommend the district officials to keep a proper computerized track of drugs.

Analysis and Outcome

Based on the study recommendations, several steps were undertaken in the state by the National Health Mission to smoothen the functioning of the NHM Programme Implementation Plan (PIP). The effect of outcomes is reflected in the fact that South District falls in the category of frontrunners in terms of meeting the SDG3 goals pertaining to good health and well-being [214].

The state has undertaken several initiatives to strengthen the schemes under the National Health Mission. The components of the health systems in the PIP—human resources (service delivery), drugs and information, education and communication—were aggregated to bring in more flexibility in the planning process and to provide a summarized view of the PIP for the programme planners, programme implementers, decision makers, and other stakeholders.

Agencies responsible for implementation:

- Health and Family Welfare Department, Government of Sikkim
- Ministry of Health and Family Welfare, Government of India

Study Title

An Evaluation of CATCH Programme in Sikkim 2014–15

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Sikkim, 2015

Objective

- Enable one to know his/her own health status and of the community.
- Spotting risk factors and diagnosis of diseases in their early stages.
- Provide comprehensive health care.
- Take individual and collective initiative to work towards making the area and Sikkim healthy.

Study Recommendation

- There is no structured monitoring mechanism for the CATCH programme. The state is under the process of identifying feasible indicators for monitoring.
- Community mobilization is done by the respective GP and ASHA representatives of the concerned village in the form of IPC. ASHAs have played a great role in the awareness generation and mobilization of the community.
- Health cards need to be issued to all beneficiaries and patients and also timely updating of the card during referred and follow-up cases.
- The payment mechanism of ASHAs for mobilizing the community and attending the camps is different from camp to camp and it needs to be uniform or case based.
- A few dedicated staff need to be deployed for the CATCH programme, and they can provide services at different camps. It may help in the functioning of PHCs without any hindrance.

Analysis and Outcome

The CATCH programme has improved the health status of people in the state by providing them with better access to health-care services. Regular conduct of the CATCH programme has resulted in an increase in health coverage, with preventive interventions focusing on pregnant women, children, elderly, and adolescents and an increase in awareness about the important determinants of health such as nutrition and sanitation. The CATCH programme has been particularly beneficial to the people of remote and hilly regions in Sikkim, enabling timely delivery of services in remote villages where bad roads often discourage villagers from getting to a hospital.

Since its launch in 2010, 509,803 people have been screened in the camps and 357,868 health cards have been issued to the people during the camp (as of March 31, 2019). The CATCH programme is in the continuation phase. The response of the people during the camps was appreciable, and the participation of all local leaders, village panchayat members, community leaders, religious leaders, ASHA, anganwadi workers, and other stakeholders was exemplary. According to the website of the Health and Family Welfare Department, Government of Sikkim, about 81% of the state's population has been screened till March 31, 2021^[215].

Agencies responsible for implementation:

- Health and Family Welfare Department, Government of Sikkim



Study Title

Report on NHM PIP, Monitoring and Evaluation of East District, Sikkim

Implementing Institution

Institute of Economic Growth

Project Location/Completion Year

Sikkim, 2015

Objective

Monitor the progress made by the states in the implementation of the annual PIP and state's adherence to the mutually agreed road map and conditionality.

Study Recommendation

- Although state officials were trying to distribute human resource equitably by giving priority to difficult areas, there was a severe shortage of orthopedicians and surgeons in the district. Furthermore, there was no surgeon at the CHC, which is located in an accident-prone area. Thus, it is highly recommended to make new deployment to smoothen the functioning of the system.
- The norms laid down under the JSSK were not clear. The basic aim of the JSSK is to provide cashless services, which is hampered since the beneficiaries are incurring costs on treatment.
- It is highly recommended to maintain proper records of cash payments made under the JSY.
- The district officials have demanded for a projector and a computer to spread awareness using visual methods.
- There were no complain/suggestion boxes in many of the facilities. It is recommended to have complain/suggestion boxes to get productive feedbacks from the beneficiaries.
- There were issues of power supply in the District Hospital Singtam. Although generators were installed, the fuel was not supplied in sufficient quantity, leading to lags in providing lab services to the beneficiaries. Thus, we recommend the state officials to look for measures to combat this problem.

Analysis and Outcome

The recommendations of the study have been partially implemented. The improvement in health-care aspects of the district has propelled East Sikkim to one of the top performing districts in the North-Eastern Region in terms of meeting the SDG3 goals pertaining to good health and well-being [214]. There has been improvement in infrastructure, capacity building, and delivery of comprehensive services through primary health sub-centres, primary health centres, and community health centres.

The State Programme Implementation Plan provides the strategies to be deployed and the budgetary requirements and health outcomes aimed under the National Health Mission (NHM). To improve the health-care delivery, an increase in the OPD and IPD services through better facilitation and coordination of public health systems has been a contribution of the NHM. Awareness generation and capacity development programmes for the health workers are required to further improve the functions and activities of the programme in the district.

Agencies responsible for implementation:

- Department of Health Care and Family Welfare, Government of Sikkim
- Ministry of Health and Family Welfare, Government of India

Study Title

Report on the Impact Assessment Study on Service Delivery of Mobile Medical Unit (MMU) in the State of Sikkim

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Sikkim, 2013

Objective

- Study the structure and functioning of mobile medical units (MMUs) in the state.
- Assess the health-care services provided by MMUs, such as maternal and child health, family planning, basic OPD services, diagnostic facilities, IEC, etc.
- Assess the financial implications of MMUs.
- Assess the impact of health care provided by the MMUs on the beneficiaries.

Study Recommendation

- With the participation of the MMU team and need assessment, a comprehensive operational plan should be prepared and all stakeholders should be intimated well in advance.
- The operational plan should contain a route plan and travel distance to be covered, and alternate route plans should be prepared to reach the uncovered areas.
- It is imperative that the MMUs deliver the expected set of services, including a comprehensive package of services comprising curative, RCH, preventive, and palliative services supported by a robust IEC/IPC plan. Specific VHND plans should be incorporated into the MMU operational plan to maximize the MMU operationalization vis-a-vis community participation.
- Moreover, camp site selection should be based on need assessment and gap analysis. It should be of utmost importance to ensure an average of 15–20 camps per month in every district.
- It is imperative that the OPD-based services of MMUs are supported by essential laboratory services in the underserved areas where there is a lack of basic health services.

Analysis and Outcome

Mobile medical units (MMUs) represent a significant investment made by the Ministry of Health and Family Welfare to enable reaching the marginalized population. The outcomes of the study will help to provide health care at the door steps in remote, difficult, underserved, and unreached areas having tribal, char, forest, and tea garden areas, which are devoid of any health-care facilities. In order to achieve effective functioning and review of the service delivery of MMUs in the state, regular monitoring and review need to be done through the state/district health functionaries. To increase visibility, awareness, and accountability, all MMUs have been positioned as “National Mobile Medical Unit Service” with universal colour and design ^[216]. As of March 31, 2018, four MMUs were operational in the state according to the website of the National Health Mission ^[217].

Regular monitoring of the number and types of patients serviced must also be undertaken to ensure that the MMUs are actually serving a need and are able to provide services to a larger number of people or comprehensive care to a smaller population who would otherwise not receive such care. MMU services should meet the technical and service quality standards for a primary health-care centre.

Agencies responsible for implementation:

- Department of Health Care and Family Welfare, Government of Sikkim
- Ministry of Health and Family Welfare, Government of India



Study Title

A Study on Out-of-Pocket Expenditure in Dhalai District, Tripura 2014–15

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Tripura, 2015

Objective

- Understand the household health status/episode of sickness or illness.
- Understand the health-care utilization pattern among the sick.
- Understand the health-care expenditure towards health insurance, payments related to health status/episode of sickness or illness as stated in the objective.
- Analyse the health-care related expenditures.
- Estimate the average medical and non-medical health-care related expenditures, households facing catastrophic health expenditures and impoverishment.

Study Recommendation

- There are no private health-care facilities in the Dhalai district, but private practices at clinics/pharmacies are available. As such, 95% of the hospitalized cases were at government facilities, but for OPD cases, the presence of private providers was observed.
- The survey results showed that the overall health status of the children in the district was good and 98% of the children did not report any short-term morbidity. Cough/cold and fever were the common diseases found among the children in the district.

Analysis and Outcome

High out-of-pocket expenditure is a major barrier to quality health-care services and access to appropriate and affordable medicine. Due to the non-availability of medicines in sub-centres and primary health centres, patients often travel long distances to procure the prescribed medicines. Therefore, out of the total expenditure incurred, the expenditure on medicines has higher share. Frontline workers—ASHA and other health workers—need to proactively reach out to households whose children require medical assistance. A robust monitoring system is also required at the district level to track the key performance indicators set for children's health.

The Tripura Health Assurance Scheme for Poor was introduced in 2014 and amended in 2015 with the aim to offer financial support to those in the state who are below the poverty line. With the sum assured of INR 1.15 lakh, the scheme aims to reduce the out-of-pocket expense of the families and individuals when receiving treatment at any empanelled hospital in the state^[218]. The scheme covers the cost of treatments, hospitalization, critical care, and surgeries up to the ceiling limit.

Agencies responsible for implementation:

- Department of Health Care and Family Welfare, Government of Tripura
- Ministry of Health and Family Welfare, Government of India

Study Title

Assessment of Ideal Labour Room in Tripura 2015

Implementing Institution

Regional Resource Centre for North Eastern States, Ministry of Health and Family Welfare, Government of India, Guwahati

Project Location/Completion Year

Tripura, 2015

Objective

- Increase institutional delivery to at least 90–95%.
- Reduce home delivery by focusing on PUSH and PULL factors.
- Reduce inter-referral/overburden of tertiary care centres.
- Prevent maternal death.

Study Recommendation

- All facilities have a sufficient number of delivery tables. But they need to be equipped with mattresses, sheets, Macintosh, foot rests, and Kelly's pads wherever needed.
- Leakage was observed in five labour rooms, which need to be immediately repaired.
- Two labour rooms do not have NBCCs, and four NBCCs are outside the labour room, which should ideally be inside the labour room.
- There is scope for the rationalization of staff. More staff nurses need to be placed in the DH from the PHCs/CHCs. The ratio of GDMO per facility is same at DH and SDH, so MO can be moved from SDH to DH.
- Training of staff is a foremost issue, which should be looked into.
- Shortage of gloves was observed at many facilities, which need to be immediately solved.
- Most of the protocols are not in the right places, which must be fixed.
- Standard printed delivery registers should be supplied to the labour rooms.

Analysis and Outcome

To improve the coverage of institutional delivery, the prime prerequisite is improving the functionality of the labour rooms in terms of infrastructure, staff, equipment, and drugs. Special focus should be given on maintaining and observing the labour room protocols by the staff nurses on infection control to ensure frequent cleaning of the corridors and floors since cleanliness of the hospitals, by and large, was not up to the mark.

Most of the recommendations of the study were undertaken in the Government of India's country-wide initiative—LaQshya (Labour Room Quality Improvement Initiative), which aims to ensure proper implementation of the existing labour room protocols in order to reduce maternal and infant mortality.

The working atmosphere in the delivery rooms has significantly improved due to the availability of all necessary resources inside the rooms. As of July 12, 2019, 12 public health facilities across Tripura have been identified for the implementation of the LaQshya programme [219]. Ensuring privacy to the mother-to-be, stressing a comfortable position during delivery, no-tolerance policy for any verbal or physical abuse of the woman, and no demand for gratuitous payment by staff are some of the guidelines under the programme. The scheme "Mayer Ghar" (mother's house), under which the labour rooms will be equipped with all facilities, is operationalized to reduce home deliveries in selected interior and tribal areas and thereby cut down on maternal and infant deaths. Tripura came second among the small states in India in reducing the infant mortality rate [220].

Agencies responsible for implementation:

- Department of Health Care and Family Welfare, Government of Tripura
- Ministry of Health and Family Welfare, Government of India



Study Title

Rapid Assessment of Health Facilities in Tripura

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Tripura, 2014

Objective

- Assess the status of functional 24 × 7 PHCs/CHCs/SDHs/DHs in Tripura.
- Assess the quality of essential services provided by the 24 × 7 PHCs/CHCs/SDHs/DHs in Tripura according to the 24 × 7 facility guidelines.
- Assess the staff and infrastructure availability of 24 × 7 PHCs/CHCs/SDHs/DHs in Tripura and identify gaps to take corrective measures.

Study Recommendation

- Essential newborn care; referral for emergencies.
- Antenatal care and routine immunization services for children and pregnant women (besides fixed day services).
- Post-natal care.
- Early and safe abortion services (including MVA).
- Family planning services.
- Prevention and management of RTIs/STIs, essential laboratory services.

Analysis and Outcome

The recommendations of the study have been partially implemented. Though Tripura has had some remarkable successes in the social determinants of health, considerable efforts still need to be made to improve its public health infrastructure and services on which a majority of the people depend. The health infrastructure shows marked improvement, according to the State Economic Review 2019–20. There were 24 hospitals, 22 rural hospitals/community health centres, 116 primary health centres, 1117 sub-centres/dispensaries, 13 blood banks, and seven blood storage centres, through which the state government has been providing basic health facilities to all the sections of society^[221].

The state faces shortage of appropriate health-care staff. However, there has been a positive change in the health scenario in the recent years. The National Rural Health Mission is a major partner, and in cooperation with the state health department, it has done effective work at the grassroots level covering hilly areas. The National Health Mission Tripura envisages a dynamic, community-owned and -managed health system facilitated by the government so that the community meets its health needs.

The state achieved well in terms of birth rate, death rate as well as infant mortality rate in comparison to the national average. However, specialist health-care services need to be augmented for quality life.

Agencies responsible for implementation:

- Department of Health Care and Family Welfare, Government of Tripura
- Ministry of Health and Family Welfare, Government of India

Study Title

Concurrent Assessment of Mobile Medical Unit (MMU) in Tripura

Implementing Institution

Regional Resource Centre for North Eastern States, Ministry of Health and Family Welfare, Government of India, Guwahati

Project Location/Completion Year

Tripura, 2013

Objective

- Assess the level of coverage of the MMUs in the outreach areas with their effectiveness of service.
- Examine various services such as RCH, FP, IEC/BCC, immunizations, and follow-up of cases provided by the MMUs.
- Examine the ownership and participation as well as the nature of involvement of the community and peer leaders of villages during and after the camps.

Study Recommendation

- The state has to appoint dedicated skilled personnel for the uninterrupted functioning of MMUs in the outreach areas. The possibility of replicating the PPP model by outsourcing the MMU service may be considered in other districts of Tripura.
- The CMHO and DPM should be actively involved in the monitoring and supervision of MMU camps. Due to the lack of dedicated MMU teams, there should be a provision for the involvement of the nearest health-care staffs in MMU camp for service delivery, but care must be taken that the services are not hampered in their respective PHC/CHC catchment areas.
- The route map of MMUs should be prepared in consultation with the DPMU and the respective PHC staff to cover the remote areas. It should be kept in mind while planning that the camps be held in the remote locations of the district rather than simply conducting them adjacent to a health facility.

Analysis and Outcome

Mobile medical units (MMUs) represent a significant investment made by the Ministry of Health and Family Welfare to reach the marginalized population. The outcomes of the study will help to provide health care at the door steps in remote, difficult, underserved, and unreached areas having tribal, char, forest, and tea garden areas, which are devoid of any health-care facilities. In order to achieve effective functioning and review of the service delivery of MMUs in the state, regular monitoring and review need to be done through the state/district health functionaries. To increase visibility, awareness, and accountability, all MMUs have been positioned as "National Mobile Medical Unit Service" with universal colour and design ^[216]. As of March 31, 2018, four MMUs were operational in the state ^[217].

Regular monitoring of the number and types of patients serviced needs to be undertaken to ensure that the MMUs are actually serving a need and are able to provide services to a larger number of people or comprehensive care to a smaller population who would otherwise not receive such care. MMU services should meet the technical and service quality standards for a primary health-care centre.

Agencies responsible for implementation:

- Department of Health Care and Family Welfare, Government of Tripura
- Ministry of Health and Family Welfare, Government of India



Study Title

Regional Plan and Strategy for Upgradation of Secondary and Tertiary Health-Care Facilities in NER by 2030

Implementing Institution

Sutra Consulting Pvt Ltd

Project Location/Completion Year

More than one state, 2020

Objective

Map the existing secondary and tertiary health-care facilities and systems in the North East Region of India for the purpose of upgradation.

Study Recommendation

- Upgrade the existing secondary and tertiary health-care facilities and services to speciality and diagnostic departments.
- Create new speciality and super-speciality facilities in all the districts hospitals.
- Reduce the ratio gap of doctor per capita.
- Introduce specialty courses in the medical institutes in the NER.
- Increase/upgrade the number of medical institutes.
- Encourage the participation of NGOs and the PPP model for the development of institutes and services.

Analysis and Outcome

The recommendations of the study have been applied in the subsequent health-care plans and programmes of the states. The existing number of health-care facilities is less compared to the requirement in the eight states. The gap can be met by a combination of two strategies—upgrading existing district hospitals as model hospitals that can house specialists and functional departments and serve as a hub for three–four adjoining districts and setting up new units as required. A majority of district hospitals and community health centres (CHCs) do not have the basic equipment required to provide diagnostics and satisfactory health care to patients without relying on private health-care institutions. In the state-wise budget estimates, a lump-sum amount has been allocated for procuring equipment and each state can identify specific equipment and finalize the budget. Public–private partnerships and NGOs can play an important role in effective service delivery.

Since scarcity of human resources is one of the main reasons for the non-functional status of various wings in government hospitals, appropriate human resource policies need to be in place to reduce attrition rates. The training of health professionals is vital to address the scarcity of human resources. The nature of human resource problems is similar across states and is mainly related to inadequacy of health-care professionals, particularly specialists.

Agencies responsible for implementation:

- Ministry of Health and Family Welfare, Government of India
- Health departments of the NER state governments

Study Title

Assessment of Rogi Kalyan Samiti (RKS) in Manipur, Meghalaya, and Tripura

Implementing Institution

Regional Resource Centre for North Eastern States, Ministry of Health and Family Welfare, Government of India, Guwahati

Project Location/Completion Year

More than one state, 2011

Objective

- Understand the role and various activities of RKS.
- Know the fund utilization and purpose of utilization.
- Assess the monitoring (supportive supervision) mechanism.
- Know the challenges being faced and mechanism of addressing them.

Study Recommendation

- Activities of the RKS are very much limited to focusing only on activities where the fund could be utilized rather focusing on the overall issues for the welfare of the patient.
- Most of the health facilities need to incorporate issues such as review of OPD and IPD performance in the agenda of RKS meeting.

Analysis and Outcome

The recommendations have been fully implemented with a significant positive impact on community health aspects. The Rogi Kalyan Samiti (RKS) model is a community health system for improved governance. The formation of these models has paved the way to an innovative intervention for strengthening the health system with the increased involvement of local leaders and civil society to improve local governance.

Under the National Health Mission, the Common Review Mission teams oversee the functioning of the RKS along with the implementation of various schemes and programmes. The RKS ensures compliance to the minimal standards for hospital care and protocols of treatment as issued by the government. The observations of the review teams indicate that the RKSs are receiving the untied funds every year and are making useful contributions towards improvements in provisions of health-care services and patient amenities ^[224]. There is a need to further build the capacities of RKS members to improve its functioning.

Agencies responsible for implementation:

- Ministry of Health and Family Welfare, Government of India



Study Title

Spatial Distribution and Source Apportionment of PAHs in Drinking Water and Soil of Surrounding Areas of Oilfields of Borhola Area of Jorhat

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2012

Objective

- Find out the spatial distributions of 16 PAHs in the drinking water and soil of the Borholla Oilfields and its surrounding areas.
- Identify the sources of PAHs, whether petrogenic or pyrogenic, by diagnostic ratio characteristics and statistical analysis (PCA).

Study Recommendation

The study shows that the PAH contamination in the whole Borholla area is not due to the crude oil itself or crude oil exploration activities, but mainly due to the wood and fossil fuel combustions and vehicular exhaust. Hence, these areas need to be looked into for the prevention and elimination of PAH contamination.

Analysis and Outcome

The environmental influx of hazardous contaminants like polycyclic aromatic hydrocarbons (PAHs) occurs due to oil and gas drilling and processing of petroleum products in industrial facilities and refineries.

The inference of the study that PAH contamination in the region is mainly due to the wood and fossil fuel combustions and vehicular exhaust has been negated by studies that demonstrate PAH contamination is occurring due to the exploration of crude oil in the region. Borholla has the highest distribution of individual PAHs. Studies have concluded that there is a possibility of bioaccumulation and their entry into the food chain ^[200]. This is specifically relevant in the state since the oil-drilling sites and refineries are mostly adjacent to tea gardens and rice field.

To restore the environment from PAH pollution, various remediation strategies have been employed, including physical, chemical, and biological methods. Significant advances have been made in developing technologies and strategies for the environmental remediation of PAH pollution. However, several challenges remain unresolved, and site remediation of PAHs is still a challenge. Laboratory- and pilot/reactor-scale studies have provided ample evidence, detailed and distinct mechanistic insights into PAH degradation ^[201]. Emerging integrated approaches such as eco-engineered bioremediation of PAH need to be explored in future research.

Agencies responsible for implementation:

- Department of Biotechnology, Government of India
- Ministry of Petroleum and Natural Gas, Government of India
- Department of Mines and Minerals, Government of Assam

Study Title

Biotoilets in Schools of North-East India

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

More than one state, 2020

Objective

- Operationalization of biotoilets.
- Benchtop demonstration of anaerobic digesters for biogas generation and utilization.
- Feasibility of biogas as a clean energy in cooking mid-day meals in schools.
- Promotion of behavioural changes among school children towards good hygiene.

Study Recommendation

- Providing water is essential to encourage users in school hostels.
- Awareness campaign is essential for enhancing the understanding of biotoilets and reducing the damage to the biotoilet installations, especially in boy's hostels.
- The FRP toilet superstructure is attractive, but the heat build-up during summer caused discomfort to the users.
- Under north-east conditions, the performance of anaerobic digesters related to effluent discharge, with 10–20 days hydraulic retention time (HRT), does not match the CPCB standard.
- When biogas is produced in the anaerobic digesters, after the exhaustion of headspace due to biogas accumulation, it exerts a reverse pressure on the inlet pipe, thus affecting the flow system. Thus, in future endeavours, an appropriate arrangement to hold the biogas may be attempted for the smooth flow of influents.

Analysis and Outcome

The project served two purposes: creation of sanitation infrastructure and demonstration of anaerobic digesters with or without reedbed. In 100 sites of eight north-eastern states covering 25 districts, 100 units of biotoilets have been installed. The operation and maintenance of biotoilets were done through awareness programmes, distribution of biotoilet operation manuals, short films on biotoilets, and biotoilet charts. The last performances of biotoilets have been evaluated for the period of 6 months from 16 sites covering four states—Assam, Meghalaya, Manipur, and Tripura. After the construction of wetland attachment, the performance of anaerobic digesters under north-east conditions revealed that the effluent discharge from anaerobic digesters with 10–20 days HRT matched the CPCB standard. The results indicate that membrane bioreactors equipped with indigenous ceramic filters are promising.

The operation procedure and overall system design need to be improved. The current prototype has to be suitably containerized with appropriate in-line instrumentation (to monitor flow rate, transmembrane pressure, permeate turbidity) and controls (for level maintenance, in-line membrane cleaning). It is also imperative to improve membrane module design (eliminating the need for a separate support and assembly) besides scaling-up production of the modules. As the application requires low-cost membrane modules, the manufacturing process has to be simple and easily scalable. Further studies need to focus on the above aspects.

Agencies responsible for implementation:

- Department of Biotechnology, Government of India
- Swachh Bharat Mission, Department of Drinking Water and Sanitation, Ministry of Jal Shakti, Government of India



Study Title

Bioformulation of Indigenous Entomopathogenic Fungi of Assam for Control of Mustard Aphid (*Lipaphis erysinbi* Holt)

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2016

Objective

- Assess the selected fungal strain for virulence against the pest *Lipaphis erysinbi* Holt.
- Study the impact of the virulent fungal isolates on predators (lady bird beetles, *Coccinella septempunctata*) and pollinators (honey bees).
- Bioformulation of the virulent fungal isolates.
- Field evaluation of bioformulation on mustard aphid.

Study Recommendation

- Development of a new bioformulation with effective bioagents for the control of mustard aphid.
- Screening of highly virulent entomopathogenic fungi against mustard aphid with biocontrol potentiality.
- Low impact on natural predators and pollinators.

Analysis and Outcome

Mustard aphid is a serious pest of mustard in India and responsible for causing yield losses ranging from 35.4% to 96% depending upon weather conditions ^[184]. The exploitation of biocontrol agents is considered as a suitable alternative to the use of chemical pesticides. In the study, an analysis of the virulence heatmap revealed two most efficient fungal strains *Penicillium pinophyllum* followed by *Acremonium cellulyticus* as bioagents with least incubation period against the target pest (mustard aphid) without any harmful effect on predators and pollinators. The formulated bioagent *Penicillium pinophyllum* effectively reduced the incidence of aphids on mustard crop. The research effort to efficient biocontrol formulations for agricultural production is expected to go a long way in replacing agricultural chemicals and making agriculture more sustainable and productive.

The conclusions of the study have been carried forward in subsequent R&D activities. Interventions by government and research institutions as well as public-private partnership are required for the speedy commercialization and adoption of bioformulation by the industry and farmers. The gap in knowledge and skills of farmers towards the bioagents has to be comprehensively addressed. Potential users and distributors should be educated about the handling of the bioformulation and need to be convinced about the value of the biocontrol product, which is somewhat more difficult to use than standard pesticides.

Agencies responsible for implementation:

- Department of Agriculture and Horticulture, Government of Assam
- Department of Biotechnology, Government of India
- ICAR-National Bureau of Agriculturally Important Microorganism

Study Title

Characterization of Starch Properties in Traditional Rice Products of Assam and Development of a Small-Scale Processing Unit for the Products

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2014

Objective

- Study the physiochemical properties of the various parboiled rice for processing into rice products.
- Study the crystalline properties of the starch in variously parboiled rice required for making different rice products.
- Understand the thermal properties of the starch in variously parboiled rice.
- Elucidate the effect of parboiling for making different rice products in the fine structure of amylopectin and breakdown of starch.
- Ascertain the effect of parboiling on the starch granular structure.
- Determine the viscosity profile of the parboiled rice and rice products.
- Analyse the digestibility of the starch and protein and the rice products.
- Develop processing units relevant for making the rice products from 50–100 kg paddy/day.

Study Recommendation

- The laboratory-scale method can be further used for analytical studies of Komal chaul and can be further scaled up.
- The laboratory dry heat parboiling can be further studied as a replacement of commercially used steam parboiling process.
- A design for small-scale processing unit for Komal chaul was made.

Analysis and Outcome

Parboiling is an age-old technique carried out to improve rice quality. Different grain parboiling techniques have been traditionally followed and scientifically developed for the preparation of rice. Assam produces a large number of rice varieties, some of which are traditionally processed into parboiled rice products like Hurum, Komal chaul, Bhoja chaul, and Sandahguri, which are of both ethnic and possible commercial significance. In spite of extensive research carried out on parboiled rice, these products and their special parboiling techniques are yet to be sufficiently explored.

The recommendations of the study have been applied in subsequent studies on the topic. The traditional techniques and newer processes described in the study will popularize the techniques and processes and should lead for further research and commercialization. The inherent characteristics of the products make them eligible for geographical indications (GI) registration by the state of Assam, India. Komal chaul or Chokuwa rice is registered in the GI registry^[190].

Agencies responsible for implementation:

- Department of Science and Technology, Government of India
- Council of Scientific and Industrial Research, Government of India
- Department of Agriculture and Horticulture, Government of Assam



Study Title

Processing and Packaging of Various Edible Bamboo Shoot Species Growing in Different Agro-Ecological Regions of Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2014

Objective

- Study the effect of processing on the quality and shelf life of various bamboo species of Assam.
- Evaluate the suitability of packaging material and methods for extending the shelf life of fresh and processed bamboo shoots.
- Validate the indigenous knowledge for bamboo shoot processing of tribal and non-tribal people of Assam.

Study Recommendation

- An anti-microbial and anti-browning film developed reduces browning and inhibits surface microbial load.
- The addition of *Garcinia pedunculata* Roxb. enhances the fermentation process and imparts desirable changes to the product.
- Osmotic drying of bamboo shoots preserves nutrition and quality.
- The study focussed mainly on the quality and safety aspects of bamboo shoots undergoing fermentation.

Analysis and Outcome

Bamboo shoots serve as a great source of functional food and a means to achieve food security. Fermented bamboo shoot is an important part of the traditional diet of the north-eastern states of India. Fermentation of bamboo shoots helps to extend the storage life and enhances the safety of foods using the natural microflora and their antibacterial compounds. A significant increase in total phenolics and antioxidant activity during fermentation highlights its nutritional status and importance.

The study was undertaken as only a few reports had studied the processing and packaging aspects of various edible bamboo shoot species growing in Assam. The recommendations of the study have been partially implemented. Commercializing fermented shoot products will preserve the traditional knowledge and provide livelihood and achieve development goals. Supplementing the diet with fermented shoots can help overcome the micronutrient deficiency and build a sound immune system against infectious diseases. There is a need to impart training to the women workforce of the villages and build their capacities to take up the preparation, packaging, and marketing of fermented shoot products so as to build a global marketplace. Government policies should promote bamboo cultivation, employment generation with bamboo shoot products by providing proper training and funding, and conservation of traditional knowledge systems pertaining to bamboo products and maintaining the food security as it remains the food of the future, showing greatest environmental sustainability.

Agencies responsible for implementation:

- Ministry of Agriculture, Government of India
- Department of Agriculture and Horticulture, Government of Assam

Study Title

Study on Preparation-Preservation and Nutritional Aspect of Indigenous Foods of Some Selected Ethnic Groups of Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2014

Objective

- Collect the indigenous food items of the selected ethnic groups and document their preparation procedures.
- Investigate the storage and preservation procedures of the indigenous food items.
- Study the social construction of culinary practices, beliefs, and traditions of three ethnic groups.
- Understand the impact of food globalization and food lores associated with the ethnic foods of selected groups of Assam.

Study Recommendation

- Ethnic foods have the potential for food tourism. Ethnic food parks can be established in airports, tourist spots as well as in other commercial ventures for promotion and popularization. This will create a better employment prospect for the youths of remote places of Assam.
- Ethnic food exhibition of SHGs of the remote areas of Assam could be strengthened with the support of the district authority as well as state and central governments.
- Proper marketing strategy, publicity will contribute to the development of the socio-economic condition of the ethnic groups of Assam.

Analysis and Outcome

The recommendations of the study have been partially implemented as the processes of preparing the traditional foods of Assam are reaching every corner of the state. People are using these foods not only for personal consumption through preservation, but also for commercial ventures. Due to various medicinal values, people throughout the state are accepting the traditional foods widely [193].

Though entrepreneurs and self-help groups are actively engaged in commercializing ethnic food to expand the market of the local traditional food products, the commercial system needs to be improved or modernized. A major problem faced for commercialization of traditional food/food products in the region includes the lack of transportation facilities and proper market place. The sector has the potential of generating employment, raising farm incomes, and improving the economic status of the Assamese people.

Agencies responsible for implementation:

- Ministry of Agriculture, Government of India
- Department of Agriculture and Horticulture, Government of Assam
- Assam State Rural Livelihood Mission, Government of Assam



Study Title

Antioxidant Capacity of Fresh and Variously Processed Fruits and Vegetables of Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2013

Objective

- Determine the antioxidant capacity of fresh and variously processed fruits and vegetables of Assam.
- Measure the effects of food-processing treatment on the antioxidant properties.
- Study the effect of temperature and minimal processing on the antioxidant properties of fresh fruits and vegetables.

Study Recommendation

- Choosing right processing techniques for fruits or vegetables to increase palatability and availability.
- Develop novel and efficient techniques or methods of treatment keeping in mind the nutritional and health benefits.

Analysis and Outcome

The recommendations of the study have been implemented and have the potential for application in other regions of the country. Several food preservation and treatment technologies are being used to retain the nutritional attributes of fresh foods and to enhance food safety. Different types of food-processing operations affect the antioxidants and the oxidative stability of foods, resulting mostly in reduced antioxidant activity, which occur rapidly during heating or slowly during the storage process. This underscores the need to develop efficient technologies of food treatment.

As more research is required to study the cellular effects of oxidized forms of antioxidants, future studies should evaluate the pro-oxidant activity of vegetables, fruits, culinary herbs, and spices and the formation of compounds during food processing and their effect on human health and disease prevention.

Agencies responsible for implementation:

- Ministry of Food Processing Industries, Government of India
- Ministry of Agriculture and Farmers Welfare, Government of India
- Directorate of Horticulture and Food Processing, Department of Agriculture and Horticulture, Government of Assam

Study Title

Development of Health Promoting Extruded RTE Breakfast Cereals Incorporating Choukua Rice and Bhimkol Banana of Assam along with Carambola Pomace

Implementing Institution

Gauhati University

Project Location/Completion Year

Assam, 2013

Objective

- Standardize the processing conditions of extruded ready-to-eat (RTE) health food.
- Conduct acceptability studies of the product.
- Study the physiochemical and rheological properties of the extrudates.
- Analyse the nutritional quality of the product.
- Estimate the health-promoting properties of the extrudates.
- Study the shelf life of the extruded products.

Study Recommendation

Scaling up the extrusion technology with different combinations of low-amylose diets incorporated with bhimkol and by-products of different fruits for the development of healthy foods.

Analysis and Outcome

Ready-to-eat (RTE) foods are becoming popular due to changes in lifestyle. However, RTE products are basically cereal-based and found to have low nutritional value. Thus, there is a need to increase protein and minerals in cereal-based extruded foods. Application of extrusion technology for the delivery of nutrients and food bioactives is a recent practice, which holds great promise for the food sector. The extruded food products are a good source of protein, dietary fibre, potassium, and magnesium. The product can be popularized as a breakfast cereal, which will utilize the agricultural produce of the state.

Thus, as recommended in the study, the scaling-up of the extrusion technology with different combinations of low-amylose diets incorporated with bhimkol and by-products of different fruits could be utilized in the development of healthy foods. Improved understanding of scale-up issues in extrusion technology is necessary for the valid interpretation of studies conducted using laboratory-scale and pilot plant extruders.

Agencies responsible for implementation:

- Ministry of Food Processing Industries, Government of India
- Ministry of Agriculture and Farmers Welfare, Government of India
- Directorate of Horticulture and Food Processing, Department of Agriculture and Horticulture, Government of Assam



Study Title

Effect of Processing on Biochemical Compositions and Production of Resistant Starch (RS), Nutraceuticals and Value Added Products from Culinary Banana (Musa ABB) Kachkal of North East India

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2013

Objective

- Study the effect of processing on biochemical composition at various growth stages of Kachkal.
- Develop resistant starch from Kachkal by heat processing and enzymatic methods.
- Develop nutraceuticals from Kachkal blossom.
- Use banana powder as a substitute in different foods and developing value-added products from Kachkal.

Study Recommendation

- The growth stages of Kachkal have profound influence on the biochemical and nutritional compositions.
- Sixty-five days after the emergence of bunch, Kachkal is found to be best for culinary purpose as well as for further processing and value addition.
- Kachkal flour may be considered as excellent ingredients in the preparation of different functional and convenience foods.
- Kachkal starch is the highest potential source for the development of type-III resistant starch due to its high amylose content.
- Foods prepared by incorporating kachkal resistant starch give low glycaemic index; therefore, they may be recommended in the diet of diabetic patients.
- Kachkal sap (male bud) is a good source of antioxidant and flavonoids, which could be considered for the development of nutraceutical foods.
- Value-added products prepared from Kachkal flour are nutritionally rich.

Analysis and Outcome

The recommendations of the study have been partially implemented. The developed value-added products of kachkal would have a potential market in north-eastern states for a wider range of snack products. Kachkal flour has a longer shelf life than the raw fruits because of the reduced moisture content. Foods prepared by incorporating kachkal resistant starch give low glycaemic index; therefore, they may be recommended in the diet of diabetic patients. The sap is a good source of antioxidant and flavonoids, which could be considered for the development of nutraceutical foods.

The project outcomes are expected to have a positive impact on the employment and income-generation capacity of the region. The processing methods can be used by farmers and rural entrepreneurs in the region to ensure food security and raise their incomes, or upgraded by the private sector in a value chain approach to curb production losses in culinary banana (Musa ABB).

Agencies responsible for implementation:

- Ministry of Food Processing Industries, Government of India
- Ministry of Agriculture and Farmers Welfare, Government of India
- Directorate of Horticulture and Food Processing, Department of Agriculture and Horticulture, Government of Assam

Study Title

Preparation, Demonstration, and Popularization of Various Food Products from Locally Available Post Harvested Food Materials for Welfare of Rural Population of Sonitpur District in Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2012

Objective

Use existing food-processing technology for locally grown agricultural raw materials of Sonitpur District, Assam, to bring about social transformation.

Study Recommendation

- The project implementation results have shown that post-harvest technology losses, spoilage, and wastage of the locally available agro-food materials can be minimized immensely.
- It also alleviates the poor and boosts the income, health, and education of the socio-economically weaker section of the society.
- Such flagship programmes of training and skill development are expected to continue.

Analysis and Outcome

Food processing and packaging are the most effective methods of preserving and adding value to the locally available food materials. The recommendations of the study can be implemented through the coordination of all stakeholders: local government, SHGs, and target groups. The training of women, student volunteers, and SHGs to increase their awareness on developing and scaling up food products at the household level from locally available raw materials was considered crucial to bring about social transformation in the area. Due to an increased demand and request from beneficiaries, such training programmes are expected to continue. A number of beneficiary families have shown higher incomes as compared to 2–3 years before.

The district administration is working towards uplifting the standards of living of the farmers by raising their farm income through the adoption of advance agriculture technologies that include the use of tools and machineries for mechanization, food processing, and post-harvest management.

Agencies responsible for implementation:

- Department of Agriculture and Horticulture, Government of Assam
- Department of Biotechnology, Government of India
- Ministry of Food Processing Industries, Government of India



Study Title

Evaluation Study on Mid-Day Meal Programme in Meghalaya

Implementing Institution

Council for Social Development

Project Location/Completion Year

Meghalaya, 2010

Objective

- Understand the constrains and bottlenecks in implementing the Mid-Day Meal Programme (MDM).
- Suggest policy measures for improvement in the functioning of the programme on the basis of in-depth observations.

Study Recommendation

- This study strongly recommends “process monitoring” and “improvement in planning” for scaling up the exercise to improve performance in all the schools in the state. It includes comprehensive, periodical, and systematic orientation to sensitize all stakeholders, including the policy makers, implementers, teachers, centre-level officials, and community people to make them understand this scheme well.
- Financial resources provided per head were felt very low. Thus, it is recommended that it should be linked with a specially designed price index, which should take care of commodities used for the preparation of the MDM.
- Adequate infrastructure, such as provisions of kitchen sheds, kitchen devices, and facility of drinking water, should be ensured in all schools.
- Funds should be provided in advance to the implementing agencies through the state nodal officer for the transportation of food grains.
- In response to the difficulties of “on-site feeding”, alternative approaches for delivering an appropriately timed and high-quality, consistent ration have been developed in other parts of India.

Analysis and Outcome

The State Government of Meghalaya has adopted different methods and practices to improve the implementation of the Mid-Day Meal Scheme. The recommendations of the study have been implemented partially. According to the website of the Mid-Day Meal Scheme, the Directorate of School Education and Literacy, Government of Meghalaya, some of the practices taken up by the state include setting up of a corpus fund, e-transfer of mid-day meal funds, community participations. Capacity-building workshops have been conducted in the office of the Directorate of School Education and Literacy, three to four times a year ^[208].

The Divisional School Education Officers, Sub-Divisional School Education Officers, Block Resource Coordinators, Block Resource Persons, and Data Entry Operators have attended the capacity-building workshops, which have assisted them in enhancing their application in the Mid-Day Meal Scheme. Awareness and training programmes have been held with stakeholders.

Several challenges remain for the proper implementation of the scheme. Shortage of manpower at district/sub-divisional level is a concern due to which monitoring of the scheme becomes difficult. Meghalaya is one of the five states that were fined by the Supreme Court in December 2018 over implementation issues of the Mid-Day Meal Scheme in schools ^[209].

Agencies responsible for implementation:

- Department of Health and Family Welfare, Government of Meghalaya
- Directorate of School Education and Literacy, Government of Meghalaya
- Ministry of Health and Family Welfare, Government of India

Study Title

Final Report of the R&D project: Quality Improvement of Traditional Method of Rice Beer Production by the Tribal People of North-East India

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2012

Objective

- Standardize the traditional method of rice beer preparation by the tribal people of North-East India.
- Conduct biochemical characterization of the plants used as starter materials during fermentation in the traditional belts of North-East India.
- Characterize the rice beer both microbiologically and biochemically collected from different tribal belts of North-East India.
- Replace rice grains with tapioca roots as raw material for the production of beer and its quality evaluation both microbiologically and biochemically.

Study Recommendation

- Develop value-added products by selecting productive microbial strains, genetic improvement, process improvement, and quality control.
- Encourage multi-institutional collaboration.
- A commercial unit of the traditional fermented foods of the north-eastern states should be developed, which would in turn help in the proper marketing of the products in packed form.
- Financial and technological support for governing and funding bodies.

Analysis and Outcome

The recommendations of the study have been partially implemented. Since the last few decades, the plant species used to prepare rice beer by the tribal communities is dwindling due to rapid urbanization and the loss of natural habitats. The traditional knowledge is reducing due to the lack of interest and the ignorance of the traditional values and beliefs in the young generation. This has created a gap leading to the absence of experienced and knowledgeable persons among the tribal communities. Limited and fragmented literatures are available regarding the preparation and consumption of traditional rice beer of this region ^[223].

Scientific studies and detailed analysis of the indigenous rice beer of tribal communities will be beneficial for the socio-economic development of the tribal population of North-East India. Documentation and preservation of the indigenous knowledge of these tribes and their recipes of preparation of rice beer need scientific input for increasing their shelf life and value addition for marketing and commercialization with increased acceptability by the people.

Agencies responsible for implementation:

- Ministry of Health and Family Welfare, Government of India
- Indian Council of Medical Research, Government of India

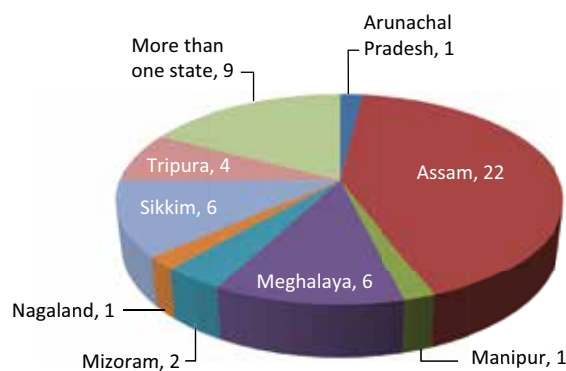


State-wise Summary

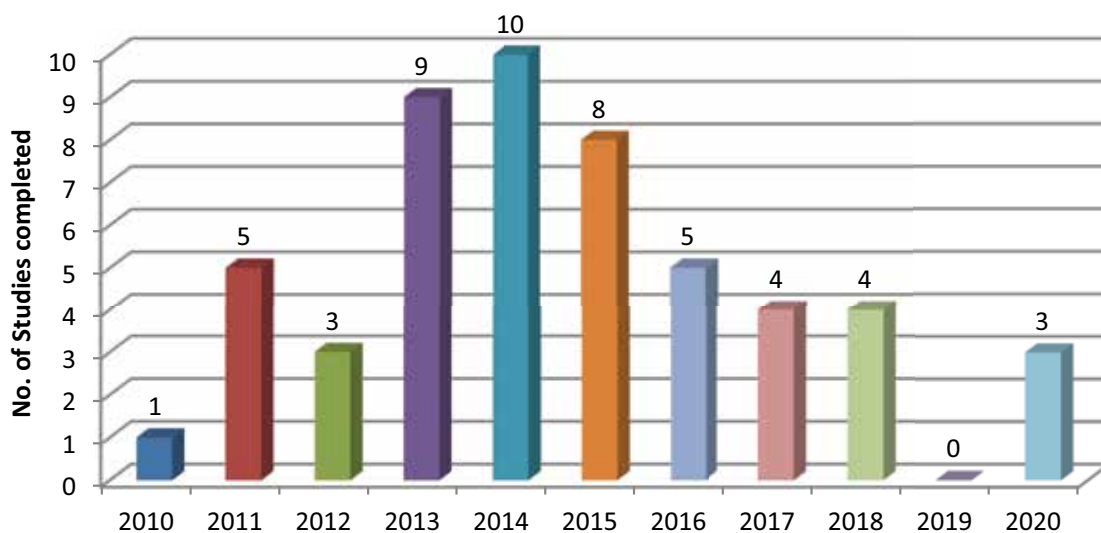
In the present study, over 52 study reports have been collected and analysed. These research studies have been carried out in North Eastern Region by various academic and research institutions on Health & Nutrition sector during 2010 to 2020.

Maximum studies were from Assam (22), followed by Meghalaya and Sikkim with 6 each. This report also includes 4 studies from Tripura, 2 from Mizoram, and one each from Arunachal Pradesh, Manipur, and Nagaland. 9 studies covered multiple states from the region.

During the time period of 2010 to 2020, maximum studies (10) were completed in the year 2014 followed by 2013 (9) and 2015 (8).



Studies completed in Health & Nutrition Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Health & Nutrition Sector in NER during 2010 to 2020 (Year-wise)

Arunachal Pradesh

The healthcare system in Arunachal Pradesh delivers healthcare utilities and services through both public and private parties, as well as from various NGOs and self-help groups. In-depth research on the various facets of high-quality, affordable, healthcare services and nutritional aspects in the state has been a challenge. Arunachal Pradesh is an agrarian state where more than 70% population is dependent on agriculture for their livelihood. The study report covers the study focussed on optimization of load carrying capacity in Sherpa and Backpack mode for agricultural workers.

Assam

Improved service delivery and people's access to healthcare, primarily in rural areas, has been the core focus of studies in the state. Assam has been a pioneer in undertaking several revolutionary initiatives in public health and healthcare. For instance, boat clinics in Assam have become the primary access to healthcare. Assam faces challenges with regard to health of women and children. It is necessary to decrease the out-of-pocket spending by allocating more revenues by the state to the healthcare sector.

There is a rising demand for Assamese local traditional foods. Though entrepreneurs and self-help groups are actively engaged in commercializing ethnic food to expand the market of the local traditional food products, the commercial system needs to be improved or modernized. Training of women, student volunteers and SHGs to increase their awareness on developing and scaling up of food products at household level from locally available raw materials was considered crucial to bring about social transformation in the area.

Manipur

Manipur shares international boundary with Burma (Myanmar) Golden Triangle, which contributes to the state's vulnerability to drug addiction. Genes and variations play crucial role in the initiation and development of substance dependence. The study covered in this report has analysed interaction among genes at the variant level contributing to heroin use disorder based on STRING database. Gene-gene interactions and protein-protein interactions are necessary for understanding cellular and system-level processes. Exploring predicted interaction networks can open up new directions in research and disease understanding.

Meghalaya

Public Private Partnership (PPP) has emerged as one of the important strategies for health sector reforms in the state. Reforms are underway in the public health services including maternal and child healthcare. Initiatives have been taken by the National Rural Health Mission and National Health Mission, Government of Meghalaya to meet the growing needs for health services.

There is immense scope of ethnobotanical studies due to the natural forest coverage in the state. Due to poor transportation and medical facilities in the rural areas, the rural folks to a great extent still hold onto their traditional faith in local medicine men and wild herbal plants. There is a concerted effort by the State towards empowerment of the local health practitioners/traditional healers with knowledge pertaining to various health issues.

Mizoram

Kayakalp initiative is a key intervention under the National Quality Assurance Programme, which was launched to improve the infection control practices and also to improve the aesthetic appearance in the hospital. The study covered in this report seeks to validate the Kayakalp achievements and provide directions to further enhance the improvement in a holistic way.

The incidence of stomach cancer in Mizoram is highest in India. The results of the study covered in this report demonstrate predicting the possibility of developing stomach cancer and correlate the percentage of methylation of the particular gene/s and stomach cancer. More such studies are required to be undertaken that will aid in tracing tumour progression and the outcome of treatment.



Nagaland

Community engagement and management of health services have contributed to improved delivery of local health services in the state. The Nagaland Health Project aims to improve management and delivery of health services and increase their utilization by communities in targeted locations in Nagaland. An Environmental Monitoring Plan, which addresses the potential impacts and risks identified through environmental assessment, has been included in the project.

Sikkim

The state has undertaken several initiatives to strengthen the schemes under the National Health Mission. The components of the health systems in the PIP were aggregated to bring in more flexibility in the planning process.

Mobile Medical Units (MMUs) have been a significant service delivery investment made by the State to enable reaching out to such marginalized population. The Comprehensive Annual and Total Checkup for Healthy Sikkim (CATCH) programme has improved the health status of people in the state, particularly of the people of remote and hilly regions, by providing them with better access to healthcare services.

Tripura

The National Health Mission, Tripura envisages a dynamic community owned and managed health system facilitated by the government so as to enable the community meet their health needs. The outcomes of the study to assess the level of coverage of the MMU will help to augment healthcare services at the doorstep in remote, difficult, under-served, and unreached areas.

High out-of-pocket expenditure remains a major barrier to quality healthcare services and access to appropriate and affordable medicine. The state has implemented scheme to provide financial support to those in the state that are below the poverty line. The study to assess ideal labour room aims to increase institutional delivery and improvement in child birth and maternal health services.

Overall Scenario

The development of health sector is fundamental to the socio-economic development of a state or a country. The healthcare sector in North Eastern states of India is yet to develop in terms of physical infrastructure, and affordable service delivery to patients, specially, in case of women and children. Strengthening of quality primary healthcare services and improving quality availability of service delivery through digital mechanism is an emerging aspect of the NER healthcare sector.

The North Eastern region has the highest incidence of cancer in India, and is also burdened by higher prevalence of risk factors and inadequate cancer treatment facilities. Understanding the genetic and epigenetic alterations in patients from particular population would help in better understanding of the disease prognosis and will be useful in predicting the severity of the disease.

Health care services have been a challenge in the north eastern region due its geographical location, difficult terrain, rainfall, and large number of ethnic groups. However, large scale development in the healthcare and nutrition sector has taken place in the region in the last few years due the sustained efforts of the Central and state governments. The establishment of Ayushman Bharat Health and Wellness Centers in the north-eastern states has achieved considerable progress, thereby strengthening the primary healthcare system as envisaged under the initiative. A large number of health screenings are being performed in these centers. A total of 7246 Health and Wellness Centers have been proposed for the north-east till December 2022. The PM-Ayushman Bharat Health Infrastructure Mission, Ayushman Bharat – Digital Mission and Pradhan Mantri Jan Arogya Yojana has contributed to strengthening the public health infrastructure. These schemes envisage a new generation of reforms to integrate and strengthen health service delivery and public health action including health research so that the communities are Atmanirbhar in managing such pandemics or health crisis.

Overall, the prospects of progress in the health and healthcare of the north eastern region are very high. The role of governments, at the central, state, regional and grass root levels and their funding will be very crucial in attaining a high standard of public health and human capital.



6.8

HUMAN RESOURCE DEVELOPMENT

Study Title

Documentation of Indigenous Knowledge System of Selected Major Tribes of Arunachal Pradesh and the Relevance of Intellectual Property Rights to IKS

Implementing Institution

North Eastern Regional Institute of Science and Technology

Project Location/Completion Year

Arunachal Pradesh, 2020

Objective

- To document the indigenous knowledge system in various aspects such as weaving, handicraft, woodcarving, and natural resource management of the selected tribes
- To prioritize the indigenous knowledge system based on the relevance to IPR
- To create awareness regarding IPR amongst the stakeholders
- To prepare digital database dedicated to the indigenous knowledge system

Study Recommendation

- More project funding and carrying out long-term studies to achieve maximum benefits in these communities.
- Awareness programme on IPR in relation to IKS for selected tribes.

Analysis and Outcome

The project sanction no. GBPNI/NMHS-2017- 18/SG-27 was funded by NMHS (National Mission on Himalayan Studies) documented and a database (www.ipr4iks.com) was created of indigenous knowledge system of Adi, Apatani, Nyishi, Monpa, and Wancho tribes of Arunachal Pradesh. The study also links its relevance to intellectual property rights and Geographical Indication (GI) in the areas of wood carving practices, indigenous food products, agricultural crop varieties, protection of plant variety and handicraft, and traditional handloom products.

The prioritization of IKS based on the relevance to IPR was done by the study by analysing market feasibility of the products viz., study on the annual sale of handloom products of Monpa and Nyishi tribe and documentation of Tasseyan indigenous food product of Nyishi tribe. Further, an awareness programme was conducted in Lower Subansiri district with 29 participants; however, 4 more awareness programmes could not be done at Papumpare, East Kameng, East Siang, Longding, Lower Subansiri and West Kameng districts due to CORONA-19-induced lockdown.

More project funding and long-term studies were recommended to achieve maximum benefits in these communities. It was noted through literature surveys and outcome of other NE evidences in the similar efforts that coordinated approach towards indigenous knowledge preservation has not been done in the region. The outcome of this project is that only one research paper got published in Indian Journal of Traditional Knowledge, a handful of tribals gained livelihood generation information directly, while around 150 people got indirect benefits through awareness generation. Another project funded by NEC in the same institute is currently in progress.

IK preservation in North-Eastern states, with special reference to Arunachal Pradesh is of utmost importance for knowledge preservation, cultural development and livelihood generation purpose for the indigenous communities. While some work at different places in NE have been conducted, however, a consolidated approach is yet to be established. For guidance and providing technical support on IPR-related issues and carrying out future studies in Arunachal Pradesh, the following two state government organizations are identified:

- Arunachal Pradesh Biodiversity Board, Itanagar
- A.P. State Council for Science & Technology (Department of Science and Technology), Itanagar

Study Title

A Feminist Enquiry into the Status of Women's Rights

Implementing Institution

Foundation for Social Transformation

Project Location/Completion Year

Arunachal Pradesh, 2019

Objective

- To understand experiences of women and the status of women's rights in Arunachal Pradesh
- To document women's voices
- To create evidence for feminist intervention

Study Recommendation

- Created programmes that introduce feminist analysis amongst women in leadership positions including that of teachers, students, activists, government officials, Panchayat leaders, etc.
- Generate women-led discussions and ideas for social change. Discussions with women themselves about their obstacles, needs and expectations will help formulate strategies for intervention.
- Support women to initiate action projects on the ground based on their ideas of change. Women's organizations, groups/collectives should be supported for actions in specific areas of their concern.
- Deepen understanding of customary laws, practices, and possible reforms. Women in organizations such as APWWS and ABK have already started the process. These processes should be supported for effective results.
- Create capacities and spaces for policy discussions through dedicated programmes will help in women-led policy formulations as at present there is little participation of women at the policy discussion in Arunachal Pradesh.



Analysis and Outcome

The report studies cases from various women stakeholders and analysed feminist issues. Males exercise supreme authority in household affairs of patriarchal society of Arunachal Pradesh, however, women make invaluable economic, political, and socio-cultural contributions making it a women-centric tribal society. Although tribal boys and girls are brought up in the same way, girls are discriminated in society. The role of married women in household activities is limited to house maintenance, cooking, making brews, working in agricultural fields. Unmarried girls, however, help their mothers in house and fields alike and take care of the minor ones. Usually, girls have no right to inherit properties of their parents and husbands, but they acquire absolute right if parents give movable properties or in special cases inherit properties as well. This amply proves that status and position of Arunachalee women are stressed but better than some parts in India; however, traditional discrimination against women are in still in practice, which stand against of liberation of women and require large-scale women awareness about their rights ^[226].

Some NGOs, societies, revised government policies, and modern young women are leading torch bearer in these efforts as we can see from literatures and stakeholders' discussions in recent years. The women rights issues are complex, deep rooted within the society, and till date awareness drive are done only partially, which require more time and efforts from all stakeholders to resolve.

However, the following organizations are carrying out research and working at the ground level to change the women discrimination practices.

- Arunachal Institute of Tribal Studies (AITS), Rajiv Gandhi University
- Arunachal Pradesh Women's Welfare Society (APWWS)
- Arunachal Pradesh State Women's Commission
- National Rural Health Mission
- Foundation for Social Transformation, Guwahati (FST)
- Women's Leadership Training Centre, Assam
- Nething, Guwahati
- Rural Development and Panchayati Raj Department, Arunachal Pradesh

Women-centric government schemes have been framed in recent years, which are in practice during recent past, but more awareness is necessary to change the social dimension. This can happen through favourable government policy changes at the local level with rigorous awareness campaign, stakeholders' consultations, and showcasing family benefits of women's financial literacy ^[227].

Study Title

Comprehensive Study on Available Skill, Skill Gaps and Skill Development Potentials in the NER-Arunachal Pradesh

Implementing Institution

North Eastern Development Finance Corporation Ltd. (NEDFi)

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

- To identify agricultural products that offer immense potential for improving exports from North Eastern Region
- To prepare a comprehensive action plan to tap the potential

Study Recommendation

- Strengthen the governance framework currently governing the skill development ecosystem of the state
- Improve the effectiveness and utilization of existing Technical Vocational Education and Training (TVET) Institutions
- Make provisions for providing specialized skill development training in identified sectors and domains relevant to the state
- Make general education in schools an integral part of skill development efforts by improving the quality and learning outcomes of school education
- Create a robust ecosystem of credible private Vocational Training Providers (VTPs) to support skilling initiatives of the state government
- Improve linkages between industry and institutions providing skill development training



Analysis and Outcome

A distinctive feature of this study is the extensive primary survey conducted at block levels in all 20 districts of the state. The students, parents, unemployed persons, skilled workers, and beneficiaries who were respondents in this survey highlighted the need to improve meaningful outcomes of these training efforts in terms of industry-specific skill development and livelihood-generation potential. The recommendations were met partially through various government sponsored schemes, training, and skill development initiatives.

Skill development is a continuous process in North Eastern Region and Arunachal Pradesh and has brought desired fruits in recent years. Recently, it is found that participation in skill development training definitely helps with employment in the non-farm sector. However, in terms of employment and income generation, one-year-long skill development training was found to be more effective than less-than-a-year-long training. (Source: Indian Journal of Human Development, September, 2020)

The State Policy on Skill Development mission implemented by Department of Skill and Entrepreneurship Development, as part of Chief Minister Yuva Kaushal Yojna, envisions the mission to empower all individuals through improved skills and knowledge at national and international levels in multiple sectors where the State has competitiveness. Creating one lakh job opportunities for all (youth, women, and disadvantaged groups) by 2022 was announced as the outcome of this initiative.

However, a closer look at the skill development system of the state of Arunachal Pradesh reveals that there is no single quality control and quality assurance system in place at the state level, which takes care of the standardized pattern for quality-related issues of all the skill development and training schemes. Implementation of National Skill Qualification Framework (NSQF) and creation of Sector Skill Councils (SSC) are presently in progress, which are expected to bring quality check in future training programmes. A comprehensive adoption of such guideline would facilitate quality check in training content and assessment, regulatory mechanism, infrastructure and logistical developments, and industry-specific courses for livelihood generation.

The following State Government departments are required to emphasize on skill improvement and improvements in implementation of government schemes: Department of Skill Development & Entrepreneurship, Department of Education, Department of Rural Development, Department of Agriculture, Department of Horticulture, Department of Tourism, Department of Housing and Urban Poverty Alleviation, Department of Social Justice & Empowerment and Tribal Affairs, Department of Women & Child Development, and Department of IT and Science & Technology. Besides, Technical Vocational Education & Training (TVET) Institutions, Private Vocational Training Providers (VTPs), local NGOs and other national-level skill and entrepreneurship development organizations should also be responsible for capacity-development ecosystem in Arunachal Pradesh.

Study Title

Studies on Distribution, Behavioural Ecology, Habitat Structure and Conservation of Newly Discovered Arunachal Macaque (*Macaca munzala*) in Western Arunachal Pradesh, India

Implementing Institution

Tezpur University

Project Location/Completion Year

Arunachal Pradesh, 2016

Objective

- To study the ecology and behavioural aspects such as time-budget activities, food preference and feeding habits, social organization and behaviour, and reproductive ecology of *Macaca munzala*.
- To evaluate the habitat characteristic and structure of natural habitat of *Macaca munzala* in relation to food species frequency, density, abundance, basal cover, importance value index, species diversity, and similarity index along with soil profile and climatic condition.
- To assess the natural regeneration status of most preferred seasonal food plants of *Macaca munzala* in relation to habitat conservation and management.

Study Recommendation

- The macaque and human interaction were found unconstructive in Tawang district due to intensive raiding behaviour of the species.
- While in West Kameng district, population status of *Macaca munzala* is largely threatened due to the hunting activity.
- There is an urgent need for conservation and management of *M. munzala* in Arunachal Pradesh, particularly in Tawang and West Kameng districts.

Analysis and Outcome

As an outcome of the study, population status of *Macaca munzala* was found to be increasing in Tawang district when compared to earlier report (Kumar et al., 2008). However, its population in West Kameng district is disturbingly low as it continues to receive greater threat due to the hunting activity by the local inhabitants.

Observation and records on behavioural activities of newly discovered Arunachal macaque in relation to the different habitat types will help in the habitat management and formulation of conservation strategies of this endangered species.

Generally, Arunachal macaque is poorly studied by the conservationist and considered as a menace by the farmers due to the prevailing human-primate conflict. It is known to cause considerable damage to the farmer crops. On other hand, habitat fragmentation from construction of farm roads and power transmission lines in their habitat are emerging, resulting into enhanced people's apathy. Therefore, more studies on the species are needed with the overall goal to reliably assess its conservation status and to simultaneously build empirical database on the species with regards to ecological and conservation threats ^[228].

A number of efforts have been proposed to help reduce Arunachal macaque's negative impact on crops, including adding crop buffers, deterrents such as water guns or loud noises that scare but do not harm the monkeys, and crop compensation or insurance programmes. Ministry of Environment, Forest and Climate Change and State Department of Environment are two primary bodies responsible for reducing human-wildlife conflict, protecting both people and animals with policies and efforts in the right direction.



Study Title

Language Contact and Convergence Study of Bugun (Khowa) of West Kameng District of Arunachal Pradesh

Implementing Institution

Tezpur University

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

- To facilitate smooth implementing of project activities, without any controversies or biasness in selecting intended project beneficiaries

Study Recommendation

- Tribal language preservation to preserve culture since younger generation is not using it
- Efforts to stop rapid change in language

Analysis and Outcome

The study found that while elder generation still communicate using Bugun language in Kameng district in Arunachal Pradesh, younger generation find Hindi and English as preferred language as these are used for official purpose. The tribal language is, therefore, used infrequently. Major reason is official jobs and higher education require proficiency in these languages. Further, younger generation feel pride in learning these language over their native Bugun language.

The beneficiaries mentioned that over 80% of population over 50 years of age know and speak in Bugun language, however, younger generation seldom speak in this language. In fact, parents are also encouraging children to study Hindi and English languages for job purpose, and Bugun language can be studied at a later phase in life.

Under these circumstances, the Bugun language-speaking people are rapidly depleting and also undergoing changes. There has to be substantial efforts from government (Education Department), local NGOs, and academic institutions to save this language through preservation efforts such as use of this language in folk songs, seminars, films, social gatherings, etc.

Study Title

Report on Post-enumeration Survey of DISE Data (Arunachal Pradesh)

Implementing Institution

Rajiv Gandhi University

Project Location/Completion Year

Arunachal Pradesh, 2010

Objective

- All children should get education in schools, EGS, alternative school, 'Back to School' camp.
- All children are to complete 5 years of primary schooling by 2007.
- All children are to complete 8 years of elementary schooling by 2010.
- Focus on elementary education of satisfactory quality and education for life
- All gender and social category gaps at primary stage should be bridged by 2007 and at elementary level by 2010. Universal retention by 2010.

Study Recommendation

- The orientation programme concerning the nature and use DCFs need to cover a large number of headmasters and teachers so that the trained teachers are available for this purpose in every school of the district
- The headmasters need to be given specific information on Data Capturing Formats and are to be filled up by the trained teachers only
- As per Post-Enumeration Survey Report-2010, these trained teachers may conduct a training programme for other teachers of the school
- The data pertaining to CWSN, repeaters, MDM need to be cared as most of the schools fail to supply the proper data about such items
- The schedule of filling up the DISE data must be fixed well in advance and passed to the schools so that the schools and their functionaries get enough time to supply data on or before 30 September of the year

Analysis and Outcome

The whole educational planning at the national and state levels depends upon the DISE data, therefore, the DISE data is to be reliable and valid in nature. Therefore, the Post Enumeration Survey (PES) needs to be conducted by having a sample of 5% Primary/Upper Primary schools of the selected districts and the collected PES data are compared with the DISE data of those selected sample of schools just to establish the validity of DISE data.

The reliable educational data are useful tool in the educational plans, formulating policies, and implementing effective programmes to show their impact on the quality of education. Hence, as outcome of this report recommendation and also from inputs from other States, Ministry of Education has put emphasis on data collection process and capturing formats. At present, DISE (District Information System for Education) and SEMIS (Secondary Education Management Information System) have been merged into UDISE+ (Unified District Information System for Education Plus) and become only information source for school education system in terms of schools, teachers, and students enrolment^[229]. A centralized data capture format (DCF) is used to capture data from all states including Arunachal Pradesh and has been feeding into the national database for policymaking process. DCF collects data on school-wise enrolment, teachers, infrastructure, facilities, safety measures, etc.

The UDISE+ system data are to be provided by respective schools, verified by the State Education Department, and final responsibility lies with Ministry of Education, Government of India.



Study Title

Education, Occupation and Associated Demographic Character and Socio-economic Well-being in Bodoland Territorial Areas District (BTAD), Assam

Implementing Institution

Gauhati University

Project Location/Completion Year

Assam, 2020

Objective

- To analyse the pattern of educational attainment including the gender disparity in the study area (BTAD) in both spatial and social contexts
- To study the occupational pattern of the people in the study area to understand the prevailing economic condition
- To assess the spatio-temporal patterns of demographic character in the study area on the basis of fertility, mortality, sex ratio, age composition, life expectancy, age at female marriage, etc. in both spatial and social contexts;
- To examine the impact of education and occupation on the demographic character and socio-economic well-being in the study area
- To evolve possible measures for a balanced and sustainable socio-economic development in the study area both spatially and socially

Study Recommendation

Educational development for all sections of tribal people are a must requirement to attain better health status in the region and to control and maintain the health of infants

Analysis and Outcome

The socio-economic development in Bodoland Territorial Area District (BTAD) of Assam is one of the most underdeveloped areas in India. BTAD region has been lagging behind in respect of educational, occupational, overall demographic, and socio-economic well-being. The various socio-economic factors including discouraging situation of literacy and education and occupation and low government initiative have been responsible for the poor physical health and socio-economic well-being in BTAD. The region has no major industries in healthcare sector, rather cottage and manufacturing sectors are grown.

The recent government policies and initiatives have changed the socio-economic conditions in BTAD region to some extent. Bodoland Territorial Council, Autonomous Councils, District Development Committees and District Vigilance and Monitoring Committees have been constituted, regulations framed and funded for specific development of BTAD region^[230]. As per the beneficiaries, while urban areas depict better performance in income, asset, education, and empowerment, they have a relatively lower score in health dimension as compared to rural areas. As the education and literacy in urban areas are more, job opportunities and women empowerment have increased substantially in recent years, which eventually impacted positively in health status of local residents. However, it was also highlighted that the level of socio-economic development of local residents depends on demographic parameters, their education level as well as social characteristics of the households^[231].

State Directorate of Welfare of Plain Tribes & Backward Classes, Assam; Bodoland Territorial Council; Autonomous Councils; District Development Committees; District Vigilance and Monitoring Committees; Ministry of Health and Ministry of Ayush, Government of India are primary bodies to develop and implement policies for health and well-being of tribals in Assam with adequate support from academic institutions and local NGOs. Other organizations who can support include NEDFI, Assam Rural Livelihood Development Mission, etc. However, such development are still in nascent stage in BTAD region and require more academic studies, awareness of government schemes in future to improve health and well-being of tribals.

Study Title

Continuity and Change Among the Buddhist Tai Communities of Assam

Implementing Institution

Gauhati University

Project Location/Completion Year

Assam, 2017

Objective

- To understand the distribution and concentration pattern of the Buddhist Tai communities of Assam
- To understand the demographic pattern of the communities
- To analyse the educational and economic status of these Tai communities
- To know the culture, customs, and traditions of these ethnic groups and explore the pattern of cultural continuity and extent of social change and development among them
- To know the degree and extent of inter and intra community variation in social change among the different Buddhist Tai groups
- To understand how the concerned Tai communities view their own position in relation to others in the society in terms of ethnicity and culture
- To explore the process of acculturation and assimilation among the Buddhist Tai communities and understand how it emboldens the growth of greater Assamese society

Study Recommendation

Possible measures for Buddhist Tai Communities for their overall socio-economic upliftment

Analysis and Outcome

This report is first of its kind study to know culture, heritage, community practices of little-known Buddhist Tai communities; however, no specific recommendation were made, which could be implemented for socio-economic development of the Tai communities.

The report paved the way to bring little known communities into public view in terms of changing culture, heritage, language, and practices followed. While continuity of their heritages are mostly retained, inter-community marriages and migration for job opportunities are two primary reasons identified for socio-cultural and economic change. This report supports the comparative analysis of Assamese Tai with that of other Tai communities in South Asian region.

The report also points out that many more scientific studies are required to explore more about Buddhist Tai communities for making impactful development. State Directorate of Welfare of Plain Tribes and Backward Classes, Assam; Autonomous Councils; District Development Committees; District Vigilance and Monitoring Committees constituted and funded by the State and Central governments with support from academic institutions are responsible for carrying out more studies and implement developmental work for Buddhist Tai communities. Other organizations who can support include NEDFI, Assam Rural Livelihood Development Mission, etc.



Study Title

Market Demand Study of Jobs in the State of Assam and Related Skills Required Under DDU-GKY

Implementing Institution

North Eastern Development Finance Corporation Ltd. (NEDFi)

Project Location/Completion Year

Assam, 2017

Objective

To understand the nature of the labour market and job opportunities in the state; as such details are vital for the successful implementation of the DDU-GKY scheme in Assam

Study Recommendation

- Focus on some thrust areas that require less cost in imparting training and high employability, such as security, retail, hospitality and food, driving, tailoring, and beautician.
- Add value to the education of trainees through language skill and other soft skills that they can compete for 'white collar' job.
- Avoid areas where imparting training and cost of equipment are costly. This includes trades such as machine operator, fitter, turner, mechanic, electrician, welder.
- Avoid trades practiced on contract basis (such as mason, plumber, painter and other building trades) as DDU-GKY aims at salaried employment

Analysis and Outcome

The study is unique in a sense that it measures the effectiveness of skill development trainings among DDU-KGY trainees across Assam. Survey response indicated that a few areas have more employability over other areas. About 31% of the DDU-GKY trainees got placements after training, mostly placed outside Assam. The low rate of placement is due to several reasons including conducting trainings in non-employable topics. Moreover, beneficiaries faced some specific issues and did not take the placements such as low salary levels, migrating outside the state, working conditions, language problems. Trainings institutes have taken up measures such as directly contacting companies, organizing 'job fairs' and forming dedicated teams to address the issues resulting into better placement rates in recent years.

We feel aggressive promotion of job opportunities, self-employment through seminars, workshops, industry meet, job fairs in the identified sectors by training agencies, with support from Rural Livelihood Mission, State nodal Agency for Skill Development, Department of Welfare of Plain Tribes & Backward Classes, academic institutions, major industries in the identified sectors would improve the success rate.

Also, new and innovative trade for business and employment generation need regular research as technology, socio-economic factors, demographic dimension, and business environment changes rapidly with time. We feel more studies in the area of measuring effectiveness of skill development are required in future.

Study Title

Caste, Class and Commons: A Study in Nagaon District of Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2016

Objective

- To understand various dimensions of power in relation to the use of common in a multi-caste village in Nagaon District of Assam.
- To analyse the ways in which caste, class and commons are interconnected reflecting the social structure and the rhythm of the village.

Study Recommendation

- The village administratively is a single revenue village, but socially the village is divided into three residential pockets based on caste, with deteriorating economic condition.
- The study recommends government to come out with suitable policy measures to conserve and save the common goods in any village.

Analysis and Outcome

The study was conducted in Dakhinpat Satra village, Nagaon district, Assam which has mixed caste residential population. The study identified that villagers have religious mindsets and many inequalities aroused due to caste differentiation. The beneficiaries felt that lack of government initiatives to preserve common activities/spaces (low irrigation facilities, maintenance of wetlands, cattle grazing grounds, etc.) has eroded agrarian and fishing economy. The Satra (controlling body of the common spaces) failed to protect such livelihood options for different castes. Further, throwing of urban wastes in wetlands, providing access to river or grazing grounds to selective caste people, actually disrupted harmonious livelihood generation in the village.

Further research has found that State and local government have initiated limited awareness generation activities, providing inputs in changing pattern of agricultural practices and pursuing young generation to education and revival of agrarian economy have been emphasized in recent past. While policy changes are essential for revival of the village economy, however, little have been done so far.

Moreover, more studies should be conducted in similar topics to assess the ongoing process. Department of Welfare of Plain Tribes and Backward Classes, State academic institutions, local NGOs should play proactive role in policy formulation to open the village common spaces, ensure best practices and awareness generation of innovative technologies to revive the deteriorating village economy.



Study Title

Status Report on Children and Women in the Tea Gardens of Assam Tea Corporation Limited

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2014

Objective

- Protect and sustain the tea industry
- Shield the interest of workers and increase the employment potential of tea garden labourers
- Decentralize and avoid the concentration of ownership of tea estates in a few hands
- Organize transportation of ATCL goods; build associations with any person or company whose objects and business are similar to that of ATCL

Study Recommendation

- For an effective health service delivery garden hospitals should be looked after by the government agencies or it should be managed by NRHM
- There should be at least one regular doctor along with ANMs and pharmacist in each tea garden hospital
- There should be regular health check-up camps and health campaign to make the people aware about various health problems
- There should be awareness campaign against the ill habit of alcohol and substance abuse
- Each garden should have the infrastructure including labour rooms, so that the delivery can take place in the garden hospitals in the presence of the trained personnel including doctors and ANMs
- Regular supply of medicine to each tea garden hospital should be ensured

Analysis and Outcome

The tea community is one of the marginalized and socially excluded groups in Assam. They remain unserved in terms of basic healthcare facilities (i.e. Hospitals) adding to high diseases burden and mortality rate. The study highlighted the status of health conditions and facilities available in Assam tea gardens under ATCL. While some of the beneficiaries mentioned that facilities are good, many gardens do not have adequate hospital and medicine facilities. Further, once retired from job, health facilities for people are very poor.

In order to develop health facilities, Assam government, through Department of Health and Family Welfare, Government of Assam, has initiated a few schemes. Using National Health Mission (NHM), Assam has executed a Memorandum of Understanding (MoU) with Tea Garden Hospitals under Public Private Partnership (PPP) with the purpose to be make healthcare services available to all the employees of the tea gardens and its adjoining areas. At present it is being implemented by 150 tea garden hospitals. The scheme funds for salary/incentive of doctors and paramedics engaged in tea garden hospitals, renovating existing hospital infrastructure, free medicines, purchase of equipment, augmentation of hospital, and to improve service delivery. Ambulance was also given to each tea garden hospital of PPP mode for referral service purpose^[232]. Also, some other Government schemes including Community Action for Health (CAH) has been implemented in 18 districts covering all blocks and 40 selected VHSNCs from each Block. Identification and profiling of Mothers groups in tea gardens have been completed.

However, regular assessment of progress of these government schemes, facilities developed, and awareness generation are major issues that still remain a major agenda in this direction and require many more surveys to understand the ground reality.

Academic institutions, NGOs, and nodal government health agencies should promote awareness and initiate such research-based surveys. Schools can play a major role in creating health awareness among the children.

Study Title

Prevention, Prohibition and Redressal of Sexual Harassment at Professional Places in Assam: Post

Implementing Institution

Gauhati University

Project Location/Completion Year

Assam, 2013

Objective

- Study the causes and types of sexual harassment at the workplace of Assam
- Examine the pattern of existence of sexual harassment at the workplace on the basis of economic classes, ethnicity and educational level
- Analyse the execution of the cases of sexual harassment as per the Acts

Study Recommendation

- Measures should be taken to implement Women Work Safety Act in workplaces in Assam
- Evaluation of existence of Internal Complaint Committee in the professional institutes post and pre 23 April 2013 should be made

Analysis and Outcome

According to the National Crime Records Bureau data for 2016, nearly 41% women face sexual harassment at workplace in Assam, which include demand for sexual favours, unwanted physical contact, explicit sexual overtures, sexually coloured remarks, and more.

The study observed that while Indian Penal Codes call for stiff punishments to sexual harassment (SH) in office places, occurrences of such incidents are not uncommon in office places. The study has found following reasons for such incidents:

- Patriarchal mind set among the male employees can be considered as one of the major causes. Also, low protests by colleagues against such SH incidents also enhance the frequency of such occurrence.
- Offices and workplaces are still continuing to exist as masculine space. This gender imbalance of women representation and participation can be attributed as a cause of SH.

These socio-cultural causes of SH require corrective measures to create gender friendly workplace environment. Further, this study reveals that while majority of the women employees have an understanding about SH, there are still nearly 30% of the women not aware what constitutes SH.

Government agencies such as NHRC, State Law Departments, local NGOs have already taken measures in both Assam government and educational institutes, private offices and industries in the organized sectors to make people change mindset and make women aware of their rights and SH, although more such trainings, awareness programmes in offices are necessary. However, rigorous awareness generation by government, local NGOs against the SH in workplaces, and stringent punishment measures in unorganized sectors are essential as little have been done there on this issue.



Study Title

School Safety Including the School Disaster Management Plan (SDMP) and Conduct of Mock Drills

Implementing Institution

All India Disaster Mitigation Institute (AIDMI)

Project Location/Completion Year

Assam, 2013

Objective

To impart thorough knowledge in the terminologies such as disaster, hazards, vulnerability and capacity, risk assessment along with disaster risk reduction focusing on earthquake and flood safety

Study Recommendation

- More training be conducted at regular intervals
- Practical demonstrations and mock drills in addition to theoretical knowledge
- Provide audio-visual materials to the participants
- More time shall be devoted for collection of information for SDMPs
- SDMP participants shall also be engaged in discussion with the school authorities other than trainee school teachers. Encourage gender balance in participation in the training programmes

Analysis and Outcome

The study conducted sample survey in various categories schools in Assam to understand disaster preparedness and emergency management plans in school. The study recommended immediate attention to this issue as small children life are in stake and an inclusive effort from all stakeholders are needed to ensure SDMP is implemented. The beneficiaries contacted believe there is vast scope of improvement. The recommendations are partly implemented by the State and is on priority list.

Under Department of Elementary Education, Government of Assam, a scheme called Axom Sarba Siksha Abyiyan Mission (ASSAM) has been in place dedicated for School Disaster Management. The ASSAM scheme has organized various training programmes on school disaster management for district officials as well as field-level officials. A pool of district-level resource person has been trained on school disaster management for facilitating schools in preparing School Disaster Management Plan under their jurisdiction in partnership with the UNICEF. As on date, all 27 District Programme Officer (Community Participation and Special Focus Group) and District Project Engineers were trained. Besides, with support from the UNICEF, under the government ASSAM scheme four district-level trainings on School Disaster Management in Majuli and Kokrajhar district were organized for 120 Cluster Resource Centre Coordinators (CRCCs) who in turn will act as key resource persons for the schools to prepare and implement school disaster management plans ^[233].

Moreover, the government has introduced a DRR component in School Management Committees (SMCs) training module with a view to make aware various stakeholders regarding necessity of disaster management in schools. All SMC members were trained using this module. Disaster Risk Reduction is also incorporated in School Development Plan. This will help to develop a comprehensive SDMP for the entire State.

In essence, Department of Elementary Education, Government of Assam; Assam Disaster Management Authority; All India Disaster Management Institute; District Disaster Management Authority and respective Commissioners; All Academic and Training Organizations in Assam and local NGOs are working together through sharing knowledge, resource persons, and organizing trainings for mass awareness drive.

Study Title

Universalisation of Elementary Education Among Tea-Tribe of Assam with Special Reference to Jorhat District

Implementing Institution

State Institute of Education
Assam, Jorhat

Project Location/Completion Year

Assam, 2011

Objective

- To know about the educational facility available in the tea gardens for elementary education
- To know the overall status and performance of elementary education in the tea-garden areas

Study Recommendation

- Special care should be taken to include co-scholastic activities in school programme. There should be proper supervision in this respect
- MDM scheme is very important for Tea-Tribe Children of the Tea gardens. It will protect their right to nutrition. There should be proper planning so that the scheme is operated smoothly
- Teachers of all the schools visited by the investigator expressed their problem in teaching Class V. Specially there are no teachers who can teach English and Hindi. Immediate steps should be taken to provide teachers with required qualification and training

Analysis and Outcome

Tea tribe children who are living in Tea garden are primarily first-generation learner whose parents are either illiterate or with low educational status, and require special school system. The existing barriers in education at tea gardens such as low income per family, distance of schools, non-availability of higher education, etc. can be removed to a great extent by introducing more schools beyond primary level in the garden areas. The state government of Assam has already initiated to introduce schools through Assam Sarva Siksha Abhiyan; however, the introduction of schools is limited to primary level only [234, 235]. Beneficiaries have complained about absence of language teachers in many tea garden schools, which have not been adequately addressed by the tea garden owners due to remoteness and low wages offered to external teachers.

The study identified that although Assam Sarva Siksha Abhiyan Mission (ASSAM) is intervening in all components of school education system, e.g. Campaign, camps, workshops, posters presentation, no striking impact is observed in terms of increase in enrollment of the children, enhancement in literacy rate among 15+ population, or developing awareness among the Tea-Tribe community. While Tea-garden area is of special focus area for ASSAM, most of the plans and strategies are not properly implemented.

In tea gardens, maximum workers are illiterate and are not able to appreciate the value of education for their children. Therefore, constant campaign of adult education through the government agencies, NGOs, and garden authorities to spread the awareness of education is very important. State government's Elementary Education and Higher Education should initiate schools beyond primary level, college, and some vocational technical centres. Tea garden owners, local academic bodies, and NGOs can also join in the development process.

Through ASSAM, the State government has initiated holistic community development system for awareness building and school education systems along with vocational trainings in Public Private Partnership (PPP) model in some places. However, aggressive measures on completion of trainings including proper wage policies, promotion schemes, pay incentives for skilled workers are yet to be developed. Once implemented, the policies which will support education and higher learning aspiration of children of tea garden workers.



Study Title

Report of the Committee on Staffing Pattern and Infrastructure Requirements of Panchayati Raj Institutions in Assam

Implementing Institution

Panchayat and Rural Development Department, Government of Assam

Project Location/Completion Year

Assam, 2010

Objective

To ensure efficiency, economy and effectiveness of the unit as the overarching principle for the staffing pattern

Study Recommendation

- All Gaon Panchayat Offices must be provided with electricity connection.
- Where the location of the Gaon Panchayat Office is very far from electricity supply line, alternative arrangements for power through DG sets need to be provided
- It is recommended that Diesel Generator Sets (minimum 1.5 kW) be provided to all such Gaon Panchayat Offices
- Gaon Panchayat and Anchalik Panchayat Offices need to have telephone connections to enable members of the public to contact them. The landlines should also have broadband facilities so that online data entry can be undertaken from the Gaon Panchayat level

Analysis and Outcome

The PRIs (Panchayati Raj Institutions) in Assam have a three-tier system. Gaon Panchayats (GPs) at the village level are the key units, while the middle level comprises Anchalik Panchayat (AP) at the block level, and Zilla Parishads (ZPs) at the apex level. The recommendations made in the report are almost achieved with the ongoing telecommunication revolution, where all rural people are having mobile phones. Panchayati Raj institutions in Assam at Zilla level are all well connected with facilities of power back-up and telephone. Recent analysis found that barring a few remote villages, telephone or mobile connections are available for keeping contact with the Anchalik or Zilla levels.

Development of PRIs is a major job of State Government. In recent times, Department of Panchayat and Rural Development, Government of Assam has started the process of institutionalizing the participatory gaon panchayat development planning process under the title 'AMAR GAON AMAR ACHONI' which means 'OUR VILLAGE OUR SCHEME'. Effort is to prepare an integrated / holistic gaon panchayat development plan through direct participation of rural people. State Institute of Panchayat and Rural Development, Government of Assam has undertaken mass awareness on a mission mode for 30–40 days in each of the 2200 GPs of the state covering 22,000 wards or villages. Massive campaigns for awareness building among rural masses have been taken up in each of the 22,000 villages/wards of the panchayats ^[236].

Study Title

Comprehensive Study on Available Skill, Skill Gaps and Skill Development Potentials in the NER-Manipur

Implementing Institution

North Eastern Development Finance Corporation Ltd (NEDFi)

Project Location/Completion Year

Manipur, 2018

Objective

- To identify agricultural products which offer immense potential for improving exports from North Eastern Region
- To prepare a comprehensive action plan to tap the potential

Study Recommendation

- Strengthening the governance framework currently governing the Skill Development Ecosystem of the state
- Improving the effectiveness and utilization of existing Technical Vocational Education & Training (TVET) institutions
- Making provisions for providing specialized skill development training in identified sectors and domains relevant to the state
- Making general education provided in schools an integral part of skill development efforts by improving the quality and learning outcomes of school education
- Creating a robust ecosystem of credible private vocational training providers (VTPs) to support skilling initiatives of the state government
- Improving linkages between industry and institutions providing skill development training

Analysis and Outcome

Entrepreneurship and skill development activities is regarded as one of the important determinants for the industrial growth of a country and it has emerged as dynamic area of any growing economy. The study highlighted important skill areas in Manipur where specialized skills based on available natural/human resources are available or are taught in schools or community levels. Also, government and private vocational training agencies are continuously providing trainings in panchayat zilla levels to local youths under Skill India Mission. Success stories are also promoted across the state for mass awareness generation.

Further to this, as a robust response to COVID -19 pandemic, the Government of India and State Government have worked towards employment generation through multiple skill development schemes such as Skill Sathi, PMKVY CSSM, and CMST. Moreover, the Government of Manipur has conducted 'Registration of Skill Card for COVID-19 returnees' for skill mapping to engage the state returnees into new jobs ^[237].

Manipur and other North Eastern states have become a major place of attraction for entrepreneurship due to the Look East Policy/Act East Policy of the Government of India. Both the trans-Asian highways and trans-Asian railway will be passing through Manipur and would generate new opportunities, more employment for the youths and utilities of the human resource potential, entrepreneurship and skill development activities ^[238].

Among other training and vocational training institute at the State and local level, National Skill Development Agency, Ministry of Entrepreneurship and Skill Development, State Department of Skill Development, Academic institutions such as Centre for Entrepreneurship and Skill Development, Manipur University and local NGOs are responsible and arranging or providing job-oriented skill development trainings.



Study Title

Comprehensive Study on Available Skill, Skill Gaps and Skill Development Potentials in the NER-Meghalaya

Implementing Institution

North Eastern Development Finance Corporation Ltd (NEDFi)

Project Location/Completion Year

Meghalaya, 2018

Objective

- To identify agricultural products which offer immense potential for improving exports from North Eastern Region
- To prepare a comprehensive action plan to tap the potential

Study Recommendation

- Strengthen the governance framework currently governing the skill development ecosystem of the State
- Improve the effectiveness and utilization of existing Technical Vocational Education & Training (TVET) institutions
- Make provisions for providing specialized skill development training in identified sectors and domains relevant to the state
- Make general education provided in schools an integral part of skill development efforts by improving the quality and learning outcomes of school education
- Create a robust ecosystem of credible private Vocational Training Providers (VTPs) to support skilling initiatives of the state government
- Improve linkages between industry and institutions providing skill development training

Analysis and Outcome

In Meghalaya, over 30% of the population and youth require skill-based training for getting job opportunities. Skill development in Meghalaya is done under the various government departments, NGOs and private institutions through hands-on vocational trainings. There is a need to converge the various initiatives to instill a sense of collective participation towards a common goal. The Meghalaya State Skill Development Society (MSSDS) was established with the authority to receive

funds from the government (central and state) and financial institutions, and to develop framework and spend the funds for fulfilling the mandate of skill development in the State. It takes the role of a collaborative platform at the state level [239]. MSSDS is implementing a Placement Linked Skill Development programme on various sectors where the State has potential and industry demand through Project Implementing Agencies (PIAs). More trainings have been organized in agriculture and horticulture crops and by-products; capturing of mineral resources from coal, limestone; handicrafts using natural resources in wood and bamboo; border trading, etc. [240]. However, many more skill development trainings, industry linkages are to be done in identified fields as mentioned in the report in coming years.

The State Departments including Agriculture, Education, Community and Rural Development, Border Areas Development, Commerce and Industries, Fisheries, Animal Husbandry, Planning and many more departments have taken specific initiatives through state government schemes to impart vocational skill training and industry linkages in their respective areas for wider development of the local youth.

Besides, vocational training institutes at the state and local levels, National Skill Development Agency, Ministry of Entrepreneurship and Skill Development, Meghalaya State Skill Development Society, Academic institutions and local NGOs are responsible and arranging or providing job-oriented skill development trainings. Based on the NSDA Guideline and NSQF Framework, institutes for vocational education and special trainings could well be a benchmark for imparting skill trainings in the State.



Study Title

Dynamics of Employment of Children and Socio-economic Reality: A Study of Children in Hazardous Occupations in East and West Jaintia Hills Districts of Meghalaya

Implementing Institution

V.V. Giri National Labour Institute

Project Location/Completion Year

Meghalaya, 2017

Objective

To examine the prevalence of child labour in the villages of East and West Jaintia Hills Districts of Meghalaya where coal mining is predominant

Study Recommendation

- Children should be withdrawn from labour force and enrolled in the schools/Special Training Centres/vocational training centres respectively, depending on their age under the SSA programme or by the NCLP Scheme
- Inter-and intra-departmental coordination for the economic rehabilitation of child labour families and educational rehabilitation of children withdrawn from work
- Transportation facility should be arranged in case the schools are located far away from their residence and residential schools should be established for the migrant children
- Identification of child labour through physical verification of locations and places of employment should be carried out regularly to ascertain the presence of child labour
- A web-based Child Labour Tracking and Monitoring System should be established. Tribal councils should be involved in monitoring and tracking of child labour in the districts
- Education Department should ensure mapping of the schools and survey of the out of school children periodically
- District-specific comprehensive Action Plan should be developed for total elimination of child labour involving the representatives of Trade Unions, PRIs, CPUs, CWCs, Civil Society Organizations, community, parents, and the employers

Analysis and Outcome

The study highlighted that, the 2011 census reported that there were 18,839 working children in Meghalaya, which is only 35% of the corresponding figure of 2001 census. Meghalaya's East and West Jaintia Hills has more than 2200 'full-time working children' from nearly 100 villages. Meghalaya Commission for the Protection of Child Rights claimed that 'illiteracy' and 'poverty' are the main factors responsible for child labour ^[241]. Every State department including NGOs are putting up hard efforts through mass awareness, SAA and providing rehabilitation to these children, but working out a collaborative singular approach to counter and eradicate child labour is a necessity.

The State Government has constituted district task forces headed by deputy commissioners and there is enough manpower. Labour inspectors are posted in each of the 46 blocks and inspectors have conducted over 31,600 inspections to identify child labours. A state protocol on child labour has been published on how to prevent, rescue children from getting forced into labour, and also to assist the victims to make the state become a child labour-free state ^[242].

The recommendations are partially achieved through inclusiveness of government departments, NGOs, and other civil society members. While we found substantial decrease in percentage of child labour in the State, however, as per the beneficiaries report, educational engagement and employment of withdrawn children are still not done in a cohesive manner. We hope to improve their financial conditions through different employable skill development trainings.

NHRC, Meghalaya Commission for the Protection of Child Rights, State Department of Education, Meghalaya State Skill Development Society, Union Labour and Employment Ministry, Ministry of Entrepreneurship and Skill Development, academic institutions, and local NGOs are responsible for eradication and rehabilitation of child labour in the state through job-oriented skill development trainings



Study Title

Business Opportunity Identification Study of Meghalaya

Implementing Institution

Entrepreneurship Development Institute of India

Project Location/Completion Year

Meghalaya, 2015

Objective

- To carry out detailed study in the State of Meghalaya to generate viable business ideas based on availability of local resources, local skills, local needs and demand
- To identify about 50 viable business opportunities and prepare project profiles on each identified opportunity based on local conditions
- To generate data/ information on existing natural resources and ways of utilization to promote small enterprises
- To focus on existing industries, trade flows in the State and service sector status, and future scope

Study Recommendation

- Youth and entrepreneurs should be guided and their handholded to achieve their goals
- Beside normal capacity development, youth should have relevant reference materials and documents to enhance their knowledge and skills

Analysis and Outcome

As per the recent reports and stakeholder responses on natural resources, policy incentives and infrastructure in the state favour investment across tourism, hydroelectric power, manufacturing, and mining sectors. Minerals and mining, agriculture and horticulture, and tourism have been identified as the thrust sectors for industrial development.

These recommendations have been partially achieved by the Meghalaya government through variety of government schemes, awareness programmes, skill development activities in identified sectors, and creating a business-friendly ambience in the state. In Meghalaya, over 30% of the population and youth require skill-based training for getting job opportunities. Skill development in Meghalaya are done under the various government departments, NGOs, and private institutions through hands-on vocational trainings. The Meghalaya State Skill Development Society (MSSDS) was established to develop framework and fulfilling the mandate of the Skill Development in the State [239]. MSSDS is implementing a Placement Linked Skill Development programme on various sectors where the State has potential and industry demand through Project Implementing Agencies (PIAs). More trainings have been organized in agriculture and horticulture crops and by-products; capturing of mineral resources from coal, limestone; handicrafts using natural resources in wood and bamboo; border trading, etc. [240]. However, many more skill development trainings, industry linkages are to be done in identified fields as mentioned in the report in the coming years. The State Institute of Rural Development (SIRD), Government of Meghalaya has entered into a MoU with Entrepreneurship Development Institute of India (EDI), Ahmedabad for training 10,000 entrepreneurs over a period of three years. This skill development training has had a long lasting impact on the local youth.

Some of the major initiatives taken by the government to promote Meghalaya's economic development has helped promote business opportunities identified earlier, which include approval of coal mining licence in the state, agreement between the Government of Meghalaya and the World Bank to improve and modernize the state's transport sector, dialogues with the Israel government to set up Centres of Excellence for Agriculture and Horticulture. Besides, launching of Meghalaya Farmers Mobilization Project; establishment of cluster-based, farmer-owned and farmer-operated markets; enhanced budget allocation in agriculture, education, roads and bridges, tourism and for the health and family welfare department are indications of the government's proactive role towards capturing local business opportunities [243].

Besides, vocational training institutes at the State and local levels, Meghalaya State Skill Development Society, Academic institutions and local NGOs are responsible and are arranging training materials, providing job-oriented skill development trainings and entrepreneurial opportunities.



Study Title

Impact Assessment of the Thousand Pond Scheme

Implementing Institution

State Institute of Rural Development

Project Location/Completion Year

Meghalaya, 2015

Objective

- To examine the impact of the scheme on the family income, loan repayment, health, education, and living standards in general among the beneficiaries
- To identify the reasons for functionality and non-functionality of the projects implemented
- To examine the impact of the scheme on women empowerment and addressing gender issues
- To study the role of different agencies involved in implementation of the scheme
- To examine the attitude, behaviour, beliefs, and opinions of the beneficiaries toward fish farming as an enterprise

Study Recommendation

- This study will be useful in terms of throwing light on the different aspects of the 'Thousand Ponds Scheme' as well as suggest corrective measures for effective implementation of such programmes
- In terms of the way forward, the study will draw lessons learnt and identify key operational experiences that maybe used for future interventions and also add to the experience of the implementation of the Meghalaya State Aqua Mission (MSAM), which has a key role in changing the face of Meghalaya's economic development

Analysis and Outcome

This study assesses the implementation of the Meghalaya State Aqua Mission (MSAM), which plays a major role in changing Meghalaya's economic development. The beneficiaries felt that the household income of all respondents showed an average increase per family and gradual improvement in the consumption level on food, clothing, and education of the beneficiaries in almost all the districts of the state. Some of the beneficiaries have also supported children to take better and higher education in State capital and other reputed institutes. There has been an overall improvement in the quality of life of the fish farmers. As per the beneficiaries, these ponds have far reaching impacts on the socio-economic life of the fish farmers. These ponds are very productive and the productivity of this scheme-driven projects provide harvesting option to medium- and large-size fishes at the end of one year culture period. The impacts of this successful scheme on fish farmer's life are tremendous. It has changed their personality, developed sound socio-economic status as the farmers now have a better opportunity and can afford more expendables to meet their needs ^[244].

To scale up this success, Meghalaya State Aqua Mission 2.0 has been launched with an optional community fishery in addition to individual ponds. Under this new scheme, community fisheries will be given more emphasis. Ponds will also be constructed on community lands if the community comes forward with land and makes some contribution in the construction of pond by way of labour. The State has also several water bodies in the form of reservoirs and lakes. While the water is primarily used for agriculture, it can also be used for the production of fish to develop further economic activities. It was understood by the beneficiaries that community ponds differ in terms of the scale as well as financial support extended by the State.

Department of Fisheries, Meghalaya; State Institute of Rural Development, Meghalaya are the primary implementation bodies for these projects.

Study Title

Skills Development : An Appraisal of Meghalaya

Implementing Institution

St. Anthony's College

Project Location/Completion Year

Meghalaya, 2015

Objective

- The private institutions are able to do justice in terms of Course Selection based on market needs. Be it Media, IT or Fashion the range is wholly professional and location advantage with supportive publicity and networking offering effective/commercial base.
- Engaged in Catering the Institutional Public - the private institutions have different experiments in their curriculum viz., visiting faculty, usage of interactive gadgets, open knowledge advocations along with the communication, adaptation and language tools (unfortunately there is no institute like NERC, NIRD, Guwahati in Meghalaya).
- Despite the small size majority of the institutions are engaged in training, accepting contractual assignments, undertaking technical service partnering, Government Assignments and putting 10 to 12 hrs work periods.

Study Recommendation

- Multiple Benefit Systems Accessible to Inverted Pyramids: Vernacular awareness programmes and outreach systems to bring in needed changes in these 'Core' Communities (CCs).
- Modified Ethnic Norms to Traditional Governance: Radical changes in traditional governance (TG) by means of collaborations/partnering with external knowledge supportive extensions (EKSEs).
- Need for Hierarchical Planning Links (HPLs): A systematic planning and execution systems (P&ESs) of hierarchical order for the state as a whole with (sub) layered sub-zonal planning systems (S-ZPSs).
- Establish Professional Outlook for Sequential Survival and Growth: A range of 'professional functionalities' need to be encouraged to create the needed image-modifications as in the co-system existence it is found that each of the ethnic skills being measured in non-ethnic terms enabled them to loosen their validities



Analysis and Outcome

In Meghalaya over 30% of the population and youth require skill-based training for getting job opportunities. Skill development in Meghalaya is done under the various Government Departments, NGOs and private institutions through hands-on vocational trainings. There is a need to converge the various initiatives to instill a sense of collective participation towards a common goal. The Meghalaya State Skill Development Society (MSSDS) was established with the authority to receive

funds from the government (central and state) and financial institutions, and to develop framework and spend the funds for fulfilling the mandate of the skill development in the State. It takes the role of a collaborative platform at the state level [239]. MSSDS is implementing a Placement Linked Skill Development programme on various sectors where the state has potential and industry demand through Project Implementing Agencies (PIAs). More trainings have been organized in agriculture and horticulture crops and by-products; capturing of mineral resources from coal, limestone; handicrafts using natural resources in wood and bamboo; border trading, etc. [240]. However, many more skill development trainings, industry linkages are to be done in identified fields in coming years as mentioned in the report.

The State Departments including Agriculture, Education, Community and Rural Development, Border Areas Development, Commerce and Industries, Fisheries, Animal Husbandry, Planning have taken specific initiatives through State Government schemes to impart vocational skill training and industry linkages in their respective areas for wider development of the local youth.

Besides vocational training institutes at the state and local levels, National Skill Development Agency, Ministry of Entrepreneurship and Skill Development, Meghalaya State Skill Development Society, Academic institutions and local NGOs are responsible and are arranging or providing job-oriented skill development trainings. Based on the NSDA Guideline and NSQF Framework, institutes for vocational education and special trainings could well be a benchmark for imparting skill trainings in the State.

Study Title

Impact of MGNREGS on Women Participation in the Development Process

Implementing Institution

State Institute of Rural Development

Project Location/Completion Year

Meghalaya, 2014

Objective

- To appraise the structure of the VEC and the process of decentralization with special reference to women-participation in the VEC
- To analyse the functioning of the VEC in respect of planning and implementation of projects for holistic development of women

Study Recommendation

- The VEC provide a forum for women to actively participate in the development process
- The women enjoy their rights and entitlements given in the scheme
- Increase presence of women in the VEC to initiate women-centric projects
- Women given opportunities for capacity building and skill training

Analysis and Outcome

This report assesses the rate of women's participation in the Mahatma Gandhi National Rural Employment Guarantee scheme (MGNREGS) and the impact of the scheme on women empowerment in Meghalaya. Meghalaya, one of the states in the Indian union, is known for its respectable position held by women. The implementation of the MGNREGS in Meghalaya is a very important milestone in so far as women participation in the grassroots development process is concerned. In Meghalaya, women are seen to be handling projects, undertake training, develops economic skills, and involved in wider economic activities.

It is observed that the performance of MGNREGS in Meghalaya, with a particular reference to women's participation, is above the expected mandate of 33% and reached a level of 43%. Hence, a positive impact of the scheme is revealed in the state. However, when it comes to state-wise analysis at the all-India level, Meghalaya is yet to catch up with other high performance state in terms of female participation in MGNREGS ^[245].

In August 2020, the State Government brought the policy of reserving at least 50% seats for women in the grassroots village-level community institutions (VECs), constituted under MGNREGA in 2006 in every village. Women leadership implies creation of agency for women that will enable them to make decisions and participate in the developmental process as well as decisions that impact their lives [246]. The result of this policy changes will enable more women to be part of skill development and economic activities.

The State Departments including Agriculture, Education, Community and Rural Development, Border Areas Development, Commerce and Industries, Fisheries, Animal Husbandry, Planning, etc. have taken and continue to take specific initiatives to engage women participants in women-centric projects, vocational skill training, and industry linkages in their respective areas for wider development and job creation.

Besides, Meghalaya State Skill Development Society, Academic institutions and local NGOs are responsible for women participation in job-oriented training.



Study Title

IND: Supporting Human Capital Development in Meghalaya

Implementing Institution

Department of Finance, Government of Meghalaya

Project Location/Completion Year

Meghalaya, 2013

Objective

- To improve teaching and learning in government-aided SHS schools
- To increase capacity and responsiveness of technical and vocational education and training (TVET)
- To increase awareness and participation
- To improve project management and monitoring and evaluation

Study Recommendation

- Need good communication and awareness building as the majority of youth, especially those from rural areas, do not fully appreciate the importance of school education and are unaware of the options for vocational and technical skills training
- Need to upgrade the infrastructure of the government-aided private schools. Poorly maintained and seismically unsafe school buildings, unreliable power, water scarcity, lack of clean drinking water, and poor road connectivity are common constraints
- Need to be train underqualified primary and secondary school teachers, especially in the government-aided private schools, on a priority basis in order to improve teaching standards and reduce the drop-out rate
- Need to increase the low salary of government-aided school teachers, and release of salary money regularly

Analysis and Outcome

The report highlighted the urgent need for job-oriented skill development of youths and reviving of primary/secondary school infrastructures. In Meghalaya over 30% of the youth population require skill-based training for getting job opportunities. Skill development in Meghalaya are done under the various Government Departments, NGOs and Private Institutions through hands-on vocational trainings. There is a need to converge the various initiatives to instill a sense of collective participation towards a common goal. The Meghalaya State Skill Development Society (MSSDS) enhances the collaborative platform at the state level [239]. MSSDS is implementing a Placement Linked Skill Development programme on various sectors where the State has potential and industry demand through Project Implementing Agencies (PIAs). More trainings have been organized in agriculture and horticulture crops and by-products; capturing of mineral resources from coal, limestone; handicrafts using natural resources in wood and bamboo; border trading, etc. [240].

Meghalaya adopted State Education Policy in 2018 to enable all learners to develop their individual potential and acquire all relevant knowledge, skills and dispositions for personal development, growth and wellbeing. As outcome of the policy initiatives, schools have ICT infusion, introduction of vocational education and entrepreneurship trainings, develop new infrastructures and positive culture of learning environment [247]. As per the stakeholders' perception, exact outcomes of this policy are yet to come out. However, mass awareness of educational benefits has been taught in communities which reflected in increase in literacy rate in Meghalaya in recent years. Besides, introduction of vocational trainings and entrepreneurship have helped children to grow in specialized employment options.

Education infrastructure development is dependent primarily on state department and related educational bodies. State Education Department, Sarva Shiksha Abhiyan, Rashtriya Madhyamik Shiksha Abhiyan, School management committees at primary and secondary levels should encourage dialogues, trainings to improve school infrastructure and teach economic benefits. Also, Meghalaya Board of School Education, Ministry of Human Resource Development, GoI, Meghalaya State Council for Technical Education, etc. should join hands to improve Meghalaya School Improvement Programme.



Study Title

Quality of Elementary Education Among the Tribal Children of Meghalaya - An Analytical Study

Implementing Institution

Gauhati University

Project Location/Completion Year

Meghalaya, 2013

Objective

- To examine the status and quality of the physical infrastructure facilities in schools and analyse their relationship with students enrolment, retention and absenteeism, and achievement
- To examine the status of teachers training across sex, locality, and community
- To study student teacher ratio across locality
- To investigate the quality of human resources in the context of absenteeism, classroom transaction, and achievement of learners
- To find out the existing in-service training facilities for professional growth and policy governing transfer of teachers
- To examine delivery systems of educational incentives, such as midday meals, free textbooks, free uniform, scholarships and other incentives and their relationship with the demand for education

Study Recommendation

- Similar studies on a larger size sample to be replicated. Intensive studies devoting themselves exclusively to a single dimension such as provision of educational facilities, their utilization, school, teacher, family and pupil inputs can be undertaken
- Studies of that socio-psychological process both in the home and at school would really be very useful. Case of high achieving primary schools in the rural areas of Meghalaya should be made to find factors responsible for their success
- Researches of a developmental type, experimenting with different types of programmes compensatory, remedial, enrichment, guidance, teacher-orientation, parental education, and curriculum renewal and so on, which will help in increasing the educational attainment and personality development of the tribal children in Meghalaya, should be undertaken on a priority basis
- Research on the socio-economic and environmental conditions, life style, values and attitudes of the tribal student's parents in Meghalaya and the child-rearing practices which impinge on the education of their children

Analysis and Outcome

As per the study, Meghalaya has high number of tribal populations, however, very poor holding capacity of the schools and entry at later levels of higher education questions the quality of elementary education. Meghalaya state education department has taken various steps to improve the educational system. This has resulted in Meghalaya's free and compulsory education policy till the age of 14. It has enhanced educational development and increased literacy rate of the state. According to Census 2011, it was also found that the literacy rate of the tribal in Meghalaya, Mizoram, and Nagaland is higher than that of the total population in those states. There has been a steady increase in school enrolment of students from 2013 to 2020 ^[248]. In this context, we can say the above recommendations are partially implemented.

To improve quality of education among the tribal children, the State government has made provision in the State Education Policy 2018, which intends to provide stimulating and equitable education of satisfactory quality that will foster innovation, transformation, and facilitate inclusive growth and development in the State.

Some cases of high achieving primary schools in Meghalaya have been taken up to replicate their success through Sarva Shiksha Abhiyan, Rashtriya Madhyamik Shiksha Abhiyan, and NCERT organized and supported programmes. However, more government initiatives, policy support, and grant-in-aid are necessary to bring school infrastructure and tribal children to the mainstream education process in Meghalaya. In most of the districts, under the umbrella of MSSDS, mass awareness generation, vocational trainings, entrepreneurship development at the school stage are carried out. Following the State Education Policy and NEP 2020, development of school infrastructure, revising curriculum structures, teachers' trainings, ICT infusion in schools, and recruiting improved quality teachers are some steps taken by the State government ^[247].

State Education Department, reputed academic bodies, Sarva Shiksha Abhiyan, Rashtriya Madhyamik Shiksha Abhiyan, School management committees at primary and secondary levels need to encourage dialogues, trainings to teachers/students and request for improved school infrastructure and quality of teachers for better education for tribal children.



Study Title

Evaluation Study of ICDS programme in Meghalaya

Implementing Institution

Martin Luther Christian University

Project Location/Completion Year

Meghalaya, 2012

Objective

- To improve the nutritional and health status of children below the age of six years
- To lay the foundation for proper psychological, physical, and social development of the child
- To reduce the incidence of mortality, morbidity, and malnutrition, and school drop out.
- To achieve effective coordination of the policy and implementation among various departments to promote child development
- To enhance the capability of the mother to look after normal health and nutritional needs of the child through proper nutrition and health education

Study Recommendation

- Awareness about the scheme need to be enhanced to the public at large and also the VLCC members so that they understand its roles and thus function effectively
- They also need to be trained as to how to monitor the Aganwadi centre in their villages
- During the evaluation process, most of the VLCC members who attended the meetings were mostly men. As clarified by the Department of Social Welfare, that VLCC members are mostly women, yet their involvement needs to be enhanced so that they just become members not just to fill positions but are motivated and actively participate in the functioning and monitoring of the AWC in their village
- It should be ensured the availability of vitamin supplements in the AWC throughout the year

Analysis and Outcome

Launched in 1975, ICDS is a unique early childhood development programme to address health, nutrition and development needs of young children, pregnant and nursing mothers. As per the last available data, ICDS projects are presently running in the 39 Community and Rural Development Blocks in Meghalaya districts and 2 Urban ICDS Projects at Shillong and Tura through a network of 5896 Anganwadi Centre. The study mentioned that people know about the ICDS programme but are not aware of the services or the target groups. VLCCs (village level coordination committees) are also not fully unaware of their roles and responsibilities. However, the programme objectives are partially achieved as evident from the ground-level data and larger coordinated role is necessary by the Government for better impact.

Under this programme, community mobilization, awareness, advocacy, and IEC are regularly conducted and services such as early childhood care, education, care and nutrition counselling, health services, supplementary nutrition programme for children, adolescent girls and pregnant women are provided. After ICDS programme revamped in 2012, Meghalaya government has added schemes such as Non-Formal Pre School Education/ ECCED, Kishori Shakti Yojana, Empowerment of Adolescent Girls (RGSEAG), Matritava Sehyog Yojana (IGMSY) – Conditional Maternity Benefit (CMB) Scheme, etc. for wider benefits to target groups. Only a few training centres are functional for AWCs and girls and provided job-oriented trainings in the areas of Angawadi skills, food safety and hygiene, nutrition, etc. As per the available data in 2016, a total of 34 trainings have been conducted, mostly attended by the male members. As indicated by our perception survey, more female participations (over 35%) have been noticed in the recent trainings conducted ^[249].

Social Welfare Department, Government of Meghalaya is the implementing body of ICDS programme in the State. At the village level, the VLCCs can be an important body for functioning and monitoring the activities of the Anganwadi workers. Besides, State Departments on Elementary Education, Rural Development should also extend support to measure effectiveness of this programme. A coordinated efforts from State nodal point and VLCCs are required to improve the impact. We feel more such studies are necessary to understand the impact of this scheme.



Study Title

Evaluation Study of Sarva Shiksha Abhiyan (SSA) in Meghalaya State

Implementing Institution

DJ Research and Consultancy Pvt. Ltd

Project Location/Completion Year

Meghalaya, 2011

Objective

To make a critical assessment of the policy, process of implementation, achievements and the impact of SSA as they relate to school-going children of different socio-economic groups

Study Recommendation

- Adequate provision of furniture in primary schools
- Timely supply of free text books
- For civil works supervision there is a need for at least three engineers in each district as against just one now present
- Training of teachers and helpers to 100%
- Increase of mid-day meal supply
- A multi-pronged approach through SSA/interventions at primary and upper primary levels in the way of MDM, free textbooks, better trained and motivated teachers, more number of teachers at primary and upper primary levels, separate teachers for Mathematics and science subjects, better school infrastructure, close monitoring by BRC and CRC, increase in access ratio are some of the major factors for improvements in reduction of dropout rates while increasing the retention rates.

Analysis and Outcome

As per the study, Meghalaya has very poor holding capacity of schools and entry at later levels of higher education, which questions the quality of elementary education. Meghalaya state education department has taken various steps to improve the educational system. This has resulted in Meghalaya's free and compulsory education policy till the age of 14. This has enhanced educational development and increased literacy rate of the state. According to Census 2011, it was also found that the literacy rate of the tribal in Meghalaya, Mizoram, and Nagaland is higher than that of the total population in those states. There has been a steady increase in school enrolment of students from 2013 to 2020 [248]. Under the Department of Education, Government of Meghalaya Directorate of Higher and Technical Education and Directorate of Educational Research and Training are implementing Sarva Shiksha Abhiyan programmes. As per the last available data, a total of 6612 schools have benefitted from Sarva Shiksha Abhiyan programmes in Meghalaya in terms of trainings, infrastructures, books distribution, access to school education, and enhancement of enrolment of students ^[250]. In this context, we can say the above recommendations are already partially implemented.

To improve quality of education, the State government has made provision in the State Education Policy 2018, which intends to provide stimulating and equitable education of satisfactory quality that will foster innovation, transformation, and facilitate inclusive growth and development in the State.

Some cases of high achieving primary schools in Meghalaya have been taken up to replicate their success through Sarva Shiksha Abhiyan, Rashtriya Madhyamik Shiksha Abhiyan, and NCERT-organized and supported programmes. However, more government initiatives, policy support, and grant-in-aid are necessary to bring school infrastructure and tribal children to the mainstream education process in Meghalaya State. In most of the districts, under the umbrella of MSSDS, mass awareness generation, vocational trainings, entrepreneurship development at the school stage are carried out. Following the State Education Policy and NEP 2020, development of school infrastructure, revising curriculum structures, teachers' trainings, ICT infusion in schools, and recruiting improved quality teachers are some steps taken by the State government ^[247].

Recently, Samagra Shiksha, an overarching programme of the Union ministry for the school education sector, was launched to boost equal opportunities for schooling and equitable learning outcomes and includes the three schemes of Sarva Shiksha Abhiyan, Rashtriya Madhyamik Shiksha Abhiyan (RMSA), and Teacher Education (TE) ^[251]. State Education Department and Directorates, reputed academic bodies, school management committees at primary and secondary levels need to encourage dialogues, trainings to teachers/students, and request for improved school infrastructure and quality of teachers for better education for tribal children. More evaluative studies are suggested in this direction.



Study Title

Comprehensive Study on Available Skill, Skill Gaps and Skill Development Potentials in the NER - Mizoram

Implementing Institution

North Eastern Development Finance Corporation Ltd. (NEDFi)

Project Location/Completion Year

Mizoram, 2018

Objective

- To identify agricultural products that offer immense potential for improving exports from North Eastern Region
- To prepare a comprehensive action plan to tap the potential

Study Recommendation

- Strengthen the governance framework currently governing the skill development ecosystem of the state
- Improve the effectiveness and utilization of existing Technical Vocational Education & Training (TVET) institutions
- Make provisions for providing specialized skill development training in identified sectors and domains relevant to the state
- Make general education provided in schools as an integral part of skill development efforts by improving the quality and learning outcomes of school education
- Create a robust ecosystem of credible private Vocational Training Providers (VTPs) to support skilling initiatives of the state government
- Improve linkages between industry and institutions providing skill development training

Analysis and Outcome

The study analysed in detail various skill requirements in Mizoram keeping in mind of the state's natural resources and already available expertise. Both long- and short-term training are provided under different state departments' various schemes, where sector-specific data showed improvements in literacy rate and employment/entrepreneurship activities. It was also noted that ICT-oriented and industry-demand-based trainings have greater employment potential. There is an urgent need to integrate such trainings to make effective progress across the districts. The stakeholders group discussions conducted under this study as well as by us, stressed on improving the quality and learning outcomes of school education over vocational trainings offered, as they are not pursued by many students as career options while undertaking higher education.

In the interest of public service and for effective implementation of the 'Mizoram State Policy for Skill & Entrepreneurship Development - 2018', the Governor of Mizoram has constituted 'Mizoram State Skill and Entrepreneurship Development Mission' (MSEDM) with various levels in the functional tiers including Mission Governing Council, Mission Steering Committee cum Coordination Board, Executive Committee, Mission Directorate and District Committees [252]. With their enhanced integrated efforts with respect to strategic road map towards skills, district level skill development plans, quality improvements, industry linkages etc we have noticed literacy rate, employment after training, interest among the students to undertake trainings have improved multifold [253]. However, more initiatives are required to achieve perceived goals of the mission. We strongly recommend, many such periodic skill gap analysis and evaluative studies be conducted to monitor progress of ongoing activities.

Recent NSDA study mentioned that the North Eastern Council (NEC) and the Ministry of Development of North Eastern Region (DoNER) have prepared Vision 2020 for the North Eastern Region, where it was envisaged overall GSDP growth at a CAGR of 11.64% between 2007-09 and 2019-20, and also per capita income growth of 12.95% [254]. This clearly shows many of the recommendations have been achieved successfully or partially with adequate government policy support. Further, several government department schemes have achieved their skill development and employment generation targets in 2019-20.



Study Title

Comprehensive Study on Available Skill, Skill Gaps and Skill Development Potentials in the NER - Nagaland

Implementing Institution

North Eastern Development Finance Corporation Ltd. (NEDFi)

Project Location/Completion Year

Nagaland, 2018

Objective

- To identify agricultural products that offer immense potential for improving exports from North Eastern Region
- To prepare a comprehensive action plan to tap the potential

Study Recommendation

- Strengthen the governance framework currently governing the skill development ecosystem of the state
- Improve the effectiveness and utilization of existing technical Vocational Education & Training (TVET) institutions
- Make provisions for providing specialized skill development training in identified sectors and domains relevant to the state
- Make general education provided in schools as an integral part of skill development efforts by improving the quality and learning outcomes of school education
- Create a robust ecosystem of credible private Vocational Training Providers (VTPs) to support skilling initiatives of the state government
- Improve linkages between industry and institutions in providing skill development training

Analysis and Outcome

The study analysed in detail various skill requirements in Mizoram keeping in mind the state's natural resources and already available expertise. Both long- and short-term training are provided under different state departments' schemes. It was also noted that ICT-oriented and industry demand-based trainings have greater employment potential. However, such trainings are by far offset by the youths' employment demand. There is an urgent need to integrate such trainings conducted by the state departments, training centres, technical training institutions to make effective progress across the districts. The stakeholder's group discussions conducted by us stressed on improving the quality and learning outcomes of school education over vocational trainings offered, as they are not pursued by many students as career options while undertaking higher education.

Nagaland has the highest unemployment rate in the country (21.4%) [255]. In order to reduce this and improve state economic growth, Nagaland government has taken a few positive steps. The state government has recently launched Nagaland SDG vision 2030 document. It provides state-specific short-, medium-, and long-term targets with measurable indicators and strategies that the state should focus on to meet the aspirations of the people for sustainable livelihoods and living standards. The government is planning a certification programme for skilling 25,000 youths associated with agro-and-allied sectors and 15,000 loom weavers. Besides, special focus for women participation in skill development and entrepreneurship would be given to reduce unemployment and poverty alleviation. Further to this, SDG Vision 2030 also addressed issues such as less number of training institutes, poor training infrastructures, low industry connect, and less awareness among people regarding various government schemes. The government would establish 4 it is in 4 districts. The government would also initiate recruit-train-deploy model for youths, set up school of excellence for skill development and training, and livelihood development through tourism as a major focus areas. Minimum wage rate and guarantee would also be ensured for people's economic development.

Besides skilling youths on demand-based subjects and stimulate career opportunities, the focus of the government would also be to organize job fairs, placements and campus interviews in collaboration with the technical education institutes to improve employment opportunities and help reduce youth unemployment rates [256].

State department of Education, agriculture, tourism, rural development, tribal affairs and skill development agencies, ITIs and technical/vocational training centres would be pioneering these initiatives. We recommend to conduct a few studies to evaluate progress of the proposed schemes.



Study Title

ASHA Evaluation Nagaland

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Nagaland, 2012

Objective

- To understand the perspective, experience, and contributions of various concerned authority and stakeholders in relation to the ASHA programme
- To understand the current/existing status of various components under ASHA programme and its overall effectiveness
- To assess the ASHA's knowledge level, its contributions and work outputs
- To assess the quality of key processes/mechanism, such as selection, training, monitoring/ support structure and community ownership
- To identify the gaps and areas of improvement, and accordingly suggest strategies to further strengthen the programme

Study Recommendation

- Considering the overall education level of ASHAs, the state may provide communication materials to ASHAs, which are more pictorial oriented such as flip books/health education card, posters, etc.
- State may do a mapping exercise based on terrain and population, and identify the need of additional ASHAs in discussion with district-/block-level officials and accordingly may propose in PIP in future
- Training of ASHAs in all the training sites should be made residential
- State may look for translation of Module 5 and Module 6 and 7 (which cover topics of Module 1 to 4) beginning with major dialects
- At district-level state may propose for District Community Mobilizers (DCMs)
- State may adopt the strategy of procuring generic drugs for state, and along with that drugs, the required drugs to be provided to ASHAs may also be procured together

Analysis and Outcome

Accredited Social Health Activist (ASHA), trained female community health activist, programme work as an interface between the community and the public health system in Nagaland. Under the NHM, the Nagaland government wanted to promote access of healthcare services to rural household through ASHA workers. As ASHA workers play a crucial part in village healthcare system, it is important to educate them and build their awareness level. These recommendations were partially implemented. In line of the recommendations, state-level awareness programmes for ASHAs have been conducted and provided them pictorial communication materials, health education card, posters, etc. At present there are 2006 ASHA activists in Nagaland [257].

At present, district and block level ASHA trainings are conducted; however, more such programmes are necessary to build health awareness among the workers. Further to this, trained ASHAs were given training for medicine use and provided medicines to administer in emergency. During pandemic, ASHA workers monthly salary, financial incentives towards selfless health services should be relooked at.

In a new strategy, the state government has roped in ASHA workers in rural awareness building campaign. ASHA's were engaged in the state health department's 'AapkeDwar- Ayushman' scheme, focused on improving awareness, increasing e-card penetration, and establishing a continuum of healthcare, which will ultimately lead to increased utilization under the scheme. The ASHAs were trained on the objectives to increase awareness about the scheme and improve utilization under the scheme, strategy for awareness drive, AYUSHMAN cards and percentage of family enrolled, key parameters to be monitored. The ASHAs were also trained how to avail services and co-operate with BIS team and operators from partner organizations [258].

To improve ASHAs engagement in rural awareness building, healthcare services, more facilitation, training and financial incentives are necessary. While most of the basic infrastructures are in place, integrated approach should be made by State Health Departments, Rural Development Department, District Hospitals, Community Health Centres, District Programme Management Units, Village Health Committees, Self-Help Group, and Village Health Sanitation and Nutrition Committees to improve effectiveness of ASHA workers.



Study Title

Comprehensive Study on Available Skill, Skill Gaps and Skill Development Potentials in the NER - Sikkim

Implementing Institution

North Eastern Development Finance Corporation Ltd. (NEDFi)

Project Location/Completion Year

Sikkim, 2018

Objective

- To identify agricultural products which offer immense potential for improving exports from North Eastern Region
- To prepare a comprehensive action plan to tap the potential

Study Recommendation

- Establish Chief Minister's High Powered Task Force for Skill Development to facilitate convergence of various activities taken by different government departments and establishment of State Skill Development Mission (SSDM) on priority basis
- Institutionalize the interaction between industry and institution for skill development
- Monitor and evaluate the skill development initiatives in the state
- Set up information infrastructure for disseminating information to all at a single platform by developing a robust Online Labour Market Information System (LMIS) in the state
- Re-structure livelihood schools under state institute of capacity building
- Create world class training infrastructure for vocational training
- Create world class infrastructure for promotion of folk art and crafts

Analysis and Outcome

The study analysed in detail various skill requirements in Sikkim keeping in mind the state's natural resources and already available traditional skills related to handloom and handicraft products. Both long- and short-term trainings are provided under different state department's various schemes. Recently, in June 2020, Skill Development Department, Government of Sikkim has opened up over 4000 job opportunities to unemployed youths after skilling in specific sectors [259]. Besides, government departments in agriculture, tourism, handicrafts, MSME, rural development, etc. are providing skilling in related areas. The report noted that ICT-oriented and industry demand-based trainings have greater employment potential. However, such trainings should have quality, focus, and fulfill industry need. There is an urgent need to integrate such trainings conducted by the state departments, training centres, technical training institutions with the industry demands to make effective progress across the districts. The stakeholder's group discussions conducted by us stressed on improving the quality and learning outcomes of school education over vocational trainings offered, as they are not pursued by many students as career options while undertaking higher education.

Sikkim has high literacy rate, gross enrolment ratio (GER) at various educational levels with low school dropouts, indicating strong elementary education system. The elementary to technical education system of Sikkim mainly depends on the government and private schools. However, vocational education and trainings provided by Industrial Training Institutes (ITIs), Polytechnics, Livelihood Schools under State Institute of Capacity Building, and Senior Secondary Schools provide vocational education.

These institutions and mentioned government departments, under the umbrella of Skill Development Department, Government of Sikkim are poised to impart quality skill development with employment opportunities provided industry linkages and demands are met. Present study was conducted in 2015, and requires a further evaluation of skill gaps particularly after the pandemic.

Study Title

ASHA Evaluation in Sikkim

Implementing Institution

Regional Resource Centre for North Eastern States (RRC, NE)

Project Location/Completion Year

Sikkim, 2015

Objective

- To study the existing status of various components of ASHA programme
- To assess the quality of key processes/mechanism, such as training, monitoring, and ASHA support structure
- To assess the contribution of ASHAs in organizing the VHND in its area
- To understand the perspectives and experiences of key stakeholders and persons involved at various levels such as SPMU, DPMU, BPMU, health facilities, community, etc. and their role in extending supportive supervision to ASHAs
- To understand the role of ASHAs in CATCH Programme implementation
- To understand the role of ASHAs in supporting Tuberculosis and Malaria patients
- To identify the gaps and areas of improvement, and accordingly suggest strategies to further strengthen the programme

Study Recommendation

- As more than 50% of the ASHAs are covering a population above 1000, so it is suggested that a mapping exercise can be done so as to rationalize the population coverage of ASHAs to get better pragmatic output.
- Considering the percentage of illiterate ASHAs, it is suggested that pictorial- oriented flipbooks/ health education charts may be used as a communication material for ASHA workers (around 15%), who missed some part of training; need to be re-oriented again during monthly ASHA meeting so that they also get complete training inputs.
- State must appoint fresh ASHA facilitators so that those who are performing dual role can be relieved and they can continue as ASHA. This will ensure better supportive supervision for ASHAs by ASHA facilitators.
- It was also revealed that a few ASHA trainings were non-residential. So, state needs to ensure that training is held in residential mode. Residential training will improve the training quality, bondage among ASHAs and it will also help ASHAs to reduce their transportation cost of attending the training
- ASHAs are to be oriented on village meeting on health promotion, which at present they are hardly doing



Analysis and Outcome

Accredited Social Health Activist (ASHA), trained female community health activist, programme work as an interface between the community and the public health system in Sikkim. Under the NHRM and NUHM, the National and Sikkim government wanted to promote access of healthcare services to rural household through ASHA workers. As per the last government record in 2017, as outcome of a state-wise ASHA mapping exercise, in NHRM a total of 639 ASHAs (99.6% of the target) were established in Sikkim to cater rural population of 456,999. Further to this, NUHM also had 25 ASHAs (71.6% of the target) to provide healthcare services [260]. In a recent study, Agarwal (2019) has found that ASHA programme is successfully connecting marginalized communities to maternity health services in Sikkim. Given the potential of the ASHA in impacting service utilization, we emphasize the need to strengthen strategies to recruit, train, incentivize, and retain ASHAs [261].

Since ASHA workers play crucial part in village healthcare system, it is important to educate them and build awareness level of ASHAs. These recommendations were partially implemented. In line of the recommendations, state-level awareness programmes for ASHAs have been conducted and provided them pictorial communication materials, health education card, training for medicine use on demand, posters, etc. During the pandemic, ASHA workers monthly salary, financial incentives towards selfless health services should be relooked at.

To improve ASHAs engagement in rural awareness building, healthcare services, more facilitation, training and financial incentives are necessary. While most of the basic infrastructures are in place, integrated approach should be made by State Health Departments, Rural Development Department, District Hospitals, Community Health Centres, District Program Management Units, Village Health Committees, Self-Help Groups, and Village Health Sanitation and Nutrition Committees to improve effectiveness of ASHA workers.

Study Title

Tripura Human Development Report II

Implementing Institution

Pratichi Institute, Pratichi (India) Trust

Project Location/Completion Year

Tripura, 2018

Objective

- To systematically develop an understanding in minute detail of the processes of human development in Tripura
- To articulate clearly the different agentic roles that have made these developments possible

Study Recommendation

While the report has specified several important socio-political issues, no specific recommendations are proposed

Analysis and Outcome

This report reflected that government policies, achievements in Tripura's Human Development Index is bringing fruit through improved literacy rate, low mortality rate, better health practices; however, the report also pointed out that there is a deep-rooted social tension between tribals and non-tribals. Further, as government programmes end, people's participation and formation of social agencies to grow more is seldom seen. While the report pointed out issues, success of government programmes and developments needed related to each of the human development sectors, it does not specify any recommendation.

However, with the available secondary literature and stakeholders discussion, we note that the State Government can provide mass education among the population to bring down their friction further, and also the government can perhaps create infrastructure to build up an amalgamated people inclusive socio-political movement.



Study Title

Documentation of some indigenous traditional knowledge (TK) and their prioritization for intellectual property rights (IPRs) issues in Tripura

Implementing Institution

Tripura University

Project Location/Completion Year

Tripura, 2016

Objective

To document the the use of indigenous medicinal plants by traditional healers

Study Recommendation

- Authorize and access to genetic resources and associated traditional knowledge to governmental bodies
- Involve participatory research and educational approaches by sharing information towards acknowledging traditional knowledge and culture
- Recognize local IPR issues
- Consider a legislation that could fit both economic and social nuances for documentation, preservation, promotion, and value addition
- Ensure employment and training opportunities for Old Ochai/ Kabiraj/TK holders
- Share in the revenues and royalties with land and resource development for the villagers by future BMC projects
- Map TK holders in each BMC
- Subsidize construction of traditional secrets, knowledge/ heritage, homes gardens, botanical plot, medicinal plant growing, harvesting and marketing.
- Arrange monthly remuneration/funding to the oldest (>70 yrs) TK holders in each BMC
- Constitute and recruit district-/village-/BMC-level expert on traditional knowledge component and promote it also in school activities

Analysis and Outcome

Tribal knowledge preservation in North Eastern states, with special reference to Tripura, is of utmost importance for knowledge preservation, cultural development, and livelihood generation purpose for the indigenous communities. This require ABS policy, tribal knowledge protection policy, remuneration and incentives for tribal knowledge holders, and proper training and awareness building of communities. While some works at different places in NE have been conducted, however, a consolidated government approach is yet to be established. As per the respondents and experts in the region, most of these recommendations are not yet implemented, however, discrete BMC-level TK preservation are happening.

The tribal communities (indigenous groups) of Tripura have their respective arts and cultures or folklores or folktales, which are initially oral and passed down to the younger generations. However, modernization of youths and influx of migrated people poses serious threats to their preservation and maintaining unique identity and traditional cultures of tribes. Digital intervention is strongly suggested for tribal communities to preserve arts and cultures or folklores [262]. The State Action Plan on Climate Change proposes that an institution 'Tripura Institute of Strategic Knowledge for Climate Change' (TISKCC) may be constituted, which will manage and coordinate all the relevant specialized knowledge and competencies including traditional knowledge practices, which are needed in the state for fight against climate change [263]. A specific study on indigenous plant protection practices (IPPPs) specific to insect and vertebrate pest management highlighted that community people acquired and inherited knowledge from ancestors. The community developed notable innovations for the management of many pest issues using locally available resources in a cost-effective and eco-friendly way. However, the study revealed that IPPP use was significantly associated with socio-demographic condition, age, education, occupation, gender, locality, and house type. The study suggests the IPPP has strong potential in an integrated pest management approach passed down from generation to generation. The vulnerable practices largely remained unexplored due to inadequate scientific scrutiny and authenticity [264].

Urgent ABS and tribal knowledge preservation policies are required to preserve BMC-specific knowledge and indigenous best practices in Tripura. Most of the government department need to envisage and take adequate responsibilities to create feasible infrastructure and trustworthy environment among the tribals. Major roles may be entrusted with Directorate of Tribal Welfares, Department of Rural Development, Tourism; Tripura Tribe Areas District Autonomous Council, Department of Science Technology and Environment (DST & E) centers/groups located within their own respective foster institutions such as Tripura University, Agricultural University, NIT Agartala; Medical Colleges; Division of Crop Protection, ICAR Research Complex for NEH Region, Tripura Centre.



Study Title

Coverage Evaluation Survey district –Khowai, Tripura

Implementing Institution

Regional Resource Centre for North Eastern States, Ministry of Health and Family Welfare, Government of India, Guwahati

Project Location/Completion Year

Tripura, 2013

Objective

- To assess the coverage of immunization of children during the year 2012-13
- To find out the factors influencing the immunization services

Study Recommendation

As the use of MCTS for complete tracking and follow up of children for vaccination along with supportive supervision and involvement of ASHAs for community mobilization is an excellent model as being shown by Khowai district, similar model can be replicated in others districts of Tripura to improve the immunization coverage where there is no additional cost involvement

Analysis and Outcome

Under the umbrella of National Rural Health Mission (NRHM), a major thrust was given to improve the rural child health services. The link between community and the healthcare delivery system was enhanced by the introduction of community health volunteers or ASHA workers. ASHAs over the years have played important role in mobilizing the community in accessing healthcare services. Moreover, to further bring the service close to the community, Village Health and Nutrition Days (VHND) are conducted under NRHM where ante-natal care to post-natal care are provided along with the immunization of children and pregnant women.

Drawn from the success of Khowai district programme, the State government has promoted several healthcare and immunization schemes for children and pregnant women. Rota virus vaccination, fractional IPV routine immunization, Indradhanush campaign and implementation of Pulse Polio Campaign are some immunization programmes practiced under various government schemes.

As per the last government data, full Immunization coverage is consistently increasing, reaching up to 85% coverage of target children in 2017. Mission Indradhanush Phase 4 has achieved 94% success while National Immunization Day success crosses 95% through house visits across all districts in Tripura [265].

Department of Health and Family Welfare, Government of Tripura along with district administration with supports from district hospitals, health offices, local NGOs and ASHA workers are mainly implementing the full immunization target in Tripura.

Study Title

Enhancing the Capacity of Women Traders in the Borders of Northeast India

Implementing Institution

CUTS International

Project Location/Completion Year

More than one state, 2020

Objective

- To understand the participation and engagement of women in trade along North East India's borders with other Asian countries
- To understand the opportunities and prospects for women traders on trading and the capacity building required to enhance their participation

Study Recommendation

- Capacity building
- Gender-sensitivity training for bank and customs officials, and other key institutions
- Small border stalls or border haats in Manipur
- Requirement for banks which deal with foreign exchange services
- Encourage women to branch out into non-traditional businesses
- Diversifying channels for information dissemination

Analysis and Outcome

This project creates an enabling environment for women entrepreneurs in the region to greatly participate in cross-border formal trade. The study focused on women traders of selected five north eastern states of India: Arunachal Pradesh, Assam, Manipur, Meghalaya, and Nagaland. The study revealed that in North Eastern states, women traders and entrepreneurs have not been able to fully exploit the opportunities of current international trade possibilities mainly due to societal conventions and gender-neutral policies, lacking knowledge of digital technology use, low intent to scale up activities, lack of information regarding finance, network access, government schemes, and potential buyers in other countries.

A recent study noted that strategic location of India's North Eastern Region offers ample opportunities for enhancing the country's economic ties. However, supply-chain constraints at the regional level hamper the trade-growth linkages, as do trade barriers, social unrest, and inadequate infrastructure and knowledge. Enhancing and improving commercial exchanges with neighbouring countries, such as Bangladesh, Nepal, Bhutan, and Myanmar, can strengthen bilateral and regional networks [266]. Also, Thailand is one of the important partners of India in cross-border trade. Policy support to resolve complex issues such as trade barriers, FTA are of prime importance. Further, training and capacity building of women traders/entrepreneurs are particularly important to protect North Eastern Region women traders' interests with growing Chinese influence in this region. State departments, industry associations, local NGOs, and academic institutions are quite active to provide knowledge through awareness and training to women traders of different domains (finance and business issues, banks dealing, forex issues, creating alternative products range, etc.). However, the stakeholders' discussions revealed that the need of social awareness and more government support to develop business environment is required.

State government departments in various domains, academic institutions, Department of Foreign Affairs and Trade, Federation of Indian Chambers of Commerce & Industry, North Eastern Development Finance Corporation Ltd, local NGOs such as Grameen Sahara (Assam), Impulse Network (Meghalaya), Manipur Chamber of Commerce and Industry and Youthnet (Nagaland), etc. are playing their part for women traders and entrepreneurs development. However, considering stiff market competition with cheap Chinese products, periodic evaluative study is highly recommended.



Study Title

Regional Plan and Strategy for Increasing the Student Intake Capacities for Medical and Para-medical Courses in NER

Implementing Institution

Medica Synergie and Integra Ventures

Project Location/Completion Year

More than one state, 2020

Objective

- To assess the existing medical and paramedical institutions across all the 8 states of the North Eastern Region (around 218 institutions)
- To measure the prevalent gaps in terms of infrastructure, services, intake capacity and student output

Study Recommendation

- Public-Private Partnership (PPP) model for improving the medical education system in the region
- Development of new institutions and upgradation of the existing ones.
- Introduction of speciality and super-speciality courses
- A North-east technical education fund with contributions from central, state government, and multilateral agencies.
- Establishment with regional medical council and link with other regional or states medical councils
- Adequate hostel facility for students
- Proper remuneration to medical professionals especially, paramedics

Analysis and Outcome

As envisaged as one of the major goals of the North Eastern Region Vision 2020 document, it was felt that there was a need to enhance health human resource, including setting up of more medical and paramedical colleges in the region. This report highlighted development of medical and health infrastructure through Public Private Partnership model, amendment in courses and rationalization of remuneration of medical and para-medical professionals. Recent study revealed that although significant emphasis has been given on medical/para-medical education across India in recent years, diffusion of educational benefits needs vast improvements. Medical school density of provinces revealed a wide range from 0 in Nagaland to 72.12 Puducherry. Further, medical schools were seen to be clustered in the vicinity of major cities as well as provincial capitals [267]. In the North Eastern Region perspective, the situation is similar. As evident from our discussions with the stakeholders, these recommendations are partly realized. While some progress has been made in medical education through Public Private Partnership model as new private medical colleges and hospitals along with student hostel facilities were established. Students' education quality has seen vast improvements since medical courses are based on new medical innovations, etc. However, adequate facilities and modern medical equipment are not available across hospitals resulting into unequal knowledge development among the students.

In accordance to National Medical Commission Act, 2019, a new regulation called 'Minimum Requirements for Annual MBBS Admissions Regulations, 2020' has been in place to ensure medical education quality, establishment of more medical and para-medical colleges, and minimum student entry in teaching hospitals, staffs (teaching and technical), and equipment in the college departments and hospitals. The regulation specified student intake strategy in medical colleges for annual student intake capacity to the tune of 100 /150 /200/250 MBBS admissions. Further, teaching colleges should obtain letter of intent and letter of permission for establishment of new medical colleges from the Medical Council of India, State and National Medical Associations, and State Directorate of Medical Education under Department of Health. As per the new regulation, the colleges should also follow a phase-wise increase plan in student intake fulfilling requirements [268].

Some of the recommendations such as creation of medical education fund, establishment of regional medical council and their links with other councils, enhanced remuneration for paramedical professionals have not been implemented. Medical Council of India, State and National Medical Associations, and State Directorate of Medical Education, private and government hospitals, district medical centres are implementing qualitative medical education.



Study Title

Regional Plan and Strategy for Promotion of Sports to Enhance Career-livelihood in NER

Implementing Institution

Ernst & Young LLP

Project Location/Completion Year

More than one state, 2019

Objective

- To study existing status of sports in North Eastern states
- To identify strategies for development of a sustainable model to promote sports to enhance career/livelihood in the region

Study Recommendation

- To establish athlete development programme
 - a) Setting up of sports nursery in each district of North Eastern Range
 - b) Establish a football baby league in different parts of North Eastern Range
 - c) Setting up Sports Academies in states and a Centre of Excellence
- To emulate North East Derby League for greater exposure and competitiveness
- To promote of adventure tourism in North Eastern Range
- To develop strategic approach to major funding avenues
- To assess future Public-Private Partnership interventions in sports
- To create vibrant livelihood ecosystem around sports

Analysis and Outcome

While North Eastern states have rich sports culture due to their strong community culture, Manipur particularly has produced several international athletes [269]. Although, North Eastern states have many talented athletes, many of them are forced to leave sports mid-career due to lack of awareness as they feel it is not a viable livelihood option. This report studied overall sport situation in North Eastern Region and identify strategies to enhance awareness, competitive attitude, and flow of funds in the sports sector. The top three facilities required by the sportspersons from North Eastern states to improve their performance are better coach (87%), better equipment (69%), and better ground/infrastructure (55%).

Most of the recommendations are not yet met, however, situations are changing fast after visible success of North Eastern athletes in Rio and Tokyo Olympics and also in national levels. State and Central Sport ministries allocation of funds, corporate sponsorships to different popular sports are increasing (e.g. Federal Bank sponsors Football) [270]. Over 7% of total sports fund requests comes to Central Sports Ministry from North Eastern states. The sports infrastructure in North Eastern states are evolving through different central and state governments schemes such as Khelo India. As on 2017, 4031 trainees at 290 SAI centres have been trained in the North Eastern States and were provided regular training and other facilities. Besides, Imphal has SAI Regional Football Academy and there is a SAI National Archery Academy in Guwahati [271].

In North Eastern states, sportspersons mainly aspire for government job and there is a lack of awareness of other livelihood options. Most of the respondents of our perception survey from Arunachal Pradesh, Assam, Manipur, and Nagaland opined that physical education and sports are helpful in curbing the menace of drug addiction, HIV, alcoholism, terrorism etc. amongst the youth. This clearly shows sports to be considered as a career option in North Eastern states, more awareness, government push, and fund supports are required.

State Sports Departments, Departments of Planning, Sports Authority of India, State Sports Associations, District sports officers, corporate houses, various clubs, etc. are regularly arranging camps, trainings, and talent hunt competitions, however, coordinated efforts of all such initiatives are yet to be seen.

Study Title

Devising Pathways for Appropriate Repatriation of Children of Bru-Reang Community

Implementing Institution

Quality Council of India (QCI)

Project Location/Completion Year

More than one state, 2018

Objective

- To undertake a study to understand the current educational, healthcare, sanitation, and development needs of the children of the Bru-Reang community
- To devise strategy for enabling appropriate educational and developmental needs of the children of Bru-Reang community

Study Recommendation

- The current conditions of the schools and NRSTCs in the makeshift camps are in poor. The allocated funds should be used adequately and efficiently to provide minimum basic education in schools, midday meal, and NRSTCs.
- The educational institutions should enrol in Midday Meal Automated Reporting and Management (MDM-ARM) System and a monthly report should be sent to District Magistrate of North Tripura.
- In order to meet the quality standards of education and the norms of the RTE Act 2009, more teachers and EVs with minimum qualification should be hired and special trainings be given
- The performance of these teachers and EVs should be evaluated on a half-yearly basis by SSA project functionaries

Analysis and Outcome

Displaced from their native state of Mizoram, Bru community has been staying in the make-shift camps located in North Tripura district since 1997 and facing immense hardship. This report highlights child education and food issues in details. Tripura government has established a few educational institutions with midday meal system; however, none of these recommendations are fully accomplished due to lack of fund support and government policy support.

The Directorate of Education, Tribal Welfare Department and local NGOs in Tripura are frequently conducting educational awareness programme, teachers' trainings to ensure quality of education. However, hiring of full capacity of required teachers are yet to be done.

As per recent news, an agreement was signed in New Delhi in 2020 to ensure Brus rehabilitation packages. The agreement was inked between the centre, state governments of Mizoram, Tripura, Pradyut Kishore Debbarma, the royal scion of Tripura, and five major organizations of the Bru community. To rehabilitate 36,140 Reang tribals, Centre and Tripura government has rolled out Rs 1200 crore scheme where Tripura Government has agreed to provide 13 locations to rehabilitate Bru-Reang people, else they will return to Mizoram [272]. Result of this deal are yet to be implemented.



Study Title

Education in the Midst of Violent Conflict in Nagaland and Manipur

Implementing Institution

Aman Trust

Project Location/Completion Year

More than one state, 2018

Objective

- To review Government of India policy on education in the context of North East, particularly the Sarva Shiksha Abhiyan (SSA)
- To flag up issues of education in conflict from the fields to inform policy, design intervention
- To review peace modules being initiated in schools, among youth by NGOs, other civil society organisations
- To document civil society initiatives, innovations in the field as case studies which can be replicated or mainstreamed

Study Recommendation

- The need to 'mainstreaming conflict' in the ongoing 'Educational for All' initiatives
- The need for a campaign for making schools 'peace zones'
- The need for training of teachers on peace education
- The need for in-depth research to investigate the links between violent conflicts and high dropout rates in Manipur and Nagaland
- The need for designing a vibrant peace course as a point of intervention

Analysis and Outcome

As violence has spilled over into homes in Nagaland and Manipur states, which collapsed civic life, schools and the education system has also come in its grip with high dropout rate. For example, as a result of forced recruitment, curfews, and boycotts, more than 80% of the schools with more than 300,000 school students across Manipur state were severely affected [273]. In recent years, the government has tried to address the conflicts through various policies from the perspective of development, building infrastructure but peace education role remains partially attended. In most initiatives and framework, neither the role of education to prevent conflicts have been emphasized nor peace education's role in reducing conflicts have been studied in-depth.

The recommendations made in this report are only partially implemented as evident from recent increase of school enrolment, less dropouts. The stakeholders in states opined that they do not want to follow others education structure and related policies. Through teachers' trainings on peace modules, aggressive awareness building, declaring schools as peace zone and developing a sense of co-existence through awareness and education is recommended. Job-oriented skill trainings in popular subject areas would create an ambience of value-based education and keep children away from violence. Nagaland has the highest unemployment rate in the country (21.4%). In order to reduce this rate and improve state economic growth, Nagaland government has recently launched Nagaland SDG vision 2030 document, which focuses on measurable indicators and strategies to meet the aspirations of the people for sustainable livelihoods and living standards [255].

As on date, there is no comprehensive peace course that deals with the theoretical as well as the practical underpinnings of peace, which include all stakeholders have not been developed or are taught in schools. Intermittent efforts of students and teachers' trainings, workshops are being carried out by government agencies, local NGOs to provide peace education; however, they are not part of curriculum. Central and State governments, Directorate of Education in both states through targets of SSA, local NGOs, who are tirelessly working towards developing improved and quality education in these states, need to work cohesively.



Study Title

North Eastern Region Community Resource Management Project for Upland Areas (NERCORMP-II)

Implementing Institution

North-Eastern Council

Project Location/Completion Year

More than one state, 2017

Objective

- To promote a more people-oriented approach to the design and implementation of development interventions
- To enhance the capabilities of the local communities to search for and manage appropriate technologies building on indigenous knowledge
- To increase incomes through the development of more sustainable farming systems and the establishment of non-farm enterprises
- To make people aware of the need to preserve and regenerate natural resources and biodiversities

Study Recommendation

- This was an umbrella project with many objectives to fulfill. Although there are no specific recommendations made as outcome of this project, however, following may be considered as programme deliverables:
- Build livelihood initiatives in rural sectors in four States (project areas)
- Development of social sectors, community access to basic amenities
- Preserve culture, natural resources, biodiversities, and develop skills for monetization/income generation in a sustainable way

Analysis and Outcome

North Eastern Region Community Resource Management Society (NERCRMS) was established as an outcome of this project under the North Eastern Council, Ministry of Development of North Eastern Region. The society is dedicated towards the transformation of far-flung rural areas of North Eastern Region of India through different livelihood initiatives.

The society adopted a holistic approach of development using social mobilization, organization, and capacity building to tap and realize the great latent potential of the communities through traditional value systems and culture; and promote economic and social activities and infrastructure with predominant thrust on income-generating activities.

- The society provided capacity building of communities and participating agencies on farm and non-farm activities, monitoring, etc.
- It promoted viable income-generation activities (IGAs) for poor households through production of field crops, horticulture, forestry, livestock, fisheries, and non-farm activities using sustainable and environmentally friendly practices.
- Social sector development objective was met through providing communities access to safe drinking water (drinking water storage tanks, piped supply of water from a nearby spring or stream) and improved sanitation (construction of low-cost toilets).
- Rural Roads and Rural Electrification was ensured through enhanced communities' access to markets, health services, education facilities, and energy. Construction of common facility centres (CFCs), inter village roads, culverts and suspension bridges, and provide home solar lighting systems was done through Public-Private Partnership mode.
- Community-based bio-diversity conservation and communication objectives were achieved through (i) biodiversity conservation and research studies on community conserved areas (CCAs) as sacred groves, protected catchment areas and sanctuaries, (ii) forestry development to promote non-timber forest products (NTFP) and forestry production systems, and (iii) communication and knowledge management to facilitate information and knowledge sharing.

The society so far has covered four states of North Eastern Region, viz. Arunachal Pradesh (Changlang, Tirap, and Longding districts), Assam (Karbi Anglong and Dima Hasao districts), Manipur (Ukhrul, Senapati, Churachandpur, and Chandel districts) and Meghalaya (West Garo Hills and West Khasi Hills districts). The society has formed 8403 SHGs (Self-Help Groups) and 2889 NaRMGs (Natural Resource Management Groups) in 2532 villages benefiting 118,843 households.

The NERCRMS worked with multiple state government departments, NEC, local NGOs, academic institutions to achieve these objectives successfully [274].



Study Title

Needs Assessment Study to Identify Gaps in the Legal Empowerment of People in Eight States of the North East

Implementing Institution

Impulse NGO Network

Project Location/Completion Year

More than one state, 2015

Objective

To undertake a detailed research exercise to identify gaps in the legal empowerment of people in the various states of the North East

Study Recommendation

- Increase legal awareness and empowerment
- Document customary laws
- Encourage the use of alternative dispute resolution mechanisms
- Increase women's empowerment
- Publicize and enhance access to free legal aid services
- Build capacity of law enforcement agencies

Analysis and Outcome

This report highlighted legal gaps that exist among North East stakeholders in accessing impartial justice under the purview of both traditional and modern justice system, rule of laws and legal empowerment provided to North East people. The report pointed out various constitutional provisions regarding legal aid and access to justice, roles and mandates of the legal services authorities and other key service providers. A deeper discussion with the stakeholders and research of access to legal aid in the region pointed out the need to relook at legal aids to common people, women, jail inmates. Use of Lok Adalats would help in speedy justice, quality of free legal services, legal literacy, and extent of awareness among people. Both central and state governments have implemented a few of these recommendations through policy support and mega awareness-building programmes. However, full implementation of these recommendations is far from over.

Department of Justice (DoJ), Ministry of Law and Justice, Government of India implemented a project 'Access to Justice in North Eastern States and Jammu and Kashmir' under Twelfth Five- Year Plan during 2012-17 at the total cost of Rs 30 crore. The project addressed legal needs of the marginalized and vulnerable sections of the society, particularly women, children, Scheduled Castes, and Tribal Communities. As part of the implementation programme, several stakeholder consultations in North East states, training of State Legal Services Authorities, 400 Para Legal Volunteers (PLVs) (50 people from each state) on Social Welfare Legislations in eight North East states were taken up by Committee for Legal Aid to Poor (CLAP), Odisha. Besides, training of 150 Panel Lawyers was successfully conducted in three North East states (Nagaland, Mizoram, and Manipur). This proved to be a unique opportunity for PLVs as it promoted ripple effect in the region. Besides, MoA signed with State Resource Centre, Guwahati, Shillong, Arunachal Pradesh and Common Services Centre, Delhi to initiate Legal Literacy activities (preparing IEC Material, training of RPs/MTs/Preraks) and conduct workshops for promotion of free legal aids in North East region.

Department of Justice, state judicial departments and district legal officers, judiciaries, human and child rights activists, local NGOs and academicians continuously play a proactive role to provide legal aids to poor and marginalized sections and develop awareness in North East states [275].

Study Title

Impact of Conflict on Children in Assam and Manipur States of India

Implementing Institution

NERSWN: The Northeast Research and Social
Work Networking, Kokrajhar

Project Location/Completion Year

More than one state, 2014

Objective

- To assess how violence and continuous conflicts have affected education system in these states
- To address value of introducing peace education in school curriculum

Study Recommendation

- Implement the Juvenile Justice (Care & Protection) Act 2000 with utmost sincerity in areas affected by armed conflict
- Formulate and implement an effective and uniform Relief and Rehabilitation Policy that adequately addresses the need of the conflict-affected families



Analysis and Outcome

As violence has spilled over into homes in Assam and Manipur states, which collapsed civic life, healthcare, economic development, social sectors as well as schools and the education system. The Report includes a vivid description of how fundamental rights have been totally violated in this context. Justice to children has been found to be totally absent in some cases. Children in armed conflict situations face tremendous problems including risks to the security of their lives. They are subjected to arrest, detention, torture, rape, disappearances, and extrajudicial executions by the law enforcement personnel. The disruption of food supplies, the destruction of crops and agricultural infrastructure, the disintegration of families and communities, displacement of population, all take a heavy toll on children.

As a result of forced recruitment of children by militants, curfews and boycotts, intermittent riots, more than 80% of the school students across these states were affected. For example, in Assam more than 126,263 persons including 19,036 children were forced to live in the relief camps for more than 15 years or over 500,000 families including children were displaced. In Manipur, over 300,000 school students across the state were severely affected and discontinued education. In recent years, the governments have tried to address the conflicts through various social welfare policies from the perspective of development, building infrastructure but peace education role remains partially attended..

The recommendations made in this report are only partially implemented as evident from recent increase of school enrolment, less dropouts since frequency of conflicts have reduced in recent years. There is an urgent need to child protection and rehabilitation policies to be implemented through eradication of child labour, engagement of children in election activities, and conflicts, etc. rather skill development trainings can facilitate their livelihood [276]. The stakeholders in states also opined that they do not want to follow others education structure and related policies. Through teachers' trainings on peace modules, aggressive awareness building, declaring schools as peace zone, and developing a sense of co-existence through awareness and education is recommended. Job-oriented skill trainings in popular subject areas would create an ambience of value-based education and keep children away from violence. As on date, there is no comprehensive peace course inducted in course curriculum that deals with the theoretical as well as the practical underpinnings of peace.

Central and State Departments of Home, Education, Women & Child Welfare are organizing many social welfare programmes for children, providing mass awareness generation for peaceful coexistence in recent years. Intermittent efforts of students and teachers' trainings, workshops are being carried out by government agencies, local NGOs to provide peace education; however, they are not part of curriculum. Central and State governments, Directorate of Education in both states should work through social inclusion of all actors to meet targets of SSA for children. Besides, other state departments, local NGOs, who are tirelessly working towards developing improved civil life and quality education for children in these states, need to work cohesively. The Department of Home and Women and Child Development together should develop guidelines to rescue, rehabilitate, and re-integrate the child participants of insurgency movements.

Study Title

Promoting Livelihoods in North Eastern India: The Cane and Bamboo Networking Project

Implementing Institution

United Nations Industrial Development Organization

Project Location/Completion Year

More than one state, 2014

Objective

- To extend supply chains from plantation management and pre-processing to industrial processing and marketing for bamboo farmers and producers through Cane and Bamboo Associations
- To assess domestic and global market demand (product development and design, standards, certifications) and guide the development of bamboo and cane industry sector
- To transfer appropriate technology and develop skill ranging from rural communities to urban industries
- To strengthen CBTC capacity as an international hub and service provider for the global cane and bamboo sector

Study Recommendation

- In the short term, the UNIDO should quickly provide NEC with the lists of all artisans trained to follow up with those artisans on training and selling/marketing of their products
- In the long term, NEC should ensure (1) improving coordination and optimization of resources (financial, human, institutions, activities) concerned with CAB in NER; (2) setting its priorities for CAB, handlooms, textiles, and water hyacinth products; (3) creating/developing a sustainable marketing scheme/mechanism of CAB products; (4) replicating BCDI as necessary in all NER states
- The UNIDO should ensure having all the field facts before finalizing a project document with more quality control points through the project phases



Analysis and Outcome

India's North Eastern Region where Bamboo plants are abundant and generate some jobs and economic well-being for villagers while contributing to some rural development. Yet, the cane and bamboo sector remains underdeveloped despite growing international markets for cane and bamboo products, and the existence and/or creation of several government and non-government agencies in India for developing cane and bamboo economies in North Eastern Region.

The Global Industry Report valued the global bamboo market at USD 72.10 billion in 2019 which is expected to reach over USD 98.75 billion by 2026. Although India has 30% of the world's bamboo resources, but taps only one-tenth of its bamboo potential contributing to only 4% share of the global market for bamboo products [277]. The Government of India in a significant move to harness the potential of bamboo sector in the North East has recently decided to set up the first Bamboo Industrial Park at Dima Hasao district in Assam. Besides, National Bamboo Mission is also providing support to artisan development and market access programmes. However, coordinated effort of state government and all stakeholders are necessary. From these data, it is clear that the recommendations are met only partially.

Stakeholders in North Eastern states felt that lack of technological innovations along with inadequate policy support has resulted in the steady stagnation of this industry. The bamboo handicraft sector is under immense pressure as far as the artisans are concerned mainly due to its unorganized stature along with the additional inhibitors, viz. poor development indicators and indices, low capital, poor exposure to new technologies, absence of market intelligence, presence of the formal and non-viable informal sector [278]. Also, the stakeholders felt that because of lack of a proper institutional and organizational arrangements, significant policy support are necessary for the industrial upliftment. Adequate policy support for the social development will provide social protection and social security to the traditional artisans. Development of efficient marketing channels, market access, use of technology, and skill development trainings are necessary for bamboo- and cane-based handicraft industry.

State departments of Commerce and Industries, Rural Development, Tribal Welfares are organizing trainings, workshops for awareness and for skill development of artisans, however, policy support along with coordinated efforts from NGOs, academic bodies and major market players can exploit potential of this industry.

Study Title

Status of Elementary Education in the States of Assam, Jharkhand, Mizoram, Odisha, and Tripura with Special Reference to The Right of Children to Free and Compulsory Education (RTE) Act 2009

Implementing Institution

Pratichi Institute, Pratichi (India) Trust

Project Location/Completion Year

More than one state, 2013

Objective

- To understand the various factors and their inter-relations and also the role of various agencies in the delivery of elementary education
- To identify not just the lacunae but also to appreciate the achievements and the stories behind them in order to suggest modification and adaptation in policies and implementation

Study Recommendation

- Enhance the literacy rate to a very high level with reduction in dropouts and spread the basic educational infrastructure including girls toilets in government schools across the states
- Focus on severe crisis on ST teachers in the education of tribal children and also increase female teachers in the government and government-aided primary schools
- Increase the proportion of single-classroom primary school
- Improve quality of schooling in primary schools



Analysis and Outcome

Based on the primary data and analysis of secondary data, the report highlighted developing an overall understanding on the status of elementary education in these states and find the knowledge gaps pertaining to the delivery of elementary education. ASER reports regularly highlighted the fact that learning outcomes were stagnant and worsening. Based on data generated by ASER and DISE on elementary education, the present study showed large scales inter-state and intra-state variations with respect to fulfilling the requirements of RTE norms in North East region of India. These regional disparities in educational development widened the gap between financial allocations and outcomes [279]. The DISE data showed that NER states used to have very poor holding capacity of students in the schools and entry at later levels of higher education questions the quality of elementary education. As violence has spilled over into homes in many of the NER states, children education has been severely affected with high dropout rate. For example, as a result of forced recruitment, curfews and boycotts, more than 80% of the schools across the NER states were severely affected [273]. However, with proactive government approach, peace keeping strategies, recent situations have improved. In recent years according to Census 2011, it was found that the literacy rate of the tribal in Assam, Mizoram, and Tripura is higher than the national average. There has been a steady increase in school enrolment of students during 2013 to 2020 [248].

Under the State Department of Education, implementation of SSA programmes have received appreciable response. Further, to improve quality of elementary education, some of the State governments have made provision of new education policies, which intend to provide stimulating and equitable education of satisfactory quality to children, and recruitment of female teachers and Scheduled Tribes teachers in the education system. Also, new teachers' trainings have been given priority in these states to facilitate inclusive elementary education growth in the State. But, coordinated efforts and government funding to develop school infrastructure remains a necessity.

Recently, Samagra Shiksha, an overarching programme of the Union ministry for the school education sector was launched to boost equal opportunities for schooling and equitable learning outcomes and includes the three schemes of Sarva Shiksha Abhiyan (SSA), Rashtriya Madhyamik Shiksha Abhiyan (RMSA), and Teacher Education (TE) [251]. State Education Department and Directorates, reputed academic bodies, school management committees at primary and secondary levels need to encourage dialogues, trainings to teachers/students and request for improved school infrastructure and quality of teachers for better education for tribal children. More evaluative studies are suggested in this direction

Study Title

Functioning of Micro-credit Scheme Under Rashtriya Mahila Kosh (RMK) in North Eastern States (Assam, Manipur and Nagaland) of India

Implementing Institution

College of Post Graduate Studies, Central Agricultural University

Project Location/Completion Year

More than one state, 2012

Objective

- To study the functioning of micro-credit scheme of RMK in NE states of India
- To investigate the saving, loaning, repayment performance of micro-credit scheme of RMK at individual and group level
- To analyse the impact of the micro-credit scheme on women empowerment
- To identify and prioritize the constraints as perceived by the participants of micro-credit scheme of RMK and suggest suitable policy initiatives

Study Recommendation

- Maintenance of books/records is one of the important issues for the SHGs
- Incentives should be given to the implementing NGOs for regular monitoring of the books and records
- Trainings on income-generating activities should be mandatory for all the SHG members as the skill development will help even if the member does not get any share in external loan



Analysis and Outcome

As per the CRISIL (Credit Rating Information Services of India Limited) report of 2018, bank penetration in the North East region is below national average, which has now been improved considerably after Government of India's MGNREGA implementation. On financial inclusion front, the CRISIL include six scores according to which except Sikkim and Tripura all other states in the region are doing poor.

The report analysed impact of RMK micro-credit functioning, benefits for women, and perceived needs of the participating SHGs and stakeholders. However, growth of microfinance loan accounts in the region has been highest (46.8%) and most of the Micro Finance Institutions' (MFIs) clients are women. Many large and small MFIs have been playing a very significant role in promoting women's finance in the region. According to Sa-Dhan Bharat Microfinance Report 2017, there are at least 21 effective MFIs extending financial products in the different states of North Eastern India. National Rural Livelihood Mission (NRLM) and National Urban Livelihood Mission (NULM), the flagship livelihood promotion programmes of the government, have been significantly changing the landscape of women's finance by facilitating universal access to the affordable, cost-effective, and reliable financial services, training and handholding in managing finances to the poor women. A good number of women have not only been able to access financial services, but also set examples of setting up microenterprises individually and in collectives [280]. As per RMK data, in Assam, Manipur, and Nagaland, 700, 842, 86 SHGs were established and 7005, 8421, 859 women were benefitted, respectively [281]. It was found that trainings in book keeping, record maintenance (i.e. members' register-joining and dropping of members, writing proceedings of group meeting) were provided to a few of the groups under this scheme. At present constitution of Outreach Committee for expanding the network of RMK & Mahila E-haat along with their capacity building and Revised Loan Guidelines of RMK are in main focus of the scheme.

Further to this, a recent survey results for women entrepreneurs before and after joining SHGs showed a significant change in levels of lifestyle improvements due to use of micro-credit programmes. It becomes apparent that joining SHGs, and getting access to financial services increased the ability of poor women to control their savings and generate income from their occupation. They also experienced a greater decision-making role in their families and in local society, enhanced levels of self-confidence, self-efficacy and self-esteem, and heightened freedom of mobility to increase business and social activities outside home [282].

National Rural Livelihood Mission (NRLM), National Urban Livelihood Mission(NULM), RMK, State Rural Development and Tribal Welfare departments with adequate supports from many banking institutions such as National Bank for Agriculture and Rural Development (NABARD), Assam State Rural Livelihood Mission (ASRLM), North Eastern Development Finance Corporation (NEDFI), Assam Gramin Vikash Bank, North East Small Finance Bank, Rastriya Grameen Vikash Nidhi (RGVN), MFIs, academic institutions and NGOs promoting women's Finance and empowerment and corporate CSR Initiatives are playing important and effective roles in NER.

Study Title

Youth of North-East India Demographics and Readership

Implementing Institution

National Council of Applied Economic Research (NCAER)

Project Location/Completion Year

More than one state, 2012

Objective

- To assess the readership status and pattern from the perspective of the 'leisure book' or 'non-text' reading
- To assess the issue of the pattern of media usage among literate youth in the north eastern states of India
- To analyse the behaviour of youth and looks at some of the related characteristics for a broader section of the population to have an overall understanding of the picture for the entire region.

Study Recommendation

There is a strong need for conducting more focused studies in smaller states like the ones in the NE states, in order to ascertain and make small states vs large states comparisons regarding factors behind changes in readership status and pattern

Analysis and Outcome

There is no specific recommendation attached to this study, however, some important findings to overall North East region youth education system requires special mention. As compared to the rest of India, the North Eastern states have a much higher readership of leisure books. The study analysed into the basic demographic and socio-economic characteristics of youths of North East region and seeks to identify how these factors impact the likelihood of reading leisure books. The results reveal that the North Eastern states, despite their economic backwardness in infrastructure and other indicators, have a greater proportion of readers in its youth population (43%), and has the highest proportion of literate youth in rural areas in the country.

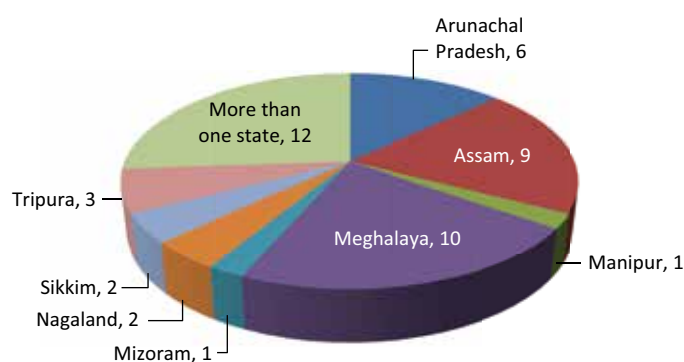
Developing a reading culture and creating adequate opportunities for reading are the foundations of rich intellectual and emotional lives and the basis for sound citizenship values in North East region. These need to be nurtured continuously in schools and sustained later in life through the conscious efforts of the public education system, libraries, and, increasingly, and access to the Internet. The Central and State policies such as Sarva Shiksha Abhiyan (SSA), National Youth Policy, National Rural Employment Guarantee Act (NREGA), Accredited Social Health Activist (ASHA), etc. are contributing to the development of youth education system.



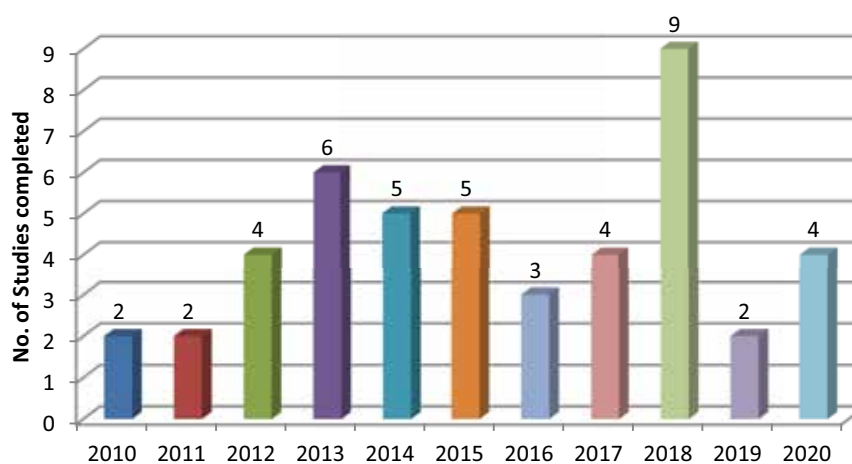
State-wise Summary

In this present study, 46 study reports have been collected and analysed. These research studies have been carried out in the North Eastern Region (NER) by different research, academic and government organizations primarily sponsored by government agencies. Among these reports, it has been observed that Meghalaya has conducted most number of studies (10 studies), followed by Assam (9 studies), Arunachal Pradesh (6 studies), Tripura (3 studies), Sikkim and Nagaland (2 studies each) and Manipur and Mizoram (1 study each). Besides, 12 studies have focus on more than one state.

If we observe the year-wise trend (2010–2020) of completed studies, it is noted that between the years 2010 and 2013, the number of studies are increasing and during 2013–2015 studies had reached a plateau and then decreased. However, in 2018 we can observe maximum of 9 studies conducted and completed. The lower number of studies during 2019–20 is perhaps due to adverse impact of COVID-19 in the region.



Studies completed in Human Resource Development Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Human Resource Development Sector in NER during 2010 to 2020 (Year-wise)

Assam

Development of PRIs (Panchayati Raj Institutions) in Assam is a major job of the State Government, which is achieved through direct participation of rural people. State Institute of Panchayat and Rural Development, Govt. of Assam, has undertaken mass awareness on a mission mode for 30–40 days in each of the 2200 GPs of the state covering 22,000 wards or villages. Massive campaigns for awareness building among rural masses have been taken up and this initiative brings fruits to government in terms of job creation, skill development, following up best practices, etc.

Skill development and job creation for Assam tribes have been studied in great depth in multiple collected studies and are recorded in many published literature. It was observed that Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-KGY) trainees across Assam have more employability (31%) over other areas. It was felt that aggressive promotion of job opportunities and self-employment through seminars, workshops, industry meet, job fairs, etc., with support from Rural Livelihood Mission and State nodal Agency for Skill Development would improve the success rate. On the other hand, in Nagaon district, Assam villagers have a religious mindset and many inequalities arose due to caste differentiation. This has eroded good practices of irrigation, sanitation, waste disposal pattern, etc., where strong government awareness generation programmes for youth and inclusive governance is necessary.

Assam being a disaster prone state, a Study was conducted in various categories schools in Assam to understand disaster preparedness and emergency management plans have shown that government has already taken actions in all districts through district administration and helping schools closely to develop disaster management plan and relevant skills. Faster actions and measurable tools need to be created in this regard.

The socio-economic development among the tribal communities of Assam have been studied in some of the reports. The Bodoland Territorial Area District (BTAD) of Assam is of great concern as this underdeveloped area has no major industries in healthcare sector and indigenous products developed in these sectors are facing low demand, however, cottage and manufacturing sectors have grown. The recent government policies and initiatives through inclusiveness of BTAD authorities have changed the socio-economic conditions in BTAD region with respect to improved education and literacy level, job opportunities, and health infrastructure. It was felt that strong coordinated efforts are necessary to take this progress ahead. Similarly, in Buddhist Tai communities inter-community marriages and migration for job opportunities are the two primary reasons identified for socio-cultural and economic change. However, more studies were recommended to be conducted to know further about this community. Also, the tea community is one of the marginalized and socially-excluded groups in Assam. Education and health issues among women and children are highlighted as areas of concern. While the Department of Health and Family Welfare, Government of Assam, has initiated a few schemes to resolve these issues and achieved some success in 18 districts, however, creation of education and health infrastructure and regular assessment of progress with aggressive awareness is necessary to reach all probable beneficiaries.

Arunachal Pradesh

While studying six (6) collected reports on Arunachal Pradesh and other published sources, the following major issues were observed and therefore specific recommendations for the State were given. It was found that skill development is a continuous process in Arunachal Pradesh and bringing desired results, particularly in the visible employment generation in the non-farm sector. The State Policy on Skill Development Mission implemented by the Department of Skill and Entrepreneurship Development visions one lakh job creation by 2022 through improved skill development in multiple sectors where the State has competitiveness. However, a closer look at the Skill Development system reveals that there is no standardized quality control and quality assurance system in place. It was strongly felt that development of industry-specific courses and faster creation of Sector Skill Councils (SSC) following National Skill Council Framework are necessities to ensure training quality, regulatory mechanism, infrastructure development in the State and subsequent livelihood generation. It was also observed through study results that women in Arunachal Pradesh face traditional discrimination against parental property inheritance and low participation of women in policy discussions, which stand against the liberation of women. It was recommended that large-scale women awareness about new regulations and government policies to know their rights is a necessity to better their lifestyle.



Studies conducted on prioritization of Indigenous Knowledge Systems were done through analysing market feasibility of the indigenous tribal products such as sale of handloom and food products of Monpa and Nyishi tribes. Coordinated approach, guidance and technical support on IPR-related issues to develop tribal products supported by mass awareness programmes have the potential to generate livelihood in the tribal communities in the long run. On the other hand, it is felt from the studies that the Bugun language speaking people are rapidly depleting and also undergoing changes. There has to be substantial efforts from government (Education Department), local NGOs and academic institutions to save this language through preservation efforts such as the use of this language in folk songs, seminars, films, social gatherings, etc.

In terms of biodiversity conservation, more studies on Arunachal Macaque are necessary to resolve the prevailing human-primate conflict to protect farm produces. Focussed approach towards minimizing adverse impact on the species due to construction of power transmission lines, farm roads, etc., are required through framing government policies. Simultaneous monitoring of biodiversity conservation, database development, and awareness creation would be key to resolve these issues.

Manipur

Manipur has become a major place of attraction for entrepreneurship due to the Look East Policy/Act East Policy of the Government of India. Further to this, both the trans-Asian highways and trans-Asian railway will be passing through Manipur and would generate new opportunities, more employment for the youths. About 10 forward looking skill development areas in Manipur have been identified and emphasized by the State Government including agriculture & allied areas, food processing, forest produces, handicrafts, education, health, construction, tourism, banking & finance, and IT-based services.

The report collected as part of this study highlights skill development status, potential of jobs and entrepreneurship development activities in Manipur. Various central government policies and involvement of state departments in multiple sectors have helped Manipur to develop skillsets across the State. Government and private vocational training agencies are continuously providing trainings in panchayat-zilla levels to local youths under Skill India Mission and other state initiatives. Success stories are also promoted across the State for mass awareness generation. However, judicious mix of innovation, industry-specific, and indigenous skill development efforts are solicited. While development of education & training facilities, ITIs, Polytechnics in remote areas will serve the purpose, but strategic decisions and coordinated actions to integrate available specialized indigenous skills based on available natural/human resources in community levels could be highly impactful.

Meghalaya

Among the 10 reports collected, 8 of them highlighted two pressing issues—child education and job-oriented skill development. Rest of the reports covered women participation in economic development process and healthcare system in the State.

As per the study reports, Meghalaya has very poor holding capacity of the schools and hence questions the quality of elementary education. Meghalaya state education department has taken various steps to improve the educational system; this results in Meghalaya's free and compulsory education policy. The State Education Policy, 2018 intends to provide stimulating and equitable education of satisfactory quality to foster innovation, transformation, and inclusive growth. Some cases of high-achieving primary schools have been replicated in other locations through Sarva Shiksha Abhiyan, Rashtriya Madhyamik Shiksha Abhiyan, and NCERT-supported programmes, however, it was found that more government initiatives, policy support and grant-in-aid are necessary to bring school infrastructure and tribal children to the mainstream education process. Recently, Samagra Shiksha, an overarching programme of the Union

Ministry for the school education sector was launched to boost equal opportunities for schooling and equitable learning outcomes. This also include teacher's assessment and training periodically. Among other education initiatives, Integrated Child Development Services (ICDS) is a unique early childhood development programme to address health, nutrition and development needs of young children, pregnant, and nursing mothers. ICDS projects are presently running in the 39 Community and Rural Development Blocks in Meghalaya districts, however, success of this programme is limited. People are not aware of the services or the target groups VLCCs (village level coordination committees) are also not fully aware of their roles and responsibilities. As evident from the ground level data, it was felt that larger coordinated role is necessary by the Government for better impact.

On child labour issue, one study highlighted that Meghalaya has 18,839 working children (2011 census) and the study noticed illiteracy and poverty are the main factors responsible for child labour. The State Government has constituted district task forces and evolved a mechanism to eradicate child labour through continuous monitoring, providing free education opportunity, and promoted a state protocol on how to prevent, rescue children from getting forced into labour and also to assist the victims. While substantial decrease in percentage of child labour was found in the State, however, as per the beneficiaries report educational engagement and employment of withdrawn children are still not done in a cohesive manner. It was strongly suggested that along with education, the improvement in their financial conditions may be considered through different employable skill development trainings.

On the other hand, it is observed that the performance of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) in Meghalaya, with a particular reference to women's participation is 43%, indicating a positive impact of the scheme. However, it is lower than the other high performance states. As per the State Government policy, 50% seats are reserved for women in the grassroots village level community institutions (VECs) constituted under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in every village. Change in this policy implies women leadership, creation of agency for women, enhanced women participation in skill development trainings, and subsequent economic development.

In Meghalaya, over 30% of the population are youth and require skill-based training for getting job opportunities. The reports collected as part of this Study highlights skill development status, potential of jobs and entrepreneurship development activities in Meghalaya. Meghalaya has identified and emphasized skill development in sectors such as agriculture & allied areas, food processing, fashion & apparel, tourism & hospitality, mineral-based industries, forest produces, handicrafts, education, health, construction, banking & finance, and IT-based services. Various central government policies and involvement of state departments, state nodal agency Meghalaya State Skill Development Society (MSSDS), NGOs and private institutions through hands-on vocational trainings have helped Meghalaya to develop skillsets of youths across the state. MSSDS is implementing a placement-linked skill development programme where the State has potential and industry demand through project implementing agencies. More trainings have been organized in agriculture and horticulture crops and by-products; capturing of mineral resources from coal, limestone; handicrafts using natural resources in wood and bamboo; border trading, etc. However, it was observed that there is a need to converge the various government-private initiatives to instill a sense of collective participation towards a common goal.

Some of the major initiatives taken by the Government to promote Meghalaya's business opportunities and subsequent economic development include approval of coal mining licence, modernization of transport sector, setting up Centres of Excellence for Agriculture and Horticulture, establishment of cluster-based, farmer owned and farmer-operated markets, etc. Also, enhanced budget allocation in agriculture, education, roads and bridges, tourism and health sectors are indications of the Government's proactive role towards capturing local business opportunities. Similarly, Meghalaya State Aqua Mission (MSAM) has successfully implemented "1000 Pond Scheme", which benefited economic life of fish farmers in almost all the districts. To scale up this success, MSAM 2.0 has been launched with an optional 'community fisheries' to engage communities further with enhanced fish production.



Mizoram

The Study collected as part of this exercise analysed in detail various skill development requirements in Mizoram keeping in mind the State's natural resources and already available expertise. It was observed that Mizoram has skill requirement in the areas of agriculture & allied subjects, sericulture, tourism, fashion & apparel, IT-based services, etc. Further to this, indigenous skills like handicrafts, cultivations, animal husbandry, forest produces, tailoring, traditional health practices, etc., require conservation efforts and also have great potential for future employment generation.

In line of 'Mizoram State Policy for Skill & Entrepreneurship Development – 2018', Mizoram has started "Mizoram State Skill and Entrepreneurship Development Mission" (MSEDM) with various levels in the functional tiers including Mission Governing Council, Mission Steering Committee cum Coordination Board, Executive Committee, Mission Directorate and District Committees. MSEDM attempted integrated efforts with respect to strategic roadmap development towards skills, district-level skill development plans, establishing training organizations, ITIs, polytechnics, etc., in remote locations, training quality improvements, and developing industry linkages for trainees. This has resulted in improvement in community-level literacy rate, employment options after training, and generated mass awareness and interest among the youths to undertake trainings. It was also noted that ICT oriented and industry demand-based trainings have greater employment potential. However, more initiatives and skill-based trainings are required to achieve perceived goals of the mission.

There is urgent need to integrate industry-specific skill trainings conducted under different state ministries to make effective progress across the districts. The stakeholders group discussions conducted under this Study as well as by the researchers, stressed on improving the quality and job-oriented learning outcomes of school education. It is strongly recommend that many such periodic skill gap analysis and evaluative studies be conducted to monitor progress of ongoing activities.

Nagaland

Nagaland has the highest unemployment rate in the country (21.4%). In order to reduce this and improve the state's economic growth, the Nagaland government has taken a few positive steps. The State Government has recently launched Nagaland SDG vision 2030 document. It provides State specific short-, medium- and long-term targets with measurable indicators and strategies that the State should focus on to meet the aspirations of the people for sustainable livelihoods and living standards. The skill gap analysis and status of skill development in 11 districts of Nagaland was analysed in the collected report.

The Study highlighted various skill development requirements considering state's natural resources, culture, and already available expertise. It was pointed out that agriculture & allied areas, food processing, animal husbandry, forest produces, handicrafts, construction, tourism, and IT-based innovative services have future demand in Nagaland. It was noticed that special emphasis from government agencies is necessary to preserve indigenous knowledge and practices in these sectors. This can be achieved through mass awareness and improvement in school education curriculum. Various central government policies and involvement of state departments in multiple sectors have helped the state to develop skillsets. However, it was observed that there is urgent need of integrated efforts from government agencies, state departments and private sectors with respect to strategic roadmap to skill development, district-level skill development plans, establishing training organizations and developing industry linkages for trainees.

In another study, it was observed that the government initiated successful work strategy of Accredited Social Health Activist (ASHA), trained female community health activist, as an interface between the community and the public health system in Nagaland. Under the NHM, the Nagaland Government promoted access of healthcare services to rural household. It was observed through reports and other secondary analysis that improvement of ASHA's engagement in rural awareness building and healthcare services can be achieved through periodic training, awareness building, and financial incentives.

Sikkim

Sikkim has high literacy rate with low school dropouts indicating strong elementary education system of government and private schools. However, vocational education and trainings are provided by Industrial Training Institutes (ITIs), Polytechnics, Livelihood Schools under State Institute of Capacity Building.

The study collected as part of this analysis detailed skill requirements and future opportunities in Sikkim. The focussed areas for skill requirement in Sikkim were identified as agriculture, tourism & hospitality, handicrafts, rural development, banking & finance, healthcare services, precision engineering, construction and IT-enabled services. Special emphasis has been given to green skills development and indigenous knowledge preservation using state's natural resources and already available traditional skills related to handloom and handicraft products. Sikkim state departments are providing long- and short-term trainings under different Central and state department's schemes. An urgent need was felt to conduct more skill development trainings with integrated efforts from government agencies, state departments, and private sectors. Also, these programmes should be aligned with strategic roadmap to state/districts skill development plans, establishing new training organizations, ITIs, polytechnics in remote locations, skill efficacy measurement and developing industry linkages for trainees. It was also observed that ICT oriented and industry demand-based trainings have greater employment potential across the districts, however, such trainings should follow integrated approach with assured quality and addressing industry need.

In another study, it was observed that the Sikkim Government initiated successful strategy of utilizing services of Accredited Social Health Activist (ASHA) workers to interface between the community and the public health system. Since ASHA workers play crucial part in village healthcare system, it is important to educate and build awareness level of ASHAs. Given the potential of the ASHA workers in impacting rural health service utilization, the need to strengthen strategies was emphasized to recruit, train, incentivize, and retain ASHAs in Sikkim.

Tripura

This study on Human Development Report (II) in Tripura, reported success of government policies, programmes and achievements in ensuring improved literacy rate, low mortality rate, and better health practices. However, the report also pointed out that there is a deep rooted social tension between tribals and non-tribals, low women participation in work and reduced people's participation once the project ends. Based on the expert opinions in secondary literature and stakeholder's inputs, it is noted that the State Government needs to provide mass education among the population to bring down their friction and also creation of government infrastructure is needed to build up an amalgamated community inclusive socio-political movement.

The other report deals in Indigenous Knowledge (IK) preservation in North-Eastern states, with special reference to Tripura. The issue is of utmost importance for knowledge preservation, cultural development, and livelihood generation purpose for the indigenous communities. This require ABS policy, TK protection policy, remuneration and incentives for TK holders, and proper training and awareness building of communities. In the present study, it has been observed that the tribal communities (indigenous groups) of Tripura have managed their respective arts, cultures, folklores or folktales through oral assertion to the younger generations, however, modernization of youths and influx of migrated people poses serious threats to their preservation and maintenance. Digital intervention supported with benefit sharing and legal protection is strongly suggested for tribal communities to preserve IK. The State Action Plan on Climate Change proposes that an institution "Tripura Institute of Strategic Knowledge for Climate change (TISKCC)" may be constituted which will manage and coordinate all the relevant specialized knowledge and competencies. A specific study on indigenous plant protection practices (IPPPs) specific to insect and vertebrate pest management highlighted that community people acquired and inherited knowledge from ancestors, however, IPPP use is associated with socio-demographic condition, age, education, occupation, gender, locality, and house type. The vulnerable practices largely remained unexplored due to inadequate scientific scrutiny and authenticity, which should be studied in greater details.

Under the umbrella of National Rural Health Mission (NRHM), Tripura has an ongoing successful child immunization model with complete tracking of vaccinated children under the supervision of ASHA workers, who have played an important role in mobilizing the community in accessing the healthcare services. Drawn from the success of Khowai district programme, the State Government has promoted several healthcare and immunization schemes for children and pregnant women across the state with greater success. It is strongly felt that inclusive community-driven healthcare services across the state involving ASHAs may be conceptualized to improve rural public health system.



Overall Scenario

During this study, 12 reports were analysed which have direct impact on more than one state in the NER. A closer look into the research focus of these project reports include conflict resolution in NE states, strategic planning for tribal education, natural resource management, legal empowerment, skill enhancement and livelihood generation in different tribal areas.

During the Study, it was found in reports that as violence has spilled over into homes in the NER, school education system has been severely impacted resulting into a high dropout rate. In recent years, the government has tried to address the conflicts through various policies from the perspective of development, building infrastructure but peace education role remains partially attended. The stakeholders felt that teachers' trainings on peace modules, aggressive awareness building, declaring schools as peace zone and developing a sense of co-existence is recommended. Further to this, job-oriented skill trainings in popular subject areas would keep children away from violence. Although, some efforts have been made under the various state government education and skill development policies, more coordinated efforts are required to address this issue. One report highlighted that the habitat of Mizoram's Bru community is seriously affected and the displaced community is facing immense hardship in child education and food issues. While the Tripura Government has taken a few measures to support these issues, however, additional fund and government policy support are required to resolve the issue.

One report highlighted that legal knowledge gaps exist among NE stakeholders in terms of various constitutional provisions regarding legal aid and access to justice, roles and mandates of the legal services authorities and other key service providers. Both central and state governments have implemented a few schemes and awareness programmes to enhance legal literacy, use of Lok Adalats, etc., however, discussion with the stakeholders pointed out a dire need to have a relook at access to legal aids to common people, women, and jail inmates in the region.

An umbrella project sponsored by the NEC helped creation of the North Eastern Region Community Resource Management Society (NERCRMS) towards the transformation of far flung rural areas of the NER through different livelihood initiatives. The society adopted a holistic approach of development using social mobilization, organization and capacity building to tap and realize the great latent potential of the communities through traditional value systems and culture; and promote economic and social activities and infrastructure with predominant thrust on income-generating activities. However, a study reported that participation of women entrepreneurs in cross-border formal trade in the NER remains underperformed. To enhance the opportunities of current international trade possibilities, the societal conventions and gender-neutral government policies and schemes are required. Also, social unrest, lacking knowledge of digital technology use, low intent to scale up activities, lack of information regarding finance, network access and knowledge of potential buyers are deterrent for women entrepreneurs. It is felt that policy support to resolve complex issues like trade barriers, free trade agreement (FTA) are of prime importance. Further, stakeholder consultations revealed that social awareness, capacity building and market access of women traders are particularly important to protect NER women traders' interests.

Despite years of political unrest and long-term violence, several studies conducted in NER region on HRD sectors (primary to higher education) highlighted that literacy rate in NER states are quite high. Beside a few tribal communities where literacy rates are low, government initiatives and policy support have recently been seen for educational development. As on date, the literacy rate in NER is showing a positive increase, nullifying the damage created due to violence driven human displacement.

NER has some specific issues which are recognized as major gaps towards the development of community empowerment, skill development and job creation. Because of the difficult mountain terrain and remoteness to reach to tribal populations, large industrial developments remain scanty in NER. Major emphasis was given on developing infrastructure facilities and skill development of populations in small scale industries utilizing biodiversity, cultural strengths of respective states. However, despite high potential of growth of economic activities in the region, low awareness of skilling benefits, wide-spread digital divide across the region, less number of skill based trainings conducted in several states, lack of integrated approach of schemes led by Central and State Departments, have resulted into relatively low job creation and self-employment in the region.



6.9 INFRASTRUCTURE

Study Title

Environmental Impact Assessment Study for the Proposed Greenfield Airport at Hologgi, Itanagar, Arunachal Pradesh

Implementing Institution

VIMTA Labs Limited

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

- To prepare environmental impact assessment report for various environmental components including air, noise, water, land, and biological components
- To prepare an environmental management plan for mitigating adverse impacts

Study Recommendation

- An airport at Itanagar should be built as it enables development of the area
- An air link would not only lead to greater connectivity and ease of accessibility but also foster economic activities by encouraging international commerce and tourism

Analysis and Outcome

Arunachal Pradesh is one of the largest state in North Eastern Region and yet it doesn't have an airport. Currently, helicopter service connects Naharlagun, which is 15 km from Itanagar. Itanagar, the state capital, is not connected to neighbouring states either by air or by train. The Government of Arunachal Pradesh plans to construct a new airport in Itanagar to improve connectivity and the overall development of the state. The general socio-economic situation of the region will then benefit directly and indirectly because of this endeavour. It was also suggested that important concerns be identified to provide appropriate mitigation measures for execution in order to prevent the degradation of various hydrological sources around the project site. Aircraft exhaust, ground servicing equipment, automobile traffic (airside and landside), and DG sets are all expected to produce significant emissions because of the proposed project. The traffic will lead to a modest rise in noise levels because of the proposed airport operation. Noise mitigation measures to be installed during the operating phase at and near the proposed airport, which would lower the expected noise levels even more. The initiative will be funded by a government grant based on socio-economic factors, with AAI serving as the implementing agency. It is essential to have an airport in Itanagar, both as the capital of Arunachal Pradesh and for the growth of the region. An air link would not only improve connectivity and accessibility, but it would also boost economic activity by promoting international trade and tourism.

Study Title

Improvement and Upgradation of Road Sections of Tamulpur–Paneri (AS-02) and Paneri–Udalguri (AS-03)

Implementing Institution

North Eastern State Roads Investment Program (NESRIP)

Project Location/Completion Year

Assam, 2020

Objective

- To define the environmental management principles and guidelines for the pre and post-constructions phases of the road improvements
- To describe the practical mitigation measures that will be implemented on road improvement works and ancillary sites quarry and borrow areas to prevent or mitigate any negative environmental impacts and enhance the positive issues
- To establish the roles and responsibilities of all parties involved in the implementation of environmental controls
- To establish monitoring and reporting systems for facilitating appropriate implementations of Environmental Management Plan

Study Recommendation

- Compensatory plantation of at least thrice the number of tree cut shall be planned along the project road with a 3-year nurturing period
- Where major portion of the project road pass through open lands, planting of trees along the entire stretches of the road is recommended as an enhancement measures, which would also serve as a mechanism to delineate right of way ROW and prevent future encroachments/squatters in to the right of way, wherever possible. (Quantum of trees as mentioned in BOQ)
- The extraction/procurement of water is to be carried out as per provisions given and the contractor will minimize wastages of water during the construction

Analysis and Outcome

An environmental impact assessment (EIA) study was conducted in response to the upgradation and improvement work done on road stretches in Assam through loans from Asian Development Bank (ADB). This will enable capacity augmentations that would enable safe and efficient movements of traffic.

The Ministry of Development of North Eastern Regions (MDONER) is the Executing Agency (EA) for the investments programme and Public Works Departments (PWD) of Government of Assam, through project implementation unit (PIU), is the implementing Agency (IA)

The EIA study was done based on the following two project sites:

- Project Road–Tamulpur to Paneri (AS-02)
- Project Road–Paneri to Udalguri (AS-03)

It has been observed that no significant environmental impacts were observed during the reporting periods. However, a few shortcomings on coordination with government authorities to get NOC/permits, dust control, road safety measures were observed for which necessary corrective measures has to be taken. In summary, the implementation of environmental management measures in this project faced some difficulties. Contractors had been instructed regularly to fulfil the requirements of the implementations of Environmental Management Plan. The CSC environmental specialist has been working closely with the Environmental officer of the PIU and conducting regular site inspections.



Study Title

Assam Inland Water Transport Project Final Social Impact Assessment Resettlement Action Plan-cum-Indigenous People's Development Plan

Implementing Institution

Arkitechno

Project Location/Completion Year

Assam, 2019

Objective

To predict, assess, and analyse the possible positive and negative social safeguard impacts anticipated during the construction and operation of the three priority locations

Study Recommendation

- The new institutional framework developed as part of this project is wide enough to accommodate addition of all ghats in a time-bound manner
- Assam being a land of landscaping beauty, and riverine stretch crisscrossing the State provides immense opportunities for tourism development, which needs to be explored
- The project is opening new vistas of development for the state providing several livelihood opportunities for their men and women, if appropriately tuned
- The project framework provides several convergent actions to facilitate gender development and area development in general, if used appropriately
- AIWTDS with a vision and mission will be able to take this forward

Analysis and Outcome

With an aim to improve passenger ferry infrastructure and services in Assam, and to improve the institutional capacity and framework, Assam inland water transport project social impact assessment resettlement action plan-cum-indigenous people's development plan was conducted.

The project had three main components and eight sub-components, which will collectively tackle the regulatory, operational, and infrastructure challenges of the sector. The three main components were as follows:

- Institutional, regulatory, and safety strengthening
- Fleet safety improvements and modernization
- Improvement in terminal infrastructure

As part of the SIA, the Resettlement Action Plan cum Indigenous People Development Plan (RAP & IPDP) was prepared to assess the potential adverse and positive effects of the project interventions on individual and/or community, in the three priority locations. The study shows the following findings:

- **Lachit Ghat (South Guwahati):** There was no negative impact, as due care was taken to consider all possible development opportunities to such vulnerable categories. There were no Project Affected Families (PAFs) in this region.
- **North Guwahati:** Direct impact on Schedule Cast (SC) persons operating shops in the impact area will be duly considered for compensation as well as livelihood safeguard in the RAP. This region has 4 PAFs and 10 Project Affected Persons (PAPs) in PAFs
- **Aphlamukh:** The directly impacted people will be compensated for their loss of structures and shifted and rehabilitated to the nearby sites. This region has 9 PAFs and 52 PAPs in PAFs.

Resettlement Action Plan (RAP) cum Indigenous People's Development Plan (IPDP) has been prepared based on the World Bank policies (OP 4.10 and OP 4.12) and relevant national and Assam governments requirements. They will get all compensation packages as per entitlement matrix.

Study Title

India Assam State Roads Project

Implementing Institution

Public Works Roads Department, GoA

Project Location/Completion Year

Assam, 2018

Objective

- To enhance the road connectivity of Assam by assisting the Public Works Roads Department to improve and effectively manage its road network
- To strengthen Assam's road connectivity by aiding the Public Works Roads department in improving and successfully managing the state's road network
- To achieve the country strategy objectives of attaining rapid and inclusive growth, increasing the World Bank involvement with laggard countries, and reducing infrastructure barriers to progress
- To improve transportation and communication by reconstructing/renovating district/state roads and improving bridges
- To remove infrastructure bottlenecks, provide basic minimum services, and create a climate conducive to private investment as also aligns with the North Eastern Council Regional Development Plans

Study Recommendation

- Effective execution of land acquisition and utility shifting
- Effective collaboration between different agencies for rehabilitation and resettlement plans
- Timely deployment of contractors
- Ensuring high quality of works



Analysis and Outcome

The project was affected due to following reasons:

- Seven-year preparation period: The long preparation was due in part to (i) the five-year wait for the policy note to be ready, (ii) discussions with DEA on the size of the loan (given that Assam as a special category state would receive 90% of the loan as a grant), and (iii) overlapping activities.
- The project was somewhat over designed for Government of Assam and PWRD, as the concerned entities had limited capacity and no previous experience of working with the Bank.
- The overall risk rating at project appraisal was 'moderate' and implementing agency risks were rated 'moderate' for both capacity and governance. Considering the ambitious project activities and the limited institutional capacity, the ratings should have been substantial, with additional mitigation measures put in place to strengthen implementing agency capacity.
- Project readiness: The project was ready for implementation, based on the Government of India's criterion for implementation readiness, i.e., contracts valued at 30% of project costs was ready for award by loan approval. Government of Assam had prepared most of the feasibility studies, initiated bidding, completed environmental and social impact assessments, and implementation arrangements were in place.

The aforementioned results for road upgradation and rehabilitation indicated the economic feasibility indicators' resilience under normal and unfavourable sensitivity scenarios, including considerable reductions in benefits, for both individual project roads and the entire programme. The end-of-project Economic Internal Rate of Return (EIRR) for all the above packages combined justified project investment with more risk absorption capacity. However, this sensitivity is unlikely to happen as:

- (a) traffic was expected to grow in tandem with the current economic growth
- (b) there was no uncertainty on the cost of the works as all the contracts were completed
- (c) VOCs were unlikely to be reduced in view of the past trend for the price of inputs such as fuel, lubricants, tires, and salaries

Furthermore, the predicted economic feasibility results were cautious because qualitative project advantages such as tourism growth, higher road safety, and improved highway environment were not taken into account in this study. The loan was extended for eighteen months from its original closing date to allow sufficient time for the completion of key activities, including the re-tendering of the terminated civil works contracts, institutional strengthening activities, and road safety activities; all these resulted in a seven-year project implementation period.

Study Title

Assam PIDP Pre-feasibility Studies for Road Project (Bhilasipara to Sherfanguri)

Implementing Institution

PwC, India

Project Location/Completion Year

Assam, 2015

Objective

- To formulate an infrastructure development plan for the key infrastructure sectors in an integrated manner to support one another
- To facilitate a holistic and inclusive socio-economic development uniformly across the state

Study Recommendation

The project may not be feasible in a pure PPP model where the developer will finance the entire project and earn 100% revenues through tolls. As, the project is not viable under BOT Toll/VGF, PPP annuity format may be considered as a preferable model.

Analysis and Outcome

As a part of the 20 years PIDP for Road infra in Assam, five road projects had been identified, based on interactions with relevant stakeholders, for conducting pre-feasibility studies. Based on stretch, connectivity, and financial assessment, the following were proposed:

- The road stretch from Bilasipara-Fakiragram-Dotma-Sherfanguri had been proposed. The site had been justified based on the geo-strategic location of Assam in relation to its neighbouring states and to boost economic growth of the state.
- A financial assessment was undertaken from the point of view of the potential developer to assess the financial viability of the project to the developer. It had been assessed that in a pure PPP model where the developer will finance the entire project and earn 100% revenues through tolls, the project may not be feasible.

As, the project was found not viable under BOT Toll/VGF, PPP annuity format may be considered with a preference of hybrid annuity model for the projects. Then the project will be feasible at INR 261 crore for 10-year bid project cost and INR 280 crore for 15 years in pure annuity model with 18% EIRR.

Achieving the envisaged vision will require physical [which include 6 (core) + 5 (supplementary) road networks, institutional interventions (including development of Assam State Road Board, Core Road Fund and Assam Road Development Corporation)] and policy interventions.

A total capital investment of INR 183,000 crore had been estimated for the envisaged physical infrastructure development over the next 20 years. The Government of Assam/PWD Roads/PWD NH and Buildings/Envisaged Assam Road Development Corporation/Relevant Authorities would be the key stakeholders in this project.

The study was important in the background of the creation of a strong road network providing connectivity to all habitation and key centers (Industry Centres, Tourism Centres, and growing Urban Centres) of the state, for developing and strengthening connectivity with the neighbouring states and countries.



Study Title

Assam PIDP Pre-feasibility Studies for Road Project (Chamaria to Pancharatna Road)

Implementing Institution

PwC, India

Project Location/Completion Year

Assam, 2015

Objective

- To formulate an infrastructure development plan for the key infrastructure sectors in an integrated manner
- To support one another and, thereby, facilitate a holistic and inclusive socio-economic development uniformly across the state

Study Recommendation

It has been assessed that the project may not be feasible in a pure PPP model where the developer will finance the entire project and earn 100% revenues through tolls. As, the project is not viable under BOT Toll/VGF, PPP annuity format may be considered as a preferable model

Analysis and Outcome

The Assam government's Preparation of Perspective Infrastructure Development Plan (PIDP) has prepared a 20-year PIDP for the infrastructural development of the state. The focus sectors for preparing the PIDP were roads and inland waterway transport, power, urban infrastructure, and industrial infrastructure. PwC India had conducted the pre-feasibility studies for the road project (Rowta to Barpeta Road).

The proposed road project is in alignment with the envisaged vision as part of the PIDP, which is to provide 100% connectivity to all populations in the state, and to bring development to underdeveloped areas. This road project would run parallel to NH37, and it helped reduce the stress on NH37. The proposed road project would serve the Goalpara Railway Junction and provide connectivity from Umrongso to the railway junction.

The expected construction end time was 31 July 2019. This project is under construction.

The government of Assam proposed a programme named 'Axom Mala' to improve state highways and major district road networks, and the reconstruction and maintenance of roads and. Under the 'Axom Mala' project, the topmost priority is given to land acquisition and utility shifting. Under the road network master plan, the vision is to build a road network of 57,617 km of approx. length covering the national highways, state highways, major district roads, rural and urban roads ^[283].

Study Title

Assam PIDP Pre-feasibility Studies for Road Project (Lumding to Umrongso)

Implementing Institution

PwC, India

Project Location/Completion Year

Assam, 2015

Objective

- To formulate an infrastructure development plan for the key infrastructure sectors in an integrated manner to support one another
- To facilitate a holistic and inclusive socio-economic development uniformly across the state

Study Recommendation

- Develop core road network encapsulating connectivity to neighbouring states, countries, and the key growth centres
- Focus on physical interventions for development of core road networks, which will form the backbone of the road transport in the state
- Capacity augmentation of key roads/stretches across the State, in addition to the five networks, which require to handle the expected traffic over the next 20 years
- Develop and strengthen key institutions to execute the envisaged physical development
- Formulate holistic policies to facilitate the envisaged physical development
- Act on certain action points that are achievable in the current conditions and are vital for the overall development

Analysis and Outcome

Assam government's Preparation of Perspective Infrastructure Development Plan (PIDP) has prepared a 20-year PIDP for infrastructural development of the state. The focus sectors for preparing the PIDP were roads and inland waterway transport, power, urban infrastructure, and industrial infrastructure. PwC India had conducted the Pre-feasibility studies for Road Project (Rowta to Barpeta Road).

The proposed road project is in alignment with the envisaged vision as part of the PIDP, which is to provide 100% connectivity to all population in the state, and to bring development to under developed areas. The proposed road project will serve the Lumding Railway Junction, and will provide connectivity from Umrongso to the railway junction. The expected construction end time was 31 July 2019. This project is under construction.

The government of Assam proposed a programme named 'Axom Mala' to improve state highways and major district road networks, and the reconstruction and maintenance of roads and rehabilitation of RCC bridges.. Under the 'Axom Mala' project, the topmost priority is given to land acquisition and utility shifting. Under the road network master plan, a vision is made of building a road network of approximately 57,617 km length covering the national highways, state highways, major district roads, and rural and urban roads ^[283].



Study Title

Assam PIDP Pre-feasibility Studies for Road Project (Rowta to Barpeta Road)

Implementing Institution

PwC, India

Project Location/Completion Year

Assam, 2015

Objective

- To formulate an infrastructure development plan for the key infrastructure sectors in an integrated manner to support one another
- To facilitate a holistic and inclusive socio-economic development uniformly across the state

Study Recommendation

- A long-term integrated infrastructure vision has been envisaged for the state as a part of this PIDP
- Assam with a road network of 55,684 km plays an important role in the integration of north east India region with the rest of the country
- Significant augmentation in terms of length, capacity (lanes), and quality of the sector
- There is a need to improve the connectivity between the north bank and south bank of River Brahmaputra, and between River Brahmaputra and Barak Valley
- Aligned with the overall infrastructure vision for the state and considering the infrastructure development that is required for the sector, a long-term vision for developing the IWT infra in the state has been envisaged

Analysis and Outcome

The Assam government's Preparation of Perspective Infrastructure Development Plan (PIDP) has prepared a 20-year PIDP for infrastructural development of the state. The focus sectors for preparing the PIDP were roads and inland waterway transport, power, urban infrastructure, and industrial infrastructure. PwC India had conducted the pre-feasibility studies for road project (Rowta to Barpeta Road).

The core road network would facilitate seamless movement of tourists from one centre to another. It connects the three National Parks (Manas, Orang, and Kaziranga), two wild life sanctuaries (Barnadi and Sonai Rupai) in Assam and also the popular tourist destination of Tawang in Arunachal Pradesh. The proposed project forms part of one of the core road network envisaged as part of PIDP. This project is important for improving the connectivity to Bhutan and the remote regions, which are on the foothills of Bhutan. The network is important for the development of newly formed districts of Baksha and Udalguri. The expected construction end time was 31 July 2019. This project is under construction.

The government of Assam proposed a programme named 'Axom Mala' to improve state highways and major district road networks, and the reconstruction and maintenance of roads and rehabilitation of RCC bridges. Under the 'Axom Mala' project, the topmost priority is given to land acquisition and utility shifting. Under the road network master plan, a vision is made of building a road network of approximately 576,17 km length covering the national highways, state highways, major district roads, and rural and urban roads ^[283].

Study Title

Assam PIDP, Pre-feasibility Studies for Road Project (Amingaon to Chapaguri)

Implementing Institution

PwC, India

Project Location/Completion Year

Assam, 2015

Objective

- To formulate an infrastructure development plan for the key infrastructure sectors in an integrated manner to support one another
- To facilitate a holistic and inclusive socio-economic development uniformly across the state

Study Recommendation

- Improve the connectivity between the north bank and south bank of River Brahmaputra, and between River Brahmaputra and Barak Valley
- Approximately, 50% of the roads in the state are unsurfaced and require immediate attention
- As per the existing traffic, 70% of the length of State Highways in the state should be double lane, whereas at present only 6% of the length is double lane
- The sector requires significant augmentation in terms of length, capacity (lanes), and quality

Analysis and Outcome

The Assam government's Preparation of Perspective Infrastructure Development Plan (PIDP) has prepared a 20-year PIDP for infrastructural development of the state. The focus sectors for preparing the PIDP were roads and inland waterway transport, power, urban infrastructure, and industrial infrastructure. PwC India had conducted a pre-feasibility studies for road project (Amingaon to Chapaguri).

The proposed road project runs parallel to NH31. It can serve as an alternative to NH31, thereby easing the stress on it. The proposed project almost connects most of the major urban areas in lower Assam. The proposed road project aligns with the envisaged vision as part of the PIDP, which is to provide 100% connectivity to all population in the state and bring development to underdeveloped areas. The infrastructure development programmes are in progress, and so are the recommendations.

The government of Assam proposed a programme named 'Axom Mala' to improve state highways and major district road networks, and the reconstruction and maintenance of roads and rehabilitation of RCC bridges. Under the 'Axom Mala' project, the topmost priority is given to land acquisition and utility shifting. Under the road network master plan, a vision is made of building a road network of approximately 57,617 km length covering the national highways, state highways, major district roads, and rural and urban roads ^[283].



Study Title

Assam Urban Affordable Housing and Habitat Policy

Implementing Institution

IPE Global Private Limited

Project Location/Completion Year

Assam, 2015

Objective

- To create an enabling environment for providing 'affordable housing for all and integrated habitat development with a view to ensure equitable supply of land, shelter, and services at affordable prices in Assam with special focus on urban poor and excluded groups of society'
- To ensure no individual is left homeless. Strategies and opportunities for intervention can help address the shortage of adequate, appropriate, and affordable housing

Study Recommendation

- There should be slum improvement programmes for upgrading the services, amenities, hygiene, and environment with a view to make the State slum free
- Slums, whether on Central Government land/State Government land/ULB land, should be taken up for 'in-situ' redevelopment for providing houses to all eligible slum dwellers
- Slums so redeveloped should compulsorily be de-notified
- Slum reconstruction programmes for creating a better environment would be encouraged by schemes with cross-subsidization. These would be based on the basis of audit of slum areas covering health status, education, sanitation, environment, employment status, and income generation. 'Land as a resource' would be used while taking up slum rehabilitation
- Land sharing and pooling arrangements would be resorted to in order to facilitate development of land and improvement of basic amenities in slums. This will be done through low-rise multi-storeyed group housing and cluster planning for optimum and efficient use of land

Analysis and Outcome

This study had carried out by IPE Global Private Limited. There was no codified policy for 'Affordable Housing,' but the government had taken the initiative to produce the stock through various housing schemes, which were implemented in the state under the Ministry of Housing and Urban Poverty Alleviation. A demand survey conducted across 97 towns of Assam under PMAY (Urban) concluded that 53% of the overall demand for urban housing is for self-built incremental housing.

As per the Press Information Bureau release, there was a shortage of 0.31 million urban housing units at the end of the 10th Five-Year Plan^[284]. According to the news published in The Economic Times, 11 January 2018, Assam government said it would build 83,000 houses in urban areas for the financially weaker section of the society under a new Affordable Housing Policy^[285].

As per Assam Affordable Housing Policy 2020, there is a serious scarcity of affordable housing for the urban poor. There is also a sizeable gap between the demand and supply of housing loans in Assam. In order to achieve the housing for all (urban) mission, the Government of India started the Pradhan Mantri Awas Yojana on 17.06.2015. This mission has the mandate to grant central assistance to provide housing to all beneficiaries of all eligible families till 2022^[286].

Implementation of the recommendation are an ongoing process, which needs government interventions.

Study Title

20 Years PIDP for Assam PIDP for Road Sector

Implementing Institution

PwC, India

Project Location/Completion Year

Assam, 2014

Objective

- To formulate an infrastructure development plan for the key infrastructure sectors in an integrated manner to support one another
- To facilitate a holistic and inclusive socio-economic development uniformly across the state

Study Recommendation

- Strengthen the Assam State Road Board as an apex body and mandate it with overall policy planning for the sector, regulate the sector and oversee implementing agencies
- Create Core Road Fund via an Act in the legislative assembly. Operationalize the proposed Core Road Fund under the aegis of the Assam State Road Board.
- Create the proposed Assam Road Development Corporation capable of raising finances on its own and mandated with execution of road projects
- Build capacity of the proposed institutions and the existing department
- Complete the ongoing road projects
- Maintain the existing network
- Formulate a holistic road sector development policy for the state by Assam State Road Board including formulation of toll policies for PPP in the road sector
- Explore PPP policy – a road-specific policy with greater role for Assam State Road Development Corporation
- Formulate master plan with inputs from all relevant stakeholders focusing on the six Core Road Networks proposed in the PIDP
- Develop a shelf of projects for PPP within the Core Road Network
- Acquire land and obtain necessary clearances
- Introduce toll policies



Analysis and Outcome

PwC, India had carried out the Preparation of Perspective Infrastructure Development Plan (PIDP) for Assam for twenty years study for The Planning and Development Department, Government of Assam. The focus sectors for preparing the PIDP were roads and inland waterway transport, power, urban infrastructure, and industrial infrastructure. The overall infrastructure vision for the state envisages various physical, policy level, and institutional interventions in different sectors. The Vision for the next 20 years are (i) creation of a strong road network providing connectivity to all habitation and key centres (industry centres, tourism centres and growing urban centres) of the state; (ii) develop and strengthen connectivity to neighbouring states, and (iii) make Assam the preferred gateway to neighbouring countries. Government of Assam has set up a social cell within PWD, which had been strengthened by appointing retired revenue officials with vast experience in land acquisition and R&R issues and representatives of the Assam Environment and Forestry Department to facilitate environmental and forestry clearances from the respective department.

The Road network in Assam comprises 58,882 km consisting of 3890 km national highways, 2530 km state highways, 4379 km major district roads, 1739 km urban roads, and 46344 km rural roads. The length of surfaced roads in Assam has increased by 7575 km or 32% from 2014-15 to 2019-20. The length of rural roads has increased from 36,544 km in 2014-15 to 46,344 km in 2019-20, an increase by 27%^[283].

Study Title

Consultancy Services to Carry Out the Feasibility Study and Preparation of Detailed Project Report for Upgradation of Road from Dikhu Bridge to Amguri, Assam

Implementing Institution

Aushta Consulting Engineers (I) Pvt. Limited

Project Location/Completion Year

Manipur, 2018

Objective

To do a feasibility study and prepare a detailed project report for upgradation of road from Dikhu Bridge to Amguri, Assam

Study Recommendation

The project road, presently single lane, shall be designed to intermediate lane carriageway configuration facility with National Highway standards with a ruling design speed of 50 kmph

Analysis and Outcome

This study was carried out by Aushta Consulting Engineers (I) Pvt Limited. As per Rajya Sabha's Report on 10 August 2021, recommendation mentioned in the report has been partially implemented. As per the report, project is in progress, and 18% of work has been completed^[287].

Organization responsible for implementation of recommendations:

- Public Works Development, Assam
- Manipur Tribal Development Corporation Ltd.



Study Title

Environmental Impact Assessment for Imphal-Kanchup-Tamenglong Road Section

Implementing Institution

Manipur Public Works Department

Project Location/Completion Year

Manipur, 2015

Objective

- To identify potential environmental impacts of the proposed road improvement work and formulate strategies to avoid/mitigate the same
- To accomplish the above objective, which will comprise understanding the baseline environmental conditions of the project area; identifying the potential environmental impacts of the project proposal
- To recommend appropriate mitigation measures to avoid/minimize the environmental impacts
- To prepare an environmental management plan for implementation

Study Recommendation

- Obtain environmental clearance for this subproject as the project road is located above 1000 m mean sea level
- Obtain forest clearance for Central/State Governments as the project would require the acquisition of about 6.3 hectares of forest land
- Use of EFRC slope protection measures to minimize the impact of slope instability, use of bioengineering technique, compensatory afforestation, measures to minimize impacts on wildlife movement, engineering alternatives to limit impacts on forest areas, etc.
- Obtain necessary clearances/permits from statutory authorities

Analysis and Outcome

The Manipur Public Works Department had carried out this study. The State Level Environment Impact Assessment Authority of the Government of Manipur granted the environment clearance for the project on 20 March 2019 ^[288]. The Environment Impact Assessment report prepared by ADB stated that no severe environment impact regarding the habitat functionality and species persistence is observed as the project area does not fall in the critical and sensitive habitat. Chief Minister O Ibobi flagged off the construction of a new road from Imphal to Tamenglong via Kangchup. The road was targeted for completion within three years and six months' time ^[289]. The works minister said that even if the project for the said road started in 2016, environmental clearance and forest clearance were received later. He continued that the exact number of people whose standing properties are affected by the said project is yet to be finalized. Nevertheless, the government has started giving compensation amounting to around Rs 6.27 crore out of Rs 35 crore ^[290].

The forests and the species experts have indicated that the project area does not fall in the critical habitat of the species assessed, and that it is not expected that there will be any measurable adverse impacts on the species populations and habitat values. The categorization has been done based on environmental screening and assessment of likely impacts while the environmental impact assessment ascertains that it is unlikely to cause any significant environmental impacts. A few impacts were identified attributable to the proposed project, all of which are localized and temporary in nature and easy to mitigate.

Study Title

Environmental Impact Assessment Report for 5 Road Section in Meghalaya East under MITP

Implementing Institution

Projects Consulting India (P) Ltd

Project Location/Completion Year

Meghalaya, 2020

Objective

To identify all relevant direct, indirect, and cumulative environmental and social risks and impacts for construction and operational phase

Study Recommendation

- The road section of Shillong–Diengpasoh runs along the boundary of Itshriyat reserve forest on RHS, approx. 3 km length. Right of way is available for improvement on LHS.
- The Pasyih-Garampani project road section is of category state highway located at an altitude of 1000 MSL. Hence, this falls under the purview of Environmental Impact Assessment Notification 2006 (amended in 2009, 2011 and 2013), as Category 'B' project. Therefore, Environmental Clearance from SEIAA/MoEFCC will be required for the section.
- The proposed Umling-Patharkama Road section length of 3 km passes through ESZ of Nongkhyliem Wild Life Sanctuary (NWLS) in Meghalaya. However, RoW is available for proposed improvement work in this section. No wildlife movement or corridor has been reported by Wildlife Officer and local community during consultation. No Objection Certificate (NOC) from State Wildlife Board will be required to undertake work on road section in ESZ of NWLS.

Analysis and Outcome

An Environmental Assessment study had done by Projects Consulting India (P) Ltd. The proposed consultancy assignment was to carry out the Detailed Project Report (DPR) to construct 122.68 km of major district roads in East Meghalaya under Phase-I of MITP. Development of the road sections would provide connectivity between important habitations of the district and help the economic development of the rural economy and market accessibility to the farmers. Commuting to either state Capital or district headquarters for work or other purposes would be easier and faster.

This project is under implementation, and according to the statement by the Deputy CM of Meghalaya, all the 12 World Bank-funded projects will be completed by December 2022, and the progress of work is very satisfactory ^[29].



Study Title

Draft Environmental Impact Assessment Report and Environment Management Plan for Limestone Mine Area 3.50 Ha. at Temjalong, Wahlong Sirdarship, District–East Khasi Hills, Meghalaya

Implementing Institution

Geogreen Enviro House Pvt. Ltd

Project Location/Completion Year

Meghalaya, 2020

Objective

- To establish the present environmental scenario
- To anticipate the impact of proposed project
- To suggest preventive and mitigative measures

Study Recommendation

- An increase in traffic density will lead to air pollution, so vehicles with PUC Certificate to be hired. Regular maintenance of vehicles is to be done to ensure the smooth running of the vehicles.
- Increased traffic may cause accidents, so to avoid them, the speed of vehicles will be low near habitation areas.
- There is a sufficient gap between proposed workings up to conceptual and level of groundwater table; thus, groundwater will not be encountered in the workings at any stage.
- The long-life Water Bound Macadam haul roads will be constructed and maintained for traffic movement.
- The speed of dumpers on haul road will be controlled as increased speed increases dust emissions. Overloading of transport vehicles will be avoided. The trucks will have sufficient freeboard. Spillage of ore on public roads will be cleared immediately, and vehicles will ply at a safe speed.
- Planting of trees all along main mine haul road and regular grading of haul roads will be practiced to prevent the generation of dust due to movement of dumpers/trucks.
- Water sprinkling will be done on the roads regularly.
- Proper tuning of vehicles to keep the gas emissions under check.
- Plantation of trees along the roads to help reduce the impact of dust in the nearby villages. Adequate silencers will be provided in diesel-operated mine machineries, trucks, and tractors. The transport vehicles should be filled up to a rated capacity of the vehicle to minimize the noise.

Analysis and Outcome

This study was done by Geogreen Enviro House Pvt Ltd. The project had been proposed for the mining of lime stone from private land occupied by the lessee by open cast semi-mechanized method. The present report has been prepared to obtain environmental clearance in compliance with the ToR issued for the mining of lime stone. The proposed project was expected to provide employment to local people in different activities such as mining, sizing (sieving), transportation, and plantation activities. The revenue generated from the production and sale of minerals will also add to the government's exchequer, which in turn will help in the growth of the state economy. The project was not expected to have any major adverse impact on the environment, and whatever impacts anticipated during the environmental impact assessment study will be minimized with the help of suitable mitigation measures. There was no habitation in the mining lease area. Therefore, neither villages nor any part of the villages was disturbed during the entire life of the mine. Mining in this lease would give job opportunities to the local people. Thus, mining will create a beneficial effect on local people.

The mining plan has been approved by the Government vide their letter dated 9 August 2019 ^[292].

Study Title

Environmental Assessment Report of Design of Roads in the State of Meghalaya (EAST) under Meghalaya Integrated Transport Project

Implementing Institution

Projects Consulting India (P) Ltd

Project Location/Completion Year

Meghalaya, 2020

Objective

- To identify potential environmental impacts of the proposed Mawmaram–Mawlyndep Roadsection improvement measures and formulate strategies to mitigate the same
- To collect primary and secondary environmental baseline data within the project boundary and surrounding areas
- To assess potential adverse environmental impacts that might arise during the operation of the project after reviewing project information, and using the environmental baseline study conducted during the feasibility study
- To analyse the alternatives in terms of alternative alignment, technology, design, and operation, including the ‘with project’ and ‘without project’ situations to assess the feasibility
- To consult public/stakeholders and incorporate their concerns into the project design
- To develop an Environmental Management Plan (EMP) to implement suggested mitigation measures and management plans to minimize adverse impacts through effective management systems, including monitoring and reporting requirements
- To conduct additional studies for the enhancement of the benefit to the local community and the road users

Study Recommendation

- Maintain a distance of at least 1 km from boundaries of designated reserved forests, sanctuary, or national park area for locating any temporary or permanent camps
- Maintain a distance of 500 m from river, stream, lake, and ponds
- Maintain a distance of 200 m from the boundary of state and national highways
- Locate facilities in areas not affected by flooding and clear of any natural or storm water courses
- Locate campsites in the downwind direction of the nearest village. The boundary of the campsite should be at least 500 m from the nearest habitation so that the incoming labour does not stress the existing local civic facilities
- Allow free drainage of the site by making the ground have gentle slope
- Hold recorded consultations with residents of the nearest settlement and their representatives to understand and incorporate, wherever possible, what they would like to see within their locality



Analysis and Outcome

The Consultancy service for preparation of Detailed Project Report has been entrusted to M/s. Projects Consulting India Pvt. Ltd. The main objective of the proposed consultancy assignment was to carry out the DPR for the construction of 122.74 km of major district roads in East Meghalaya under Phase-I of MITP. This Environmental Impact Assessment Report was prepared for Mawmaram–Mawlyndep road section to identify all relevant direct, indirect, and cumulative environmental and social risks and impacts for the construction and operational phase. The baseline environment parameter within the Corridor of Impact was conducted by the consultants during November-December 2019. Primary data for ambient air quality, ambient noise status, water quality (ground and surface), and soil quality was collected and analysed through an NABL accredited laboratory. The monitoring results were found within the prescribed limits for air and noise levels at the monitored locations in the project area. The proposed Mawmaram– Mawlyndep Road is located in the north-eastern part of East Khasi Hills District, where mostly elevation is in the range of 940-1765 m. Considering high hazard seismic zone of the project road section area, design standards for structures stipulated in the clause under IRC: 6-2014 has been taken into account.

This project is under implementation ^[293]. The Mawmaram-Nongthliew-Mawmih-Mawlyndep road project is expected to be completed in 2023 ^[294].

Study Title

Sewerage and Sanitation Scheme-Shillong Phase I Works

Implementing Institution

Mott MacDonald Private Limited

Project Location/Completion Year

Meghalaya, 2017

Objective

- To develop sewerage system
- To develop solid waste management facilities, including an engineered landfill site and improvements to primary and secondary collection as well as creating beneficiary awareness

Study Recommendation

- Sequential batch reactor-based sewage treatment plants be provided
- Odour control measures to be included during the construction of STP
- A decentralized separate sewerage collection system is proposed looking into the topography of Shillong city
- Strict enforcement of municipal bye-laws on sanitation
- Making the sewer connection mandatory to all premises with access to a piped sewer required to connect to the pipeline within a specified period
- Sewerage bill to be paid based on volumetric water charges, as a part of the water bill
- An alternative charging system would be developed where the sewerage user does not use piped water or his own/other sources of water (bore wells, open wells, etc.). This will help in generating the required funds for regular O&M of sewerage systems
- Complete ban on dumping of solid waste into the drains and littering of public places
- Approval from various departments, such as Highways, PWD, etc. and statutory clearances (forest, pollution control board, etc.)
- Identify and shift existing utilities such as water supply lines, telephone, electrical cables, etc.

Analysis and Outcome

The Mott MacDonald Private Limited had carried out this study. The primary objective of the subproject was to adopt sanitary landfilling for ultimate disposal of the rejects from the compost plant as per Municipal Solid Waste (Management and Handling) Rule (MSW Rules) (2000) in the interests of health and economic wellbeing of the people of Shillong. For the city of Shillong, this programme would support (i) the development of sewerage systems and (ii) the development of solid waste management facilities, including an engineered landfill site and improvements to the primary and secondary collection, creating beneficiary awareness. The development of short-term landfill site and associated works at Shillong, Meghalaya was carried out on the existing land fill site. The land was already in possession of SMB. No land was acquired from private parties. An odour control measure had been provided.

As per ADB's North Eastern Region Capital Cities Development Investment Programme - Tranche 2 report, some the of the works including construction and rehabilitation of water supply infrastructure; construction of sanitation infrastructure; construction and installation of SWM infrastructure; strengthening of local government for better financial management and sustainable service delivery; operation of an efficient Project Management Unit (PMU) have been completed ^[295].



Study Title

Land Acquisition for Construction of Two Laning with Paved Shoulder of NH-44 from Jowai to Tuber, Including a Toll Plaza at 7th Mile Pasyih, West Jaintia Hills

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

- To carry out baseline survey on the project location
- To identify the likely impacts from the road-widening project
- To understand the opinion and perceptions of the people on the setting up of toll plaza in National Highway 44 as well as the proposed land acquisition
- To bring out a mitigation plan to reduce impacts from the proposed project

Study Recommendation

- The land owners in the five village of Sabah Muswang, Lalong, Phramer, Pasyih, and Tuber Sohshrieh requested that compensation for land to be acquired be paid at the earliest and before the work commences so that there will be no disturbance during the construction process.
- Majority of the land owners feel the need for re-evaluation of the land to be acquired. According to the village authority, most of the land owners are not included in the official survey and list of names in the survey are misspelled and incorrect. In order to address this error, there is a need for the involvement of land owners and village authority with the government officials when surveying the land.
- According to the secondary data on assessment of building/brick wall/gate likely to be dismantled during the road-widening project, it is advisable that priority in terms of financial assistance or compensation be given first to this project-affected families, who need to relocate themselves, for buying new land or fencing their partially dismantled assets.
- Some of the land owners in Sabah Muswang have paddy field near the road and they fear that the road-widening project will further reduce the size of their land if the owner has to create a pedestrian walkway on their own. To address this fear, it is important that the implementing agency see that paved surface are constructed in these region.
- The implementing agency should further keep in mind that proper drainage are dug up or constructed near the agricultural and cultivable land to avoid water logging or water and soil run off during rainy season into agricultural and cultivable land.

Analysis and Outcome

The Meghalaya Institute of Governance carried out this study. From the proposed project, one could say that there was no sign for resettlement of project-affected families as most of the landowners was indirectly affected by the project. Majority of the landowners live inside the village and not near the highway except in the area where a small cluster of the commercial area has been set up. With the majority of the people agreeing to the proposed road-widening project, these small vendors may have to relocate themselves elsewhere. Most of the mitigation measures mentioned in this study had been fully implemented. The impact of the recommendations was high in infrastructure development (e.g. road/communication) and access to market/finance.

Study Title

Social Impact Assessment on Acquisition of Land for Improvement of DAJ NH -40(E) Including Widening from Single Lane to Double Lane from 208.00 km to 214.00 km at Demthring and Pynthor Langtein Village, Meghalaya

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

To improve and widen the DAJ NH 40 (E) from a single lane to a double lane road from the 208.00 km to 214 km points. The Dawki-Amlarem-Jowai Road is a section of NH-40, which links Jorabat-Shillong-Jowai and Dawki. This road runs for 216 km

Study Recommendation

- Provide proper financial compensation to remedy the loss of land and/or natural resources to landowners, occupiers, and tenants
- Provide better information on how much land needs to be acquired by the government for this project and settle the discrepancies
- Speedy completion of work to reduce troubles that may arise during the construction period
- The village authority and the construction company work in tandem to locate suitable sites for soil dumping and check that water sources and agricultural fields are not destroyed by haphazard disposal. The proper placement of construction materials would ensure the cleanliness of the village
- The presence of road safety measures, signs and symbols would reduce the problems of over speeding, traffic congestions, and accidents. Footpaths should be built. Steps must be put in place to reduce accidents and road mishaps
- Steps to be taken to reduce pollution and its effects on water sources, air, siltation, and/or destruction of ponds and paddy fields. Proper drains must be built to ensure that sludge and effluents do not disturb paddy fields or dirty the surrounding areas
- People whose land has been affected want to ensure that their land and residences will not be disturbed further. Expropriation to be avoided wherever possible through the development of the design
- Planting and replacing trees to provide a net gain in biodiversity

Analysis and Outcome

The Meghalaya Institute of Governance carried out this study. The perspective survey indicated that the recommendations of this study had not been implemented because of some administrative issues. For better implementation, better coordination among various government departments and among all stakeholders, public-private partnership, pro-active local government, and enthusiasm among the target group (like association), etc. are necessary. The impact of the recommendations was high in employment generation and infrastructure development.

Procedures for rehabilitation and resettlement of the affected people have already started ^[296].



Study Title

Social Impact Assessment on Land Acquisition for Construction of Facilitation Center –Entry and Exit Point in Khanduli, West Jaintia Hills District

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

- To check the entry of people into the state
- To facilitate legal flow of people, goods, and vehicles into the state

Study Recommendation

- To address to the need of the people, an early implementation of the proposed construction should be executed
- This proposed construction may start a long overdue dialogue between the governments of Assam and Meghalaya to address the border issues
- Officials working in the Facilitation Centre provide identity cards or keep a register of locals to avoid over checking and difficulty in passing through these points. There should be reduction of restriction on regular users, especially farmers. Employment of local people should be a priority for unskilled or clerical jobs
- Use of locals to check the entry and exit of people would be best as the locals themselves can identify unwanted elements. It would to a certain degree create local employment
- Collaboration between the Meghalaya and Assam governments is required to improve the accessibility to basic amenities in these border areas in terms of education, health, livelihoods promotion, etc.
- Practice of accountability and transparency should be encouraged for functionaries who will be taking charge of the Entry and Exit Points cum Facilitation Centre

Analysis and Outcome

The Meghalaya Institute of Governance carried out this study. The perspective survey indicated that the recommendations of this study had not been implemented because of some administrative issues. For better implementation, better coordination among various government departments and all stakeholders, public-private partnership, pro-active local government, and enthusiasm among the target group (like association), etc. are necessary. The impact of the recommendations was high in employment generation and infrastructure development.

The project could also be expected to bring development to the area by creating an environment conducive for the market complex, which would be economically beneficial to the people of the area.

The government had identified two locations Khanduli and Saphai for setting up the entry and exit points in West Jaintia Hills district. The process of land acquisition has nearly been completed at Khanduli ^[297].

Study Title

Social Impact Assessment on Land Acquisition for Construction of Facilitation Center–Entry and Exit Point in Umkyrpong Village, East Jaintia Hills District

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

- To check the entry of people into the state
- To facilitate legal flow of people, goods and vehicles into the state

Study Recommendation

- To address the people's need, early implementation of the proposed construction should be executed without hampering the local peoples' lives, and they should not face any insecurity and hardship when using this point
- After the completion of the proposed project, majority of the respondent felt that the project will have a better impact on the village in terms of community way of living and safety. This proposed construction may start a long over-due dialogue between the governments of Assam and Meghalaya to address the border issues
- To address the concerns, the officials working in the Facilitation Centre provide identity cards or keep a register of locals to avoid over-checking and difficulty in passing through these points. There should be reduction of restriction on regular users, especially farmers. Employment of local people should be a priority for unskilled or clerical jobs. It may be recommended that the use of locals to check the entry and exit of people would be best as the locals themselves can identify unwanted elements
- Collaboration between the Meghalaya and Assam governments is required to improve the accessibility to basic amenities in these border areas in terms of education, health, livelihoods promotion, etc.
- The practice of accountability and transparency should be encouraged for functionaries who will be taking charge of the Entry and Exit Points cum Facilitation Centre
- Employment opportunities should be given to the local people during the construction phase and operational phase
- Steps should be taken to address community safety during the construction phase, especially where boulder and stone need to be properly disposed of so that accident does not occur in the area
- Local people should be exempted from paying any fee except in certain cases as deemed fit by the functionaries and legal laws
- A fee that has been already paid should be monitored and restricted



Analysis and Outcome

The Meghalaya Institute of Governance carried out this study. The perspective survey indicated that the recommendations of this study had not been implemented because of some administrative issues. For better implementation, better coordination among various government departments and among all stakeholders, public-private partnership, pro-active local government, and enthusiasm among the target group (like association), etc. are necessary. The impact of the recommendations was high in employment generation and infrastructure development.

The infiltration and immigration problem is one major issue that causes a significant threat to society's socio-economic, cultural, and political aspects. The project could also be expected to bring development to the area by creating an environment of the market complex, which would be economically beneficial to the people of the area.

The government had identified five locations for setting up of the entry and exit points in East Jaintia Hills District Malidor, Ratacherra, Mooriap, Lakasein, and Umkyrpong. The amount for land compensation had been released to the Deputy Commissioner, and the land acquisition process is in progress ^[297, 298].

Study Title

Social Impact Assessment on Land Acquisition for Construction of Integrated Facilitation Center – Entry and Exit Point in Abhirampara, West Garo Hills District

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

- To check the entry of people into the state
- To facilitate legal flow of people, goods, and vehicles into the state

Study Recommendation

- The land statement provided by the Garo Hills Autonomous District Council (GHADC) had certain mistakes regarding the number of landowners and their area of landholdings. This needs to be examined to avoid future chaos. Hence, the GHADC must access the proposed land and correct the same.
- To address the people's needs, early implementation of the proposed construction should be executed. However, the local people should not face any insecurity and hardship while using the Facilitation Centre and Entry and Exit Points.
- There needs to be a system that would provide identity cards or keep a proper register of locals to avoid over checking and difficulties in registration for arrival and departure of the local people, especially daily visitors.
- The employment of local people should be a priority for unskilled or clerical jobs. It may be recommended that the use of locals to check the entry and exit of people would be best as the locals themselves can identify unwanted elements. To a certain extent, it creates local employment opportunities.

Analysis and Outcome

The Meghalaya Institute of Governance carried out this study. The perspective survey indicated that the recommendations of this study had not been implemented because of some administrative issues. For better implementation, better coordination among various government departments and among all stakeholders, public-private partnership, pro-active local government, and enthusiasm among the target group (like association), etc. are necessary. The impact of the recommendations was high in employment generation and infrastructure development.

The infiltration and immigration problem is one of the major issues that causes a significant threat to society's socio-economic, cultural, and political aspects. The project could also be expected to bring development to the area by creating an environment of the market complex, which would be economically beneficial to the people of the area.

The government had identified setting up of entry and exit points at four locations in West Garo Hills district Medhipara, Abhirampara, Phulbari Ghat, and Singimari Trijunction. The amount for land compensation had been released to the Deputy Commissioner, and the land acquisition process was in progress ^[297, 298].



Study Title

Social Impact Assessment on Land Acquisition for Construction of Integrated Facilitation Center – Entry and Exit Points in Medhipara, West Garo Hills District

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

To check the entry of people into the State and facilitate legal flow of people, goods, and vehicles into the State

Study Recommendation

- Early implementation of the proposed construction should be executed, and the local people should not face any insecurity and hardship when using this point
- Provide identity cards or keep a register of locals to avoid overchecking and difficulty in passing through these points. Reduce restriction on regular users, especially farmers. The employment of local people should be a priority for unskilled or clerical jobs. The use of locals to check the entry and exit of people would be best as the locals can identify unwanted elements
- Collaboration between Meghalaya and Assam governments is required to improve the accessibility to basic amenities
- The practice of accountability and transparency should be encouraged for functionaries taking charge of the Entry and Exit Points cum Facilitation Centre
- Proper maintenance of the entry and exit points to prevent any unforeseen problems
- The land ownership statement provided by Garo Hills Autonomous District Council (GHADC) has certain mistakes regarding property owners of some landowners, which need to be ratified
- The landowners should be compensated for their movable and immovable assets. The land patta in question is to be reviewed and scrutinized

Analysis and Outcome

The Meghalaya Institute of Governance carried out this study. The perspective survey indicated that the recommendations of this study had not been implemented because of some administrative issues. For better implementation, better coordination among various government departments and among all stakeholders, public-private partnership, pro-active local government, and enthusiasm among the target group (like association), etc. are necessary.

The infiltration and immigration problem is one major issue that causes a significant threat to society's socio-economic, cultural, and political aspects. The project could also be expected to bring development to the area by creating an environment of the market complex, which would be economically beneficial to the people of the area.

The government had identified setting up of entry and exit points at four locations in West Garo Hills district Medhipara, Abhirampara, Phulbari Ghat, and Singimari Trijunction. The amount for land compensation had been released to the Deputy Commissioner, and the land acquisition process was in progress ^[297, 298].

Study Title

Social Impact Assessment Report on the Construction of Integrated Facilitation Centre - Entry and Exit Point at Tangaon, West Garo Hills District, Meghalaya

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

The objective of this project is to check the entry of people into the state and to facilitate legal flow of people, goods and vehicles into the State.

Study Recommendation

- In order to address the needs of the people, early implementation of the proposed construction should be executed at the earliest. However, the local people should not face any kind of insecurity and hardship when using this point.
- After the completion of the proposed project, the majority of the respondents felt that the project would have a better impact on the village in terms of community way of living and safety.
- Practice of accountability and transparency should be encouraged for functionaries who will be taking charge of the entry and exit points cum Facilitation Centre.

Analysis and Outcome

The Meghalaya Institute of Governance had carried out this project. The main aim of this project was to check the entry of people into the State and facilitate the legal flow of people, goods, and vehicles into the State. The proposed project would have minimal effect on the community. Setting up the Facilitation Centre within Tangaon village would bring the people a sense of security and well-being. The people saw this Facilitation Centre as an initiative to regulate the flow of goods and people and also an initiative to address immigration, land encroachment, and bring about development in terms of the market. This project was viewed to strengthen trade between the two states, boost the economy, and expand economic opportunities in the surrounding communities.

The Project Investigator's response indicated that the study's recommendations have yet to be adopted because the project's location has been shifted.

If implemented, this project has a high impact in the sectors of employment generation, infrastructure development (e.g., road/communication), etc. For better implementation, better coordination among various government departments, effective coordination among all stakeholders, public-private partnership, pro-active local government, and enthusiasm from the target group (like association) are required.



Study Title

Social Impact Assessment Study for Setting up of Facilitation Centre – Entry and Exit Point in Lakasein Village, East Jaintia Hills district

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

- To carry out baseline survey from the project site.
- To bring out the likely impact from the proposed project.
- To draw out preventive measures to address the likely impacts from the project.

Study Recommendation

- Practice of accountability and transparency should be encouraged for functionaries who will be taking charge of the Entry and Exit Points cum Facilitation Centre.
- Employment opportunities should be given to the local people during the construction phase and operational phase.
- Steps should be taken to address the community safety during the construction phase, especially where boulder and stone needs to be properly disposed of so that accident does not occur in the area.
- Local people should be exempt from paying any fee except in certain cases as deem fit by the functionaries and legal laws.
- A fee that has been already paid should be monitored and restricted.

Analysis and Outcome

The Meghalaya Institute of Governance had carried out this Social Impact Assessment Study to set up Facilitation Centre – Entry and Exit point at Lakasein Village, East Jaintia Hills district. The objective of this study was to identify the likely impacts, which may result from the proposed project. The structural assessment showed that no individual household would be affected by the proposed project at entry and exit points. People felt it would reduce illegal activities and make the surrounding area safer for the local people. It reduced illegal activities such as blast fishing and illegal transportation of natural resources like trees from Meghalaya to Assam.

The Project Investigator's response indicates that the study's recommendations have not been implemented because of some administrative issues. Better coordination among various government departments; effective coordination among all stakeholders; public-private partnership; proactive local government; enthusiasm from the target group (like association); more engagement of social institutions (such as NGOs, SHGs); and transparency are requirements for successful project implementation.

Study Title

Social Impact Assessment Study for Setting up of Facilitation Centre – Entry and Exit Point in Malidor Village, East Jaintia Hills District

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

- To carry out baseline survey from the project site.
- To bring out the likely impacts from the proposed project.
- To draw out preventive measures to address the likely impacts from the project.

Study Recommendation

- In order to address the need of the people, early implementation of the proposed construction should be executed at the earliest. However, the local people should not face any kind of insecurity and hardship when using this point.
- After the completion of the proposed project, majority of the respondents felt that the project will have a better impact on the village in terms of community way of living and safety. This proposed construction may start a long overdue dialogue between the governments of Assam and Meghalaya to address the border issues.

Analysis and Outcome

The Meghalaya Institute of Governance had carried out Social Impact Assessment Study to set up Integrated Facilitation Centre – Entry and Exit in Malidor village, East Jaintia Hills district.

The proposed project did not affect community safety; rather it would improve and strengthen the safety level of the people. The Project Investigator's response indicates that the study's recommendations have not been implemented because of some administrative problems. Better collaboration among various government departments, effective coordination among all stakeholders, public-private partnerships, proactive local government, enthusiasm from the target group (like association), and more engagement of social institutions (such as NGOs, SHGs) are requirements for successful project implementation.

If implemented, this project has a high impact on employment generation, infrastructure development (e.g., road/communication), etc.

The State Government had entrusted the Meghalaya Institute of Governance with carrying out social impact assessment at 14 locations, including five in the Garo hills, for setting up of entry and exit points. Mr Mukul Sangma, the then Chief Minister of Meghalaya said that the SIA study at Malidor in East Jaintia hills district had been completed ^[299].



Study Title

Social Impact Assessment on Land Acquisition for Construction of Integrated Facilitation Centre – Entry and Exit Point in Phulbari Ghat, West Garo Hills District

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

- To carry out baseline survey of the project site.
- To bring out likely impact from the proposed project and to draw out preventive measure for the likely impact.

Study Recommendation

- Implementation of the proposed construction should be executed at the earliest. Proper maintenance of the entry and exit point.
- Facilitation Centre should provide identity cards or keep a register of locals to avoid over checking and difficulty in passing through these points. Restriction on regular users, especially farmers should be made minimal.
- Use of locals to check the entry and exit of people would be best as the locals themselves can identify unwanted elements. Collaboration between the Meghalaya and Assam Government is required to improve the accessibility to basic amenities.
- Practice of accountability and transparency should be encouraged for functionaries who will be taking charge of the Entry and Exit Points cum Facilitation Centre.
- The development of the river port is very important because it is the only way to develop the waterways between the two states. There is scope for promoting tourism, which can further boost the economy.

Analysis and Outcome

The Meghalaya Institute of Governance had carried out a Social Impact Assessment Study to set up Integrated Facilitation Centre – Entry and Exit point at Phulbari Village. The proposed project had a marginally high effect on the community as a whole. Setting up the Facilitation Centre within Phulbari Ghat would bring a sense of security and well-being to the people and develop the Riverport. The people saw this Facilitation Centre as an initiative to regulate the flow of goods and people and as an initiative to address immigration and land encroachment and bring about development in terms of the market.

The Project Investigator's response indicates that the study's recommendations have not been implemented because of some administrative problems. Better collaboration among various government departments, effective coordination among all stakeholders, public-private partnerships, proactive local government, and enthusiasm from the target group (like association) are requirements for successful project implementation.

If implemented, this project has a high impact in the sectors of employment generation, infrastructure development (e.g., road/communication), etc.

Study Title

Social Impact Assessment Study for Setting up of Facilitation Centre – Entry and Exit Point in Mooriap Village, East Jaintia Hills District

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

To carry out baseline survey of the project site, to bring out likely impact from the proposed project and to draw out preventive measure for the likely impact.

Study Recommendation

- Implementation of the proposed construction should be executed at the earliest. Facilitation Centre provides identity cards or keeps a register of locals to avoid over checking and difficulty in passing through these points.
- Reduction of restriction on regular users, especially farmers. Employment of local people should be a priority for unskilled or clerical jobs. Collaboration between the Meghalaya and Assam Government is required to improve the accessibility to basic amenities in these border areas.
- Practice of accountability and transparency should be encouraged for functionaries who will be taking charge of the Entry and Exit Points-cum-Facilitation Centre.
- Steps should be taken to address the community safety during the construction phase, especially where boulder and stone needs to be properly disposed of so that accident does not occur in the area.
- Local people should be exempt from paying any fee except in certain cases as deem fit by the functionaries and legal laws.

Analysis and Outcome

The Meghalaya Institute of Governance had carried out a social impact assessment study to set up Integrated Facilitation Centre – Entry and Exit point at Mooriap Village, East Jaintia Hills District.

The proposed project had a marginally high effect on the community as a whole. Setting up the Facilitation Centre within Mooriap Village would bring a sense of security and well-being to the people. The proposed project would reduce illegal activities within the area and make the surrounding area safer for the local people, prevent the disturbance from militant groups who reside within the Assam border and reduce the illegal transportation of natural resources such as trees from Meghalaya to Assam.

The Project Investigator's response indicates that the study's recommendations have not been implemented because of some administrative problems. Better coordination among various government departments; effective coordination among all stakeholders; public-private partnership; pro-active local government; enthusiasm from the target group (like association); and more engagement of social institutions (like NGO, SHGs) are requirements for successful project implementation. If implemented, this project has a high impact on employment generation, infrastructure development (e.g., road/communication), etc.



Study Title

Semi-annual Social Safeguard Monitoring Report (Shillong)

Implementing Institution

State Investment Program Management and Implementation Unit (SIPMIU)

Project Location/Completion Year

Meghalaya, 2014

Objective

To improve the urban environment and promote reforms for sustainable, efficient, and responsive urban service delivery.

Study Recommendation

Urban infrastructure provision, supplementing financial resources and technical capacity and meeting the unmet urban public health and sanitation needs.

Analysis and Outcome

The Executing Agency for this programme was the Urban Development Department, Government of Meghalaya, and the Implementing Agency was the State-level Investment Programme Management and Implementation Unit. The various Programme components were Water supply, Sewerage and sanitation, and Solid Waste Management (SWM) infrastructure. The sub-project components taken up under Tranche 1 in Shillong Municipal Corporation were: (i) Development of short-term landfill site and associated works; (2) Construction of garage cum workshop shed and staff restroom at the old landfill site at Marten, Mawiong; (3) Procurement of primary, secondary collection vehicles, and workshop machinery; (4) Procurement of different types of bins and personal protective equipment, respectively.

This project was already implemented. A sanitary landfill for disposing of inert waste was already inaugurated at the dumping ground in Mawlai ^[300].

The SWM sub-project in Shillong had not created any significant negative impact on the community. The sub-project work was carried out in government land, so there were no resettlement or rehabilitation issues. There was no negative impact on vulnerable groups and no issue related to indigenous people during execution. Adequate provision had been made in the bid documents for labour laws, occupational health and safety, and child labour. Locality level awareness training activities were also carried out from July to December 2016, including those carried out since 2013.

Study Title

Evaluation Study on Pradhan Mantri Gram Sadak Yojana in Meghalaya State

Implementing Institution

DJ Research and Consultancy Pvt. Ltd.

Project Location/Completion Year

Meghalaya, 2012

Objective

To assess Pradhan Mantri Gram Sadak Yojana (PMGSY) intervention made in the state of Meghalaya covering all the seven districts, indicating physical achievements, socio-economic impacts and constraints that need to be removed or acceleration and quality improvement in the coming years.

Study Recommendation

- All the gravel roads be converted into black topping in different phases.
- Integrated approach to road planning: market infrastructure and roads be built simultaneously.
- Region-specific population criterion should be considered.
- Recruitment of technical personnel.
- The cost norms for hilly areas such as in almost all the districts of Meghalaya must change with realistic assessment of cost for quality roads.
- Connect roads with public transport.
- Awareness programme of the PMGSY scheme.
- Convergence of PMGSY with other development programmes such as MNREGS, etc.

Analysis and Outcome

This study was conducted by DJ Research & Consultancy Pvt. Ltd. to evaluate the scheme Pradhan Mantri Gram Sadak Yojana (PMGSY) in Meghalaya State. Four blocks each from East Khasi Hills and West Garo Hills districts, three blocks each from East Garo Hills, West Khasi Hills, and Jaintia Hills districts, two blocks from South Garo Hills and Ri-Bhoi districts were selected for sample survey by simple Random Sampling Method.

The Government of Meghalaya was taking steps to convert the roads into blacktopping roads. To reduce distance from the main road from 1.5 km to 1 km in all hilly places of Meghalaya, ensuring more habitations coverage, the State Government took this matter up with the Ministry of Rural Development, Government of India.

The implementation status of the project is not known. Some of the constraints in the implementation of PMGSY are due to hilly territory that makes tasks time-taking and difficult. Land acquisition, shortage of technical staff, and rainy seasons add to the woes of implementing agencies.

According to the website of the Public Works Department, Govt. of Meghalaya, during the year 2013–14, upgradation of 105 km of existing State Highways & Major District Roads, conversion of 919.20 running metre of SPT bridges into RCC bridges, improvement of 139 km of critical feeder roads & missing gaps, and 5 numbers of parking bays have been approved by the Planning Commission for taking up under Special Plan Assistance. Till March 2016, the physical progress is 76% ^[301].



Study Title

Draft Environment Impact Assessment of Rehabilitation and Upgradation of Existing 2 Lane to 2 Lane with Paved Shoulder from Jowai (km 69.2) to Meghalaya/Assam Border (km 173.20) Section of NH-44 in the State of Meghalaya under NHDP Phase-III Programme

Implementing Institution

Intercontinental Consultants and Technocrats Pvt. Ltd

Project Location/Completion Year

Meghalaya, 2012

Objective

The main objective of the Environmental Assessment is to improve decision-making and to ensure that the highway improvement options under considerations are environmentally sound and sustainable.

Study Recommendation

- Protection of people by regulating traffic flow, using signages, etc.
- Compensatory afforestation of trees, which are going to be felled.
- Stringent Pollution Control Measures during construction activities, which are responsible for pollution.
- Enhancing community properties such as water resources, religious structures, etc.
- By providing proper sanitation at construction/labour camp and improving traffic flow conditions.
- Safety measures for the workers at construction sites.
- Awareness about the environment and its management.

Analysis and Outcome

The National Highway Authority of India (NHAI) was entrusted with implementing this project, and the environmental impact assessment study was awarded to Intercontinental Consultants and Technocrats Pvt. Ltd. Mitigation measures for the environmental concerns raised (protection of people, afforestation of trees, air pollution, enhancing community properties, etc.) were given in this study.

The recommendation of the environmental impact assessment study was fully implemented, and the work is under process. Improvement of NH-44 from Jowai to Ratacherra (length 104 km) in Meghalaya to two-lane with the paved shoulder is in progress by NHAI ^[302].

Based on baseline information collected during Environment Survey, the mitigation measures were taken care of. The adverse impact of the project would be reduced considerably if the EMP were fully implemented. The impact of road improvement on the socio-economic environment will be significantly beneficial, as it is likely to stimulate the economic growth of the area. The specific benefits of the road improvement will include a reduction in travel time, travel cost, and drop in the time to bring the agricultural goods to the markets.

Study Title

Draft Environmental Impact Assessment for Captive Biomedical Wastes Treatment Facility

Implementing Institution

Centre for Environment Protection (CEP)

Project Location/Completion Year

Mizoram, 2020

Objective

- Identifying probable environmental impacts due to the proposed project and suggesting appropriate mitigation measures.
- Preparation of Environmental Management Plan (EMP).
- Development of post project environmental monitoring programme.

Study Recommendation

- The EMP is a site-specific plan developed to ensure that the project is implemented in an environmentally sustainable manner where all stakeholders including the project proponents, subcontractors, and the consultants, understand the potential environmental risks arising from the proposed project and take appropriate actions to properly manage that risk.
- Adequate environmental management measures need to be incorporated during the entire planning, installation and operating stages of the project to minimize any adverse environmental impact and assure sustainable development of the area.

Analysis and Outcome

The Zotres Hospitals Pvt. Ltd. was the nodal agency for the preparation and implementation of the project. This study was awarded to the Centre for Environment Protection (CEP). The report was prepared in compliance with the Terms of reference (ToR) formulated by the State Expert Appraisal Committee (SEAC), Mizoram. The Scope of the study was to carry out the Environmental Impact Assessment studies to identify, predict, and evaluate the potential environmental impacts resulting from the proposed captive biomedical wastes treatment facility and develop a suitable EMP to mitigate the undesirable effects.

The recommendation of the environmental impact assessment study was fully implemented. The proposed Captive Biomedical Wastes Treatment Facility at Trinity Hospital, Silaimual, Melthum, Aizawl, Mizoram would get a cleaner and healthier environment. Organized methods for biomedical wastes treatment, i.e., incineration, autoclaving, shredding, and ETP were adopted. A complete biomedical waste disposal solution using the best technology methods was provided. In addition to revenue to the state by taxes, it would provide direct and indirect employment to local people.



Study Title

Detailed Project Report for Construction of 2-lane Highway NH-717-A (From Ranipool to Pakyong) in East Sikkim

Implementing Institution

CM Engineering & Solution

Project Location/Completion Year

Sikkim, 2018

Objective

- The stretches of the road under this report is between 00/00 km to 19/100 km of NH 717(A) as per existing chainage required for upgradation and improvement to 2-lane standard.
- Improve 19.10 km stretch of existing road to standard 2-lanes. Realignment of roads in some stretches, and improve some existing stretches to conform to National Highway Specification in respect of its gradient, curves, super elevations, etc.
- Widening to 2-lane with geometric improvement and re-alignment of NH-717 (A) passes through steep terrain, gorges, nallah, and other natural features.
- Built retaining walls, breast walls, culverts, and other structures.

Study Recommendation

There is no specific recommendation mentioned in this report.

However, the following points culled out from the report:

- Upgradation of the existing road, having formation width of about 6.50 m, to a formation width of 12.0 m.
- Construction of pavement work for the entire length.
- Culverts and permanent works at essential places.
- Widening and improvement of blind curve portion.
- Realignments at the portions where steep gradients have to be avoided.
- Construction of pucca side drains at needy stretches.
- Installation of traffic/informatory sign and kilometre.

Analysis and Outcome

The Roads & Bridges Department, Govt. of Sikkim, on behalf of the Ministry of Road Transport and Highways, Govt. of India has prioritized taking up for upgradation and improving NH 717-A from km 0/00 to km 19/100 to 2-lane in Sikkim. The preparation of a detailed project report was awarded to CM Engineering & Solution.

The proposed project was intended to widen the road to 2-lane, re-alignment, and geometric improvement of NH 717 (A). This road connects Capital City Gangtok to Paykong Airport & Sub-Division Head Quarters of the East District. The area is mountainous and steep. It was a single-lane road with a formation width of about 6.5 m without conforming to any standard/specification.

The project was proposed for commencement during 2017-18, with target completion by the year-end of 2021-2022. This project is under implementation stage. As per the news published by Voice of Sikkim the Ranipul to Pakyong highway NH 717-A of length 16.539 km 2-lane with paved shoulder is under construction. After completion, this highway would serve as an important link to Pakyong Airport, Nathula border ^[303].

Study Title

A Report on Site-specific Study of Proposed Pakyong Airport Area, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2014

Objective

The objective of the work is to study the dynamic behaviour and probable causes of the slope instability and conduct site-specific geotechnical evaluation and assessment of the affected slope.

Study Recommendation

In artificially cut-slope and fill areas, design must consider measures that will prevent immediate and sudden failure as well as protect the slope and fill over the long term. The airport area comprises mainly of western cut-slope and eastern filled areas, whose stability is an important long-term measure.

Analysis and Outcome

The Geological Survey of India conducted this study as a part of the construction of Pakyong Airport, Sikkim. The proposed project area falls in the medium hazard zone. As per the study, the Airport area was showing Low to Moderate Peak frequency values. High vulnerability indices were associated with the central portion of the Airport area, north of the Airport area, and many other sites. Detailed mapping at the airport area showed a number of ground cracks at the western upslope part of the area, which extends beyond the mapping area. Overburden slope stability analysis indicated factors of safety ranging from 0.58 to 0.98, with the lowest stability at the centre portion of the airport. Slope Mass Rating study on the exposed rock units indicated partial stability of the rock slope with the probability of planer and wedge failures ^[304].

This project had been completed and had implemented the recommendations. This Airport was inaugurated on September 24, 2018 by India's Prime Minister Shri Narendra Modi ^[305].

Even though the project is useful for the development of the state, especially for tourism business, there are reports of cries and woes from the local people, like changed geography, non-payment of compensation, lost means of livelihood, etc. ^[306].



Study Title

Slum Free City Plan of Action for Gangtok

Implementing Institution

Urban Development & Housing Department,
Gangtok, Government of Sikkim

Project Location/Completion Year

Sikkim, 2013

Objective

- Bringing all notified slums vide Sikkim gazette notification No. 394/GOS/UD&HD/5(8)97-98 part II dated 17.06.03 and notification No. 733/UD&HD/1(284)044 dated 23.08.04 and slum like situation within the formal system and enabling the slum dwellers to avail the same level of basic amenities and services as the rest of the places.
- Rectification of the failure of the system that lie behind the creation of slums and slum-like situation.
- Tackling the shortages of the government land and housing in the urban and semi-urban areas that keep the shelter out of reach of the urban poor and force them to inhabit in deplorable situation in a bid to retain sources of livelihood and employment.

Study Recommendation

- A new Planning or Development Authority under the control of UD & H Deptt., may be formed as an Autonomous Body with necessary powers to assist the State Govt. in development of the Greater Gangtok Area. UD & H Deptt., Govt. of Sikkim will act as a facilitator as per the National Housing Policy.
- Devolution of Power & assigning prescribed Roles & Responsibilities as per 74th Constitutional Amendment to the Gangtok Municipal Corporation.
- State Urban Development Agency (SUDA) to be properly structured for taking up the responsibility of Slum Improvement & Relocation works in Gangtok through various implementing agencies. Along with this, Sikkim Housing Development Board (SHDB) may be considered to be revived for undertaking formal layout-based housing project.
- Land Assembly Cell should be established to address and coordinate the data bank for land and land assembly for development.
- A regional study should be done at macro level with the Central Water Commission and other appropriate organizations for assessing the Regional Vulnerability and understand the extent of carrying capacity of city of Gangtok, since Gangtok falls under Seismic Zone-IV.

Analysis and Outcome

This project was funded by the Ministry of Housing & Urban Poverty Alleviation, Government of India, and implemented by HUDCO. Slum Free India is a mandate of the Government of India. Slum Free City Plan of Action of every city is a step towards a slum-free India.

This Plan envisioned the development of a Slum Free Gangtok using a universal entitlements framework with a futuristic vision. The Plan aimed to make Gangtok an inclusive city where all people, especially the poor, had access to an equal and comprehensive set of services that were also socially and environmentally sustainable. It should recognize that all people, women and men, especially the poorest, excluded, and most vulnerable groups, have the right to a decent house, livelihoods, services, and resources, without discrimination based on religion, caste, ownership of land, formal identity or formal livelihoods.

The recommendations mentioned in this study are not yet implemented due to financial constraints. The SFCPoA was prepared under Rajiv Awas Yojana, a centrally sponsored scheme that has been subsumed by PMAY-Urban with In-Situ Slum Rehabilitation using land as a resource.

For better implementation, a public-private partnership and more engagement of social institutions (like NGOs, SHGs) are required.



Study Title

A Socio-economic Survey of Cities and Towns of Tripura

Implementing Institution

Seri Infrastructure Finance Limited

Project Location/Completion Year

Tripura, 2019

Objective

To identify the needs of citizens for infrastructural improvement of basic amenities.

Study Recommendation

Scope for further developmental initiatives of each urban area surveyed include water supply, drainage, the introduction of transportation based on cleaner fuels, besides construction of parks and playgrounds

Analysis and Outcome

This project was funded by Tripura Urban Planning & Development Authority and implemented by Seri Infrastructure Finance Limited. This survey attempted to obtain a detailed understanding of the ground-level realities of 20 important cities and towns of Tripura in line with the goals of Atal Mission for Rejuvenation and Urban Transformation (AMRUT) pertaining to urban amenities and infrastructure. Some important areas that needed further development initiatives include water supply, drainage, the introduction of transportation based on cleaner fuels, besides the construction of parks and playgrounds.

We may assume that the recommendations are met. Providing quality water supply and proper sanitation system to the community was the priority sector of the Government. According to the Economic Survey of Tripura 2019–20, safe drinking water and safe sanitation had been provided to all by 2020 ^[307]. The percentage of the population using basic sanitation services increased from 86 (Census 2011) to 100 by 2020. The report mentioned that all urban areas would be made inclusive, safe, resilient, and sustainable by providing 100% urban population access to the efficient pollution-free transport system, proper sewerage, stormwater drainage, underground electric lines, and internet connectivity. The North Eastern Region District SDG Index Report and Dashboard 2021–22 ranked East Sikkim, Gomati, and North Tripura as the top three out of 103 districts in eight states on socio-economic and environmental parameters ^[308].

Study Title

Consultancy Services for Construction Supervision of Improvement and Upgradation of Road Section of Udaipur to Melaghar (TR02) (Tranche-2 Road in the State of Tripura) Under North Eastern State Roads Investment Program-Semi-Annual Environmental Monitoring

Implementing Institution

Public Works Department, Government of Tripura

Project Location/Completion Year

Tripura, 2019

Objective

- Improve about 430 km of priority road sections under Tranche-1 & Tranche-2 in six states in the North Eastern Region (NER) of India
- Provide capacity building support to the executing agency of NESRIP, i.e., The Ministry of Development of North Eastern Region (MDoNER), implementing agencies (IAs) (The State Public Works Department (PWD) or its equivalent) in each participant state.

Study Recommendation

- Implementation of environmental mitigation measures provided in civil work contract; including areas like personnel safety equipment use by workers, safety provisions for traffic, debris/construction waste disposal, camp site management, etc.
- NOC for the batching plant.
- Take necessary corrective measures as suggested for the pending issues identified earlier.

Analysis and Outcome

Asian Development Bank had funded this project. This report presented the status of environmental compliance of the project for the period from January 2019 to June 2019. The scope of this report was to assess the compliance status on different environmental safeguards as per loan agreement during construction, where works were in progress. During the period between January 2019 and June 2019, no significant non-compliance had been observed regarding the Environmental Safeguards except for the absence of NOC for Batching plants established at km 5.900. All environment safeguard requirements were implemented in accordance with relevant policies and regulations of the Government of India, State Government of Tripura, and the ADB Safeguard Policy Statement, 2009 (SPS). The compliance with the mitigation measures stipulated in the EMP was constantly monitored in the project, and necessary corrective actions were taken at the site from time to time as required.



Study Title

Semi-annual Social Safeguard Monitoring Report (Agartala)

Implementing Institution

State Investment Program Management and Implementation Unit (SIPMIU)

Project Location/Completion Year

Tripura, 2019

Objective

To improve the urban environment and promote reforms for sustainable, efficient, and responsive urban service delivery

Study Recommendation

No specific recommendations are mentioned in this report.

Analysis and Outcome

In Agartala, the Executing Agency (EA) for the programme is the Urban Development Department (UDD) of the Government of Tripura; and the Implementing Agency is the State-level Investment Program Management and Implementation Unit (SIPMIU).

No specific recommendations are mentioned in this report.

As per the report, the subproject work was carried out in government land, so there were no resettlement or rehabilitation issues. There was no negative impact on vulnerable groups. During project execution, there was no issue related to indigenous people.

Study Title

Geotechnical Investigation Work for Agartala Smart City Project, Tripura

Implementing Institution

TATA Consulting Engineers Limited

Project Location/Completion Year

Tripura, 2018

Objective

To know engineering properties of subsoil required to meet design and construction requirements of Infrastructure.

Study Recommendation

Safe bearing capacity for open foundations, pile capacity for deep foundations, and CBR values for roads.

Analysis and Outcome

Tata Consulting Engineers Limited was the Project Management Consultant to design, develop certain parts of Agartala, the capital city of Tripura, under Area-based Development, and C E Testing Company Pvt. Ltd., Kolkata as their Geotechnical Consultant. This study was a part of the whole project and deals with soil investigation for Highrise Building for Slum Dwellers at Akhaura. This report presented the bore logs, soil profile, laboratory, and field test results. The most suitable type of foundation suggested was based on field tests and laboratory test results and their analysis. Due to very poor subsoil conditions, the open foundation was not used, and a deep foundation in a pile was recommended for the proposed structure. Bored cast-in-situ piles were preferred due to the availability of construction agencies, ease of construction, and low level of noise pollution. It was seen that the values were within permissible limits (as per IS 456), so no special cement was required for foundation concrete. Either Ordinary Portland Cement or Portland slag cement, or Portland Pozzolana cement might be used for the purpose.

The recommendations of the project were fully implemented. This was a high-impact study for infrastructure development.



Study Title

North-Eastern Region Capital Cities Development Investment Program - Agartala Water Supply (Tr-2)

Implementing Institution

State Investment Program Management and Implementation Unit (SIPMIU), Urban Development Department, Govt. of Tripura

Project Location/Completion Year

Tripura, 2011

Objective

The objective is to apprise the stakeholders about the programme's environmental and social impacts and present safeguards to mitigate any potential significant impacts.

Study Recommendation

- The subproject is unlikely to cause significant adverse impacts. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures.
- Based on the findings of the IEE, the classification of the Project as Category "B" is confirmed, and no further special study or detailed EIA needs to be undertaken to comply with ADB SPS (2009) or GoI EIA Notification (2006).

Analysis and Outcome

Implementing Agency of this project was the State Investment Program Management and Implementation Unit (SIPMIU), Urban Development Department, Govt. of Tripura.

The Programme assisted the North-Eastern states in achieving improved environment and well-being of urban residents in Agartala, Aizawl, Gangtok, Kohima, and Shillong. Tranche 2 of the programme continued to support the physical improvement of urban infrastructure in water supply systems, sewerage and sanitation systems, and solid waste management in these cities. Tranche 2 also supported the programme cities to achieve improved urban governance and financing, municipal financial reform, improved service delivery, and improved capacity to manage the Investment Program in Aizawl, Gangtok, and Kohima^[309].

The project is completed and has implemented the recommendations fully.

Study Title

Semi Annual Environment & Social Safeguard Monitoring Report

Implementing Institution

Power Grid Corporation of India Ltd.
(Environment and Social Management
Department)

Project Location/Completion Year

More than one state, 2019

Objective

To create a robust power network by improving the intra-state transmission and distribution (33 kV and above) network with required capacity building initiatives for effective utilization of assets.

Study Recommendation

The state governments are being persuaded for enhancing the compensation as per MoP guidelines on RoW compensation. Besides, direct or indirect benefits of the subprojects like the employment opportunity, improved & uninterrupted power supply, improvement in infrastructure facilities, improved commercial/economic activities will not only ensure the overall development of the project area but will also outweigh any leftover negative impacts (though unlikely) of the project.

Analysis and Outcome

Power Grid Corporation of India Ltd conducted this study. The project implementation approach in close coordination with the respective State Utilities involving the selection of optimum route before design stage, proper implementation of EMP, and monitoring mechanism throughout project life cycle supported by solid institutional arrangement had considerably nullified the adverse impacts arising out of project activities. All efforts had been made to minimize the social impacts associated with the project. The endeavour to reduce the social impacts started right from the selection of land for the proposed substations. Of the total 254.529 acres of land required for the proposed 129 substations, 120.619 acres of land were encroachment-free. Government land had no Project Affected Persons (PAPs) and was handed over to POWERGRID by State Utilities without creating any adverse social issues. The balance 133.91 acres of private land required for 44 nos. of substations was secured either through donation or purchased through willing buyer- willing seller basis on negotiated rate without invoking land acquisition act. POWERGRID has already started paying land compensation for tower footing and RoW Corridor. Direct or indirect benefits of the subprojects like the employment opportunity, improved and uninterrupted power supply, improvement in infrastructure facilities, improved commercial/economic activities ensured the overall development of the project area but also outweighed any leftover negative impacts (though unlikely) of the project. All possible measures had already been taken and not only towards mitigation of adverse environmental and social impacts.



Study Title

Study of Infrastructure Based on Act East Policy Connectivity, Marketing Shed, Electrification etc. for NER States

Implementing Institution

Mott MacDonald Private Limited

Project Location/Completion Year

More than one state, 2018

Objective

- To study and assess the existing infrastructure based on the Look/Act East Policy.
- To identify infrastructural gaps in the region regarding: Connectivity, Social Infrastructure Study and assess market infrastructure in the region (existing infrastructure at Border Haat (LCS/ICP)).
- To examine trade opportunities arising due to Act East Policy.
- Identification of internal trade routes, which have a potential to enhance accessibility to sub-regional markets for boosting bilateral trade.
- To explore the possibility of establishing robust linkages with neighbouring countries.
- Study North Eastern Region's competitive advantage vis-a-vis ASEAN/BIMSTEC countries.
- To prepare a perspective plan to bridge infrastructural gaps identified in the study.

Study Recommendation

- Fifty per cent subsidy on branding, labelling, packaging and measures taken to increase shelf-life in food processing sector.
- States making efforts to improve EODB and improving their ranks may be incentivized with enterprise resource centre (Nodal body for facilitating start up business).
- Subsidy for bandwidth acquisition up to 80% of cost of acquisition of frequency in the North East.
- Plug and play scheme for setting up BPOsliT enabled in the North East.
- Support for vocational colleges in PPP mode for upgrading traditional skills.
- Subsidy for tourism ventures for resort, home stay as central share with matching state share.
- IT-based platform to provide support to people-to-people network for stakeholder interface.

Analysis and Outcome

Mott MacDonald Private Limited had carried out this study. The need for this study stems from the developmental needs of North Eastern Region, which was crucial pre-requisite for the successful implementation "Act East" Policy. The "Act East" Policy highlights North East as an integral part of India's foreign policy and accords this region as the main beneficiary and primary actor in our foreign policy concerning South East and East Asian countries.

The recommendations mentioned in this study were partially implemented. Some of the connectivity initiatives were mentioned hereunder.

To improve connectivity, India's Vision 2020 initiative has undertaken three key projects in the Northeast: the Kaladan Multimodal project; building India-Myanmar rail links; and the Trilateral Highway project between India, Thailand, and Myanmar. However, despite many policy initiatives, optimum utilization of the northeast as a hub of regional connectivity is yet to be achieved. Greater digital connectivity, via Bangladesh's Cox's Bazaar to India's Northeast, has strengthened bilateral initiatives to foster infrastructural development ^[310].

Study Title

A Study on Road Infrastructure Project in North East Indian Borderland

Implementing Institution

Jawaharlal Nehru University

Project Location/Completion Year

More than one state, 2018

Objective

To understand the objective and implications of the connectivity infrastructure project in the Northeastern region under India's Act East Policy with special emphasis on road building projects.

Study Recommendation

- Increasing the length of the roads (National Highways, State Highways, Rural and Urban roads, Border roads) and bridges across the region extending up to the bordering areas will reduce the distance and creating the possibilities for economic materiality.
- Creating infrastructure networks, which has the potential to rescue millions out of poverty, and a sound synergy can make such strategy a success.

Analysis and Outcome

This study was conducted by Special Centre for the Study of North East India, Jawaharlal Nehru University. This study looked into the changing socio-economic scenario of the region and its implications on people's lives and their traditional activities.

Increasing the length of the roads (National Highways, State Highways, Rural and Urban roads, Border roads) and bridges across the region extending up to the bordering areas quickly reduces the distance and creates the possibilities for economic materiality. Infrastructure networks are essential for economic development and are imperative for any nation-state to create global value chains and industrial networks. Green infrastructure is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. Such a concept needs to play a vital role in achieving India's policy objectives of transforming the geography of the Northeast in the long run.



Study Title

Preparatory Study for North East Road Network Connectivity Improvement Project (Phase 2)

Implementing Institution

Padeco India Pvt Ltd. (PIPL)

Project Location/Completion Year

More than one state, 2016

Objective

The objectives of the study are to develop a project purpose and outline, project costs, implementation plan, maintenance and operation structures, environmental and social considerations, etc.

Study Recommendation

Transfer technical knowledge of Japan to local parties regarding the operation and maintenance of roads in mountains as mentioned in the study report.

Analysis and Outcome

Japan International Cooperation Agency funded this project. Padeco India Pvt Ltd. (PIPL) and Nippon Engineering Consultants Co. Ltd. had conducted this study. The objective of the Project is to improve the connectivity in and around northeast states in India by strengthening the existing national highway network.

In India, the development of National Highways (NH) in the mainland has progressed while those in NE states have stagnated due to insufficient budget and technical difficulty.

JICA supported improving and constructing prioritized national highways (total 523 km) through the North East Connectivity Improvement Projects (Phase 1 – Phase 3). The phase 1 project is currently being implemented to improve and construct NH51 from Tura to Daru (51.5 km) in Meghalaya state and NH54 from Aizawl to Tuipang (350.7 km) in Mizoram.

This project is under the implementation stage. The Phase 2 project aimed to improve and construct NH40 in Meghalaya and NH54 bypasses in Mizoram, NH40 from Shillong to Dawki (81 km), and a new five bypasses section (21.4 km) are under construction. ^[311, 312]

This road construction is expected to strengthen regional connectivity within North-East states and cross border connectivity between India and Bangladesh while bringing about significant socio-economic impacts in facilitating the movement of people and the flow of goods.

Study Title

Telecom Infrastructure Augmentation in North Eastern States

Implementing Institution

Telecommunications Consultants India Ltd

Project Location/Completion Year

More than one state, 2014

Objective

- Providing 2G coverage to the villages that are uncovered by any Telecom Service Provider (TSP).
- Providing 2G coverage to the uncovered National Highway (NH) network of North East.
- Providing redundancy and diversity for the optical media from State Headquarter to District Headquarter and Inter-State capitals connectivity.

Study Recommendation

- There is a huge recurring investment required to maintain this infrastructure in the form of fibre and equipment maintenance. As the North Eastern Region has tough terrain and currently the tele-density is low, operators do not see a lucrative business model or rate of return in this part of the country because of the gap in huge investment of capital and operational expenses through the revenue earned. Therefore, there is a need to cover operating costs also, this will encourage operators to keep providing services in the North Eastern Region (NER).
- The CAPEX as estimated above for the BTS deployment on uncovered highway may be funded by USOF.
- This will encourage operators to establish infrastructure. As OPEX is also very high in the NER, the same can be factored by taking the net revenue while calculating the subsidy. On an average, OPEX per year is taken as 20% of capex cost. Such cost includes AMC costs, manpower, drive test and optimization, regular site maintenance, diesel cost, etc.
- It is to mention in earlier schemes of USOF, passive sharing of towers is mandated. However, as per current guidelines active sharing of RAN is also allowed and the main advantage of this technology is the reduction in CAPEX and OPEX as both active and passive component is shared by operators.
- The subsidy calculation to fund the gap may consider this technology and mandate the active sharing of RAN.



Analysis and Outcome

Telecommunications Consultants India Ltd. (TCIL) had carried out this project. This report covers 2G coverage to the uncovered National Highway (NH) network and transmission media network gap analysis for providing redundancy and diversity for the optical media from SHQ to SHQ and SHQ to DHQ of North East Region including Sikkim, a total of 8 States. The key findings are the quantity and cost required for upgrading the telecom infrastructure in the NER.

The following news items show that this project is under implementing stage.

- PM Gati Shakti programme would involve sixteen central government agencies, including Railways, Roads and Highways, Petroleum and Gas, Power, Telecom, Shipping, Aviation, and others ^[313].
- In September 2014, the Cabinet had approved a big-ticket telecom connectivity programme 'Comprehensive Telecom Development Plan' for the NER encompassing eight states ^[314].
- The ambitious Comprehensive Telecom Development Plan for the NER, approved in September 2014, aimed to deploy 6673 mobile towers for 8621 identified uncovered villages ^[315].
- Northeast India will witness investment close to Rs 15,000 crore for improving the telecom connectivity in eight states of Northeast India.
- India's frontier state Arunachal Pradesh which shares border with China will get over 2817 mobile towers.
- In the eight states of Northeast India there are 12,017 GPs, out of these 7338 GPs were taken up in Phase I and it is only 2240 GPs that are Service Ready ^[316].

Study Title

Report of Working Group on Improvement and Development of Transport Infrastructure in the North East for the NTDPC

Implementing Institution

National Transport Development Policy Committee (NTDPC)

Project Location/Completion Year

More than one state, 2012

Objective

The objective of the Transportation Development Strategy for the North Eastern Region is to promote and support the balanced and equitable economic development of the region.

Study Recommendation

- North East is a compact region—transport planning has to be done at three levels—intra-regional, with the rest of India and connectivity with the international neighbours and beyond for South Asia, South East Asia, and China.
- Multi-modal transport planning—the North East, for reasons well known is the region with its peculiar characteristics. Therefore, regional solutions for intra-regional movement of goods and passengers, connectivity with the rest of India and international connectivity have to be planned.
- Explore the possibilities to provide at least 3–4 alternate linkages between all the State Capitals (Intra-Region Connectivity) and rest of the country (Inter-Region Connectivity) with National Highway standard road as well as Rail Linkages through multi-utility tunnelling for reducing travelling distances and time.

Analysis and Outcome

This study was implemented by the National Transport Development Policy Committee (NTDPC).

A robust transportation and communication network is a pre-requisite for rapid industrialization and socio-economic development of a region. Development of any one mode of transportation alone is not going to adequately serve the changing economic and political necessity globally. A massive change is happening in the transportation sector in the northeast under the Act East Policy of the government. Some of the changes have become visible, but most of them are yet to become apparent as the scheme of the things are so huge that it would take a few more years to actually materialize.

This project is under the implementation stage. Sagarmala and Bharatmala are the two flagship schemes of the Government of India. Bharatmala is an “umbrella” programme of the Ministry to enhance road connectivity across country while Sagarmala is the government's flagship programme to develop and modernize ports along the coast line. The plan for improving connectivity in the Northeast under Bharatmala includes development of Northeast Economic Corridor connecting state capitals and development of seven waterways terminals on Brahmaputra River [317]. Shri Nitin Gadkari laid the foundation stone of India's first multi-modal logistic park in Assam on October 20, 2020. The Rs 693.97 crore park project provided direct or indirect employment to nearly 20 lakh youth in Assam [318].



Study Title

State-wise Risk Assessment, Infrastructure and Institutional Assessment of Phase IV States (Arunachal Pradesh, Assam, Chhattisgarh, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Sikkim, Tripura, and West Bengal)

Implementing Institution

Risk Modeling and Insurance

Project Location/Completion Year

More than one state, 2012

Objective

- To carry out GIS thematic map based Fire Hazard and Risk analysis through overlaying hazards and quantified risk, and classify the districts as base units into appropriate risk categories such as very high, high, medium, or low.
- To prepare a detailed Investment and Financing Plan for next 10 years for upgradation, expansion and modernization of Fire Services, based on existing situation analysis and risk-based actual requirements.
- To develop an open-source GIS-based software known as a Fire Decision Support System (FDSS) containing administrative boundaries, quantified risk GIS layers and with capability of estimation of financial implications for desired capacity development.
- To prepare an Institutional Assessment and Capacity Building Plan, based on field-data collection, enquiry, spatial analysis and understanding of the availability and gaps in the fire service infrastructure.

Study Recommendation

- The Arunachal Pradesh Fire Service Force lacks firefighting manpower and there are large number of vacancies at all levels in the State in operational Fire Stations, which need to be filled up at the earliest.
- Based on prioritization of Fire Stations, Arunachal Pradesh Fire Service Force needs to add new Fire Stations at a faster pace, as there is a huge gap in rural areas.
- Online Vehicle tracking through GPS and development of a fully computerized response system is another area for improvement.
- Periodic fire drills and fire-inspection of schools, hospitals, shopping complexes, multi-storied buildings, and industrial centres should be taken care by the State fire services.
- The Arunachal State Fire Services should ensure that for operational duty, physically unfit firefighter should not be part of team, and he/she should be allowed to work in the areas, other than fire response.
- The Fire Service Force in the State should have audit by a central authority to ensure good finance mechanism for capital, and O&M expenditures.

Analysis and Outcome

This study was done by Risk Modeling and Insurance (EMSI). The study area for this assignment is the entire fire service area of the country under the Directorate of NDRF & Civil Defence (Fire Cell). The primary objective of this comprehensive study on "Fire Hazard and Risk Analysis in the Country" is to prepare a capital investment and institutional strengthening plan for the accelerated Development of Fire Services in the country. The risk of fire in urban areas has increased over the years, and the rising cost of fire losses would seem to indicate that they are growing at a greater rate than the measures devised to control them. Cities are growing in size and complexity day by day; therefore, they need to be managed more efficiently.

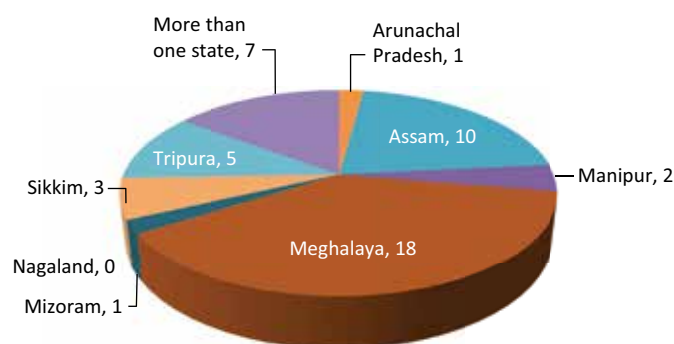
As per the minutes of the 35th meeting of Standing Fire Advisory Council held at The Pride Hotel, Ahmedabad, Gujarat on November 18–19, 2013 (pages 883–911), all the recommendations mentioned in the study were discussed, accepted, and actions taken were recorded in the minutes ^[319].

State-wise Summary

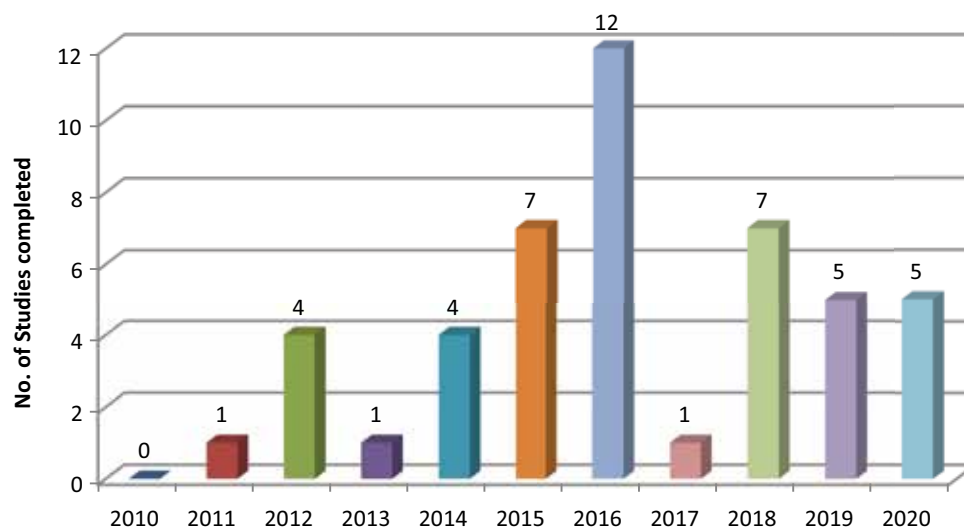
In the present study, over 47 study reports have been collected and analysed. These research studies have been carried out in North Eastern Region by various academic and research institutions on Infrastructure sector.

The state of Meghalaya received the most projects (18), followed by Assam (10), Tripura (5), Sikkim (3), Manipur (2), Arunachal Pradesh (1), and Mizoram (1). Infrastructure development in transportation, housing, and other areas were the focus of this research. In multi-state areas across the northeast, seven projects connected to infrastructure development (roads, telecom, etc.), infrastructure review, and road connection improvement were completed. According to the survey, no such development projects have been carried out in Nagaland in the recent ten years.

The most completed projects (12) were in 2016, followed by seven projects in each of 2015 and 2018, five projects in each of 2019 and 2020, four projects in each of 2012 and 2014, and one project in each of 2011, 2013, and 2017.



Studies completed in Infrastructure Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Infrastructure Sector in NER during 2010 to 2020 (Year-wise)



Arunachal Pradesh

In the present study, one study report on “Environmental Impact Assessment Study for the Proposed Greenfield Airport at Holongi, Itanagar” was collected and analyzed. Arunachal Pradesh is the largest state in the North Eastern Region of India and is without any airport. The state capital of Itanagar is neither connected to other states by air nor by rail. VIMTA Labs Limited did the Environmental impact assessment study for the Greenfield Airport at Holongi, Itanagar. It is essential to have an airport at Itanagar to develop the area. An air link would lead to greater connectivity and ease of accessibility and foster economic activities by encouraging international commerce and tourism. The terminal will be an energy-efficient building with a rainwater harvesting system and a sustainable landscape. On completion, the airport will be able to handle 100 arrivals and 100 departures. With an area of 4100 sq. m, the new domestic terminal building of the Hollongi Airport will be able to handle 200 passengers during peak hours. The airport is planned for operationalization on August 15, 2022. The contractor was from outside and therefore faced problems in managing labourers. Issues like airport security, shifting of HT line (The 132 kv HT line on the eastern side of the airport), and the threat of flooding from nearby rivers need to be addressed. There is a huge scope in the tourism sector in Eastern Arunachal Pradesh. Road connectivity remains the most challenging issue in the northeastern state. In Arunachal Pradesh, there are huge development potentials in infrastructure like road connectivity, transformation in the tourism industry, and reformation in the power sector such as mega hydropower projects, etc.

Assam

In the present study, 10 projects reports have been collected and analyzed. Out of ten study reports, eight were transport infrastructure development projects. The Vision for the Assam Road Sector in the next 20 years was to (i) Create a strong road network providing connectivity to all habitation and key centres (Industry Centers, Tourism Centers, and Growing Urban Centers); (ii) Develop and strengthen connectivity to neighbouring states; and (iii) Make Assam the preferred gateway to neighbouring countries.

The Government of Assam has embarked on a journey to develop the state’s infrastructure over the next 20 years. Nine of the ten projects completed in the study period were in the transportation/road sector. Assam plays a vital role in integrating the North Eastern Region with the rest of the country. It also shares international borders with Bhutan, Myanmar, and Bangladesh and has the potential to act as a gateway to these countries. Comprehensive infrastructure development is essential for a state’s holistic and inclusive socio-economic development.

There were 5 study reports on PIDP pre-feasibility studies of roads in Assam. Under these studies PIDP pre-feasibility studies of road projects were conducted at Bhilasipara to Sherfanguri, Chamaria to Pancharatna Road, Lumding to Umrongso, Rowta to Barpeta Road, and Amingaon to Chapaguri in Assam. Roads and inland waterway transportation, power, urban infrastructure, and industrial infrastructure were the focus sectors for the PIDP. The state’s comprehensive infrastructure vision envisions a variety of physical, policy-level, and institutional actions in numerous sectors. Assam’s road network spans 58,882 kilometres, with 3890 kilometres of national highways, 2530 kilometres of state highways, 4379 kilometres of main district roads, 1739 kilometres of urban roads, and 46344 kilometres of country roads. The Length of surfaced roads in Assam has increased by 7575 km during 2014-15 to 2019-20, an increase of 32%. Length of rural roads has increased from 36544 km in 2014-15 to 46344 km in 2019-20, an increase by 27%. Govt of Assam has set up a social cell within PWD, which has been strengthened by appointing retired revenue officials with vast experience in LA and R&R issues and representatives of the Assam Environment and Forestry Department to facilitate environmental and forestry clearances from the respective department.

Chamaria to Pancharatna Road project was in alignment with the envisaged vision as part of the PIDP, which was to provide 100% connectivity to all populations in the state, and bring development to underdeveloped areas. This road project would run parallel to NH37, reducing traffic congestion on the highway. The road project would connect Umrongso to the Goalpara Railway Junction and serve the Goalpara Railway Junction. The project has been determined to be unfeasible in a pure PPP model, in which the developer finances the entire project and earns 100% of toll revenue.

Lumding to Umrongso road project would serve the Lumding Railway Junction and provide connectivity from Umrongso to the railway junction. Development of Core Road Network encapsulating connectivity to neighbouring states, countries, and key growth centres. Physical interventions should focus on development of core road networks which will form the backbone of the road transport in the state. In addition to the 5 Networks, key roads/stretches have been identified across the State, requiring capacity augmentation to handle the expected traffic over the next 20 years. Key institutions must be developed and strengthened to execute the envisaged physical development. Holistic policies will have to be formulated to facilitate envisaged physical development.

The Core Road Network -- Rowta to Barpeta Road -- would facilitate seamless movement of tourists from one centre to another. It connects the three National Parks (Manas, Orang and Kaziranga) and two wildlife sanctuaries (Barnadi and Sonai Rupai) in Assam. This project is important for improving the connectivity to Bhutan and the remote regions on Bhutan's foothills. The network is important for developing the newly formed districts of Baksha and Udalguri. Significant augmentation in terms of length, capacity (lanes), and quality of the sector is required. There is a need to improve the connectivity between the north bank and south bank of the river Brahmaputra, and between Brahmaputra and Barak Valley. Aligned with the overall infrastructure vision for the state, and considering the infrastructure development that is required for the sector, a long-term vision for developing the inland water transport infrastructure in the state has been envisaged.

Amingaon to Chapaguri road project runs parallel to NH31 and can serve as an alternative to NH31, thereby easing the stress on NH31. This project almost connects most of the major urban areas in lower Assam. This road project aligned with the envisaged vision as part of the PIDP: to provide 100% connectivity to all population in the state and bring development to underdeveloped areas. Approximately 50% of the roads in the state are unsurfaced and require immediate attention. As per the existing traffic, 70% of State Highways in the state should be double lane, whereas only 6% of the length is double lane. The sector requires significant augmentation in terms of length, capacity (lanes), and quality.

One of the study report "Assam Urban Affordable Housing & Habitat Policy, a demand survey conducted across 97 towns of Assam under PMAY (Urban)" concluded that 53% of the overall demand for urban housing is for self-built incremental housing. As per the Press Information Bureau release, there was a shortage of 0.31 million urban housing units at the end of the 10th Five Year. As per Assam Affordable Housing Policy 2020, there is a serious scarcity of affordable housing for the urban poor. There is also a sizeable gap between the demand and supply of housing loans in Assam. In order to achieve the housing for all (urban) mission, the Government of India started the Pradhan Mantri Awas Yojana on 17.06.2015. This mission has the mandate to grant central assistance to provide housing to all beneficiaries of all eligible families till 2022.

Another study report was "Improvement & upgradation of Road Sections of Tamulpur – Paneri (AS-02) and Paneri – Udalguri (AS-03)". This project's environmental management plan focuses on protecting the environment during the planning, operation, and construction of all project-related activities and the impacts of the development as defined. The implementation of environmental management measures in this project faces some difficulties. Where major portion of the project road pass through open lands planting of trees along the entire stretches of the road is recommended as an enhancement measures, which would also serve as a mechanism to delineate ROW and prevent future encroachments / Squatters in to the right of way, wherever possible. (Quantum of trees as mentioned in BOQ). The extraction/Procurement of water is to be carried out as per provisions given and the contractor will minimize wastages of water during the construction.

Study report is based on India Assam state roads project that aims to enhance the road connectivity of Assam by assisting the Public Works Roads Department to improve and effectively manage its road network. Assam's road infrastructure, especially the state roads, was underdeveloped mainly due to insufficient funds and sub-optimal use of the funds leading to inadequate maintenance. Only about 25 percent of state highways in Assam were in either fair or good condition. Government of Assam announced the "Asom-Mala" program for improving the state road infrastructure in the next 15 years, based on the RAMS outputs and the asset management strategy to develop the State Highway and Major District Roads network.



Manipur

In the present study, two study reports have been collected, which mainly focus on building and upgrading roads in the infrastructure sector. The objective of the projects was to develop the road network and establish improved road connectivity. One project was to upgrade the road from Dikhu Bridge to Amguri, Assam. The reduction in the quantity and severity of horizontal curves was one of the most important proposed improvements to the present road geometrics. Another project runs from Imphal City to Tamenglong, covering a total distance of 103.02 kilometres. The alignment connects the important settlements of Imphal, Kangchup, Haochong, Bhalok, and Tamenglong by passing through the districts of West Imphal, Senapati, and Tamenglong. Increased market access; access to new employment centres; employment of local workers during project execution; improved quality of life; strengthening of local economies; reduction in travel time and development of important places in the districts of Tamenglong and Imphal West; reduction in erosion and landslides from multi-tracking and stone pitching of elevated embankments; the widened road network were the few outcomes of the projects. The project faces many difficulties due to the mountainous terrain it passes through. Limited Rights of Way (ROW) meant large steep cuts were needed to be stabilized and held back from the utility zone.

At present, Manipur is facing an acute shortage of infrastructural facilities. Manipur should establish a proper road, rail connectivity, and adequate power and water infrastructure to enable trading activities to flourish. The state should focus on establishing warehousing, and cold storage facilities. Plans should be made to establish a logistic hub to cater to the region's expected flow of trade and commerce. To include the hills in the development of tourism, there is a necessity to develop eco-tourism sites at various lakes, waterfalls, and caves in the hill districts and promote them with the Manipur Tourism Tag.

Meghalaya

During the study period, 18 study reports have been collected which focuses on road construction, road development, solid waste management infrastructure, and urban development. Transportation networks such as state roads, inter-district roads, village roads, airports, and other projects that helped connectivity and trade-related facilities such as customs and check posts to expand cross-border trade were all part of Meghalaya's infrastructure development. Developing tourism infrastructures like – landscaping and building of tourism amenities across different locations of the state, developing connectivity etc., is the potential of Meghalaya.

There are ten study reports based on social impact assessments on land acquisition for construction of facilitation center – entry and exit point projects viz., in Khanduli in West Jaintia hills district; Abhirampara, Medhipara, Phulbari Ghat, Tangaon in West Garo Hills District; Umkyrpong village, Lakasein village, Mooriap Village, Malidor village in East Jaintia Hills district. Setting up the Facilitation Centre in all the above villages would bring the people a sense of security and well-being. The people saw this Facilitation Centre as an initiative to regulate the flow of goods and people and also an initiative to address immigration, land encroachment and bring about development in terms of the market. These projects were viewed to strengthen trade between the states, boost the economy, and expand economic opportunities in the surrounding communities. Common suggestions derived in all the above projects were (i) Implementation of the proposed construction should be executed at the earliest. Facilitation Centre provides identity cards or keeps a register of locals to avoid over checking and difficulty in passing through these points. (ii) Reduction of restrictions on regular users, especially farmers. Employment of local people should be a priority for unskilled or clerical jobs. Collaboration between the Meghalaya and Assam Government is required to improve the accessibility to basic amenities in these border areas. (iii) Practice of accountability and transparency should be encouraged for functionaries who will be taking charge of the Entry and Exit Points-cum-Facilitation centre. (iv) Steps should be taken to address community safety during the construction phase, especially where boulder and stone must be properly disposed of so that accident does not occur in the area. (v) Local people should be exempt from paying any fee except in certain cases as deemed fit by the functionaries and legal laws. In Phulbari Ghat, West Garo Hills District, the development of the river port is very important because it is the only way to develop the waterways between the two states. There is scope for promoting tourism which can further boost the economy.

Draft environment impact assessment of rehabilitation and upgradation of existing 2 lane to 2 lane with paved shoulder from Jowai (km 69.2) to Meghalaya/ Assam Border (km 173.20) Section of NH-44 in the State of Meghalaya under NHDP Phase-III Programme was another project. Mitigation measures for the environmental concerns raised (protection of people, afforestation of trees, air pollution, enhancing community properties, etc.) were given in this study. The recommendation of the environmental impact assessment study was fully implemented, and the work is under process. Improvement of NH-44 from Jowai to Ratacherra (length 104 km) in Meghalaya to a two-lane with a paved shoulder is in progress by NHAI. Based on baseline information collected during Environment Survey, the mitigation measures were taken care of. The project's adverse impact would be reduced considerably if the EMP were fully implemented. The impact of road improvement on the socio-economic environment will be significantly beneficial, as it is likely to stimulate the area's economic growth. The specific benefits of the road improvement will include a reduction in travel time, travel cost, drop in the time to bring the agricultural goods to the markets.

In one of the study report, "Evaluation on Pradhan Mantri Gram Sadak Yojana (PMGSY) in Meghalaya State", assessed the PMGSY intervention made in Meghalaya covering all seven districts, indicating physical achievements, socio-economic impacts and constraints that need to be removed or acceleration and quality improvement in coming years. Four blocks each from East Khasi Hills and West Garo Hills districts, three blocks each from East Garo Hills, West Khasi Hills, and Jaintia Hills districts, and two blocks from South Garo Hills and Ri Bhoi districts were selected for sample survey by simple Random Sampling Method. The Government of Meghalaya was taking steps to convert the roads into blacktopping roads. To reduce the distance from the main road from 1.5 km to 1 km in all hilly Meghalaya, ensuring more habitations coverage, the State Government took this matter up with the Ministry of Rural Development, Government of India. Some of the constraints in implementing PMGSY due to hilly territory that makes tasks time taking and difficult, land acquisition, shortage of technical staff, and rainy seasons add to the woes of implementing agencies. According to the website of Public Works Department, Govt of Meghalaya, during the year 2013-14, up-gradation of 105 Km of existing State Highways & Major District Roads, conversion of 919.20 running metres of S.P.T. bridges into R.C.C. bridges, improvement of 139 Km of critical feeder roads & missing gaps and 5 Numbers of parking bays have been approved by the Planning Commission for taking up under Special Plan Assistance. Upto March 2016 the physical progress is 76%.

Another study report was "Semi-annual social safeguard monitoring report (Shillong)". Various Program components of this project were Water supply, Sewerage, and Sanitation, and Solid Waste Management (SWM) infrastructure. The sub-project components taken up under Tranche 1 in Shillong Municipal Corporation were (i) Development of short term landfill site and associated works; (2) Construction of garage cum workshop shed and staff restroom at the old landfill site at Marten, Mawiong; (3) Procurement of primary, secondary collection vehicles, and workshop machinery; (4) Procurement of different types of bins and personnel protective equipment respectively. This project is already implemented. A sanitary landfill for disposing of inert waste was already inaugurated at the dumping ground in Mawlai. Another study was EIA report for 5 road section in Meghalaya East Under MITP. The road sections in the study were Diengpasoh, Pasysih - Garampani, Umling-Patharkama. The consultancy assignment was to carry out the DPR to construct 122.68km of major district roads in East Meghalaya State. Development of the road sections would provide connectivity between important habitation of the district and help the economic development of the rural economy and market accessibility to the farmers. Commuting to either State Capital or district headquarters for work or other purposes would be easier and faster. This project is under implementation, and according to the statement by The Deputy CM of Meghalaya, all the 12 World Bank-funded projects will be done and dusted by December 2022.

Another study was draft environmental impact assessment report & environment management plan for limestone mine area 3.50 Ha. at Temjalong, Wahlong Sirdarship, District – East Khasi Hills, Meghalaya. The project had been proposed for the Mining of Lime Stone from the Private Land occupied by the lessee by open cast semi-mechanized method. This report has been prepared to obtain environmental clearance in compliance with the ToR issued for the Mining of Lime Stone. This project was expected to provide employment to local people in different activities such as mining, sizing (sieving), transportation, and plantation activities. The revenue generated from the production and sale of minerals will also add to the government's exchequer, which will help the state economy's growth. The project was not expected to have any major adverse impact on the environment, and whatever impacts are anticipated during the EIA study will be minimized with the help of suitable mitigation measures. There was no habitation in the mining lease area. Therefore, neither villages nor any part of villages was disturbed during the entire life of the mine. Mining in this lease would give job opportunities to the local people. Thus, mining will create a beneficial effect on local people.



The primary objective of the study Sewerage and sanitation scheme-Shillong Phase-I was to adopt sanitary landfilling for the ultimate disposal of the rejects from the compost plant as per Municipal Solid Waste (Management and Handling) Rule (MSW Rules) (2000) in the interests of health and economic wellbeing of the people of Shillong. For the city of Shillong, this program would support (i) the development of sewerage systems and (ii) the development of solid waste management facilities, including an engineered landfill site and improvements to the primary and secondary collection, creating beneficiary awareness. The Development of short-term Landfill Site and Associated Works at Shillong, Meghalaya was carried out on the existing landfill site. The land was already in possession of SMB. There was no land acquisition from private parties.

Mizoram

Only one study has been collected and analysed pertaining to Mizoram, i.e., "Environmental impact assessment for captive bio-medical wastes treatment facility at Trinity Hospital, at Silaimual, Melthum, Aizawl, Mizoram". In this study, the Centre for Environment Protection had prepared a comprehensive and proper waste segregation, treatment, and disposal plan. The hospital should adhere to the Biomedical Waste Management Rules, 2016 and the Solid Waste Management Rules, 2016. Biomedical waste is highly hazardous and can give birth to severe diseases that may be lethal; therefore, it is a problem of global nature. Biomedical waste management is of prominent importance to lessen the severe health consequences. Inadequate management of waste produced in healthcare facilities causes direct health hazards on the general public, healthcare workers, and the environment. The supervision of biomedical waste must lessen the risk of contamination outside the hospital for waste handlers, scavengers, and those living in the locality of hospitals. Manipur requires a high degree of infrastructure development. There should be urban solid waste management policy, including hospital waste management.

Sikkim

During the study period, three study reports have been collected and analysed pertaining to Sikkim. One project was the site-specific study of the proposed Pakyong Airport Area, Sikkim. Major part of the study area belongs to gentle slope, followed by very gentle slopes and moderately steep slopes and steep slopes. This project aimed to comprehend the dynamic behaviours and probable causes of the slope instability in and around the proposed airport area with the help of detailed geological mapping (1:2000 scale) and conduct site-specific geotechnical evaluation and assessment of the affected slope. Slope stability analysis has also been carried out to find out the most vulnerable plane of failure. It is imperative to mention that requisite engineering solutions may help minimize the impact of earthquake shaking by reducing the extent of amplification of the sub-surface formations through enhancement of the relative strength of the soft sediments underlying the Pakyong airport site for the development of risk resilient infrastructural facility for Sikkim. Robust engineering solutions might have been applied to develop risk resilient Pakyong airport as a vital infrastructural facility for Sikkim, India. Next project was DPR for the construction of 2-lane highway NH-717-A (From Ranipool to Pakyong) in East Sikkim. This is an important NH and lifeline for the people of the East District of Sikkim & Darjeeling District in West Bengal. Several villages in the area adjoining this road are also heavily dependent on it for their social and economic development. Thus, the importance of this road and its role in the upliftment of the region needs no more emphasis. It is essential for the improvement and upgradation of existing NH-717-A conforming to National Highway Standards. The existing alignment also passes through steep terrains that are unstable and landslide-prone areas at many locations, which could pose serious future problems. Slum-free city plan of action for Gangtok was another project. Slum Free City Plan of Action for every city is a small but definitive step towards a slum-free India.

The Sikkim Government has made sufficient provisions for sectors like housing and sanitation, transport, rural roads, urban infrastructure, health facilities and infrastructure, education, organic farming, ecotourism, sustainable forest management, etc.

Tripura

During the study period, five study reports have been collected and analysed which focus on habitat, infrastructure development, road construction & safety, urban services, and smart city. The goal of the socio-economic assessment of Tripura's cities and towns project was to determine the fundamental needs of the citizens of each city and to highlight the need for infrastructural improvements to the city's basic amenities. This initiative aimed to understand the ground realities in 20 of Tripura's most important cities and towns, in keeping with AMRUT's aims for urban amenities and infrastructure. Water supply, drainage, the introduction of transportation based on cleaner fuels, and the creation of parks and playgrounds were major sectors that offer the potential for further development initiatives in each urban area examined. In another project under the North Eastern State Roads Investment Program, consulting services were provided for construction supervision of the road section from Udaipur to Melaghar (TRO2) (Tranche-2 road in Tripura). This project aimed to analyse the state of compliance with the environmental safeguards stipulated in the loan agreement while construction is underway. The objective of the geotechnical investigation work for Agartala Smart City project, Tripura, was to appraise the stakeholders about the programme's environmental and social impacts and present safeguards to mitigate any potential significant impacts. To improve the urban environment and promote reforms for sustainable, efficient, and responsive urban service delivery, Agartala prepared a semi-annual social safeguard monitoring report.

Overall Scenario

During this study, seven reports were analysed which has direct impact on more than one states in NER. A closer look into the research focus of these project reports include infrastructure development (roads, telecom, electrification etc.). There were three report related to connectivity/road infrastructure development projects.

Infrastructure networks are essential for economic development and creating global value chains. Developing infrastructural networks can lift millions of people out of poverty, and a good synergy can help make this a successful plan. Given the ecological sensitivity of particular locations, such as the Northeast, such logistical transformation is sometimes viewed as a threat to the present eco-structure, which would inevitably reduce the region's forest and green land. Such crucial issues must be included in the greater framework of connectivity infrastructure for policy debate.

Another project was a feasibility assessment for improving the North East road network's connection (Phase 2). The research produced a project goal and outline, project budgets, implementation plans, maintenance and operation structures, environmental and social issues, and so on. In response to the Government of India's (GoI) loan request, the Government of Japan used this as the basis for evaluating the loan as Japanese Official Development Assistance (ODA). The project was aligned with upper-level plans of the GoI and complied with overarching goals. Transfer the technical knowledge of Japan to local parties regarding the operation and maintenance of roads in the mountains is necessary.

Another report was the working group on improvement and development of transport infrastructure in the North East for the NTDP. This project aimed to promote and support the region's balanced and equitable economic development. The challenges of infrastructure creation in NER were to (a) complete the provision of infrastructure by 2025, (b) create institutional and functional mechanisms to sustain and maintain the infrastructure, and (c) create a policy regime for free movements of goods & people.

NERPSIP (North Eastern Region Power System Improvement Project) semi-annual safeguard monitoring report project covered six North Eastern States including Meghalaya to create a robust power network by improving the intra-state transmission & distribution (33kV and above) network with required capacity building initiatives for effective utilization of assets.

"Fire Hazard and Risk Analysis in the Country for Revamping the Fire Services in the Country" aimed to identify existing gaps in terms of availability and requirement of Fire stations, capacity-building, trained man-power and fire-fighting, rescue, and other specialized equipment. The report concluded with the recommendation that the Arunachal Pradesh Fire Service Force can be revamped in next 10 years.



There were two reports on 'Study of infrastructure based on Act East Policy Connectivity, Marketing Shed, Electrification, and Other for NER States'. The need for these studies derived from the North-East Regions developmental needs, which was a necessary precondition for successfully implementing the "Act East" Policy. The slow pace of integration within South Asia amidst economic reforms coupled with growing trends towards globalization and regionalism led India to initiate the Look East Policy to pursue stronger bilateral and transnational strategic and economic engagement with the Southeast Asian and East Asian countries. Access to sea for the landlocked NER states opening trade opportunities with ASEAN countries. It also strengthen the country's economic, political and security influence in Southeast Asian countries.

Another study a detailed project report for telecom infrastructure augmentation in northeastern states covered 2G coverage to the uncovered National Highway (NH) network and transmission media network gap analysis for providing redundancy and diversity for the optical media from SHQ to SHQ and SHQ to DHQ of North East Region including Sikkim, a total of 8 States. NER has a total highway length of 8480 km out of which 1272 km (15%) is uncovered for mobile communication. Based on the desktop study, a total no of 233 BTS has been found suitably to cover the area at a total cost of Rs 97.37 Crores. Other Challenges in rolling out Telecom Network in North East were Terrain Difficulties, ROW permissions, Inadequate Power availability, and Infrastructure Issues.

Five basic deficits were identified in the vision NER 2020 Document of the North East Council. These are (1) Basic needs deficit, (2) Infrastructure deficit, (3) Resource Deficit, (4) Deficit of understanding with the rest of the country and (5) Governance deficit. The biggest constraint in the NER has been the poor state of infrastructure, in particular, roads, railways, waterways and power. Augmenting infrastructure, including rail, road, inland water and air transportation to facilitate a two-way movement of people and goods within the region and outside, communication networks including broadband and wireless connectivity, and harnessing of the vast power generation potential, all of which will open up markets for products from the region, attract private investment, create greater employment opportunities and expand choices for people of the region.

In NE states, there are huge development potentials in infrastructure like road connectivity, transformation in the tourism industry, and reformation in the power sector like mega hydropower projects etc. Improving the state's connectivity within the region and the rest of the country is key to its prosperity and growth. Inland rivers, air infrastructure and connection, power, and tourism have enormous promise in northeast states. It is necessary to promote eco-tourism sites at various lakes, waterfalls, and caves in the hill districts and promote them. There should be an urban solid waste management policy, including hospital waste management. National and international infrastructure development will be the best option for inclusive development in India's Northeast because national and international borders bind it.



6.10 LAW AND GOVERNANCE

Study Title

Study on Pendency of Cases before the Juvenile Justice Boards (JJB) in Assam

Implementing Institution

State Child Protection Society, Assam

Project Location/Completion Year

Assam, 2016

Objective

- Study the gamut, nature, factors and trends of pending cases before each JJB and the role of the existing mechanism to address the problem of CCLs (Children in Conflict with the Law);
- Develop an information system on pending cases that will aid the Govt. and Judiciary to better monitor (and subsequently improve) the situation of such children within the care jurisdiction.
- Provide specific and substantial recommendations for immediate action for speedy disposal of cases pending with JJBs.

Study Recommendation

- Sensitization of the Police and sensitization of Magistrates. They must insist on production within a reasonable period of time. They must verify with the JCL (Juvenile in Conflict with Law) how long was he kept in custody.
- Training and Sensitization by the State Home Dept. in partnership with the DSW (Director of Social Welfare);
- Developing mechanisms for coordination between Police, PI Court and Boards.
- Police to ensure production of JCLs directly before the JJBs

Analysis and Outcome

The number of juvenile crime case has risen at an alarming rate in Assam. The state registered 247 crimes committed by juveniles in 2020, which is a rise from 129 cases registered in 2019^[320]. The core reason behind why juvenile crimes in Assam have been progressing is because of the absence of parental guidance and kids being complete unaware of certain circumstances.

The present study was commissioned by the State Child Protection Society (SCPS), Assam with support from the Hon'ble Guwahati High Court & UNICEF, Assam and was executed with technical support from Jayaprakash Institute of Social Change, Kolkata, for the purposes of identifying the major causes for delays in the disposal of cases by Juvenile Justice Boards (JJBs) in Assam. The study is useful for all related stakeholders of Juvenile Justice System, to make the system more vibrant & outcome based.

The recommendations outlined in this study are feasible and implementable. It has been observed that the action taken on the recommendations by the stakeholders are slow in pace and partial due to the lack of coordination among the stakeholders. Hon'ble High Court at Guwahati and JJB have been taking an initiative to sensitize the police and magistrates. Training programmes have been conducted for the judicial officers^[321].

Hon'ble High Court, Guwahati, Juvenile Justice Board and concerned NGO's should take the responsibility to implement the recommendations outlined in this study.

Study Title

Secondary Data Analysis on Trafficking of Women and Children in Assam

Implementing Institution

Department of Social Welfare, Government of Assam

Project Location/Completion Year

Assam, 2014

Objective

To collate various secondary data-sets available with a range of stakeholders in the State, in order to understand the phenomenon and trends of human/child trafficking from and within Assam, and initiate specific targeted interventions based on this evidence.

Study Recommendation

The secondary data analysis may be treated as a pilot study which needs to be followed up by in-depth primary research in to the following areas, in order to develop a comprehensive need-specific preventive programme against human trafficking in the state.

- Push, pull and facilitating factors behind trafficking of children and women in and from Assam using qualitative methodologies.
- Focused research on the phenomenon of child labour in the state.
- Special focus on transport, eateries and domestic labour needs to be given immediately.
- A focused study on the changes that happened or the steps that were taken to reduced the number of missing children and women.
- Immediate Plan of Action for the districts of Baksa, Cachar, Dibrugarh, Golaghat, Jorhat, Kamrup Metro, Nagoan, Sivasagar, Sonitpur and Udalguri toward preventive activities against trafficking.
- Strong collaboration and convergence with other states and non-state actors to ensure fast rescue and restoration of survivors of trafficking.
- Further research to bridge the documentation gaps and regular coordination among departments for data collection.

Analysis and Outcome

Assam and other North Eastern Region is hub of human trafficking to other part of the country. It has been observed from the studies and secondary data, every year a number of women and children are missing from the state ^[322].

This study has been carried out by Department of social welfare, Government of Assam and State Child Protection Society with the support from UNICEF. This study is useful to understand the key trend of trafficking in women and children in Assam. The outcome of this study will help state government and various non-government organization to address the issues in more realistic and informed manner.

The recommendations outlined in the study report are quite significant. It is difficult to find out from the ground whether the recommendations have been followed in the state or not but State Government has shown its concern in this direction and taking appropriate steps to prevent human trafficking. Assam Government has created and operationalized Anti Human Trafficking Units (AHTU) in all district of Assam to effectively combat crimes related to trafficking of persons especially women and children ^[323].

In Assam, the problem trafficking mostly happens in the border areas where people are predominantly illiterate and are alienated from the mainstream society. Media can raise awareness to inform people about these crimes and can mobilize people to stop it. Media also can strengthen prevention by warning vulnerable groups



Study Title

KAP Endline Survey Report for Citizens of Meghalaya

Implementing Institution

North Eastern Educational Development Society

Project Location/Completion Year

Meghalaya, 2019

Objective

To understand the extent and level of the knowledge, belief, perception, readiness, trends, factors, reasons of participation and non-participation of the registered voters in the election/voting process

Study Recommendation

- Television, Newspaper and Internet are one of the predominant sources of media which the respondents are highly exposed to. Therefore, election department should take this opportunity to use these media to a larger extent for sharing/providing any election related information.
- SVEEP choice of programmes should be conducted specifically to target more male voters and gain their attention on why it is important for them to exercise their franchise.
- Street plays and entertainment programmes can also be used for generating higher awareness levels among the general population especially for the young and future voters.
- Educational institutions and local community Dorbars can be used to an extent for spreading knowledge and awareness on the above by targeting the general population and young eligible voters of the state in particular
- There needs to education and enlightenment on the basis of bring about transformation and development through their participation in voting
- Specific attention needs to be addressed on transparency to open scrutiny, privacy of voters, integrity of a voter and accessibility to all voters regardless of location, caste, tradition, language and disability in order to have free and fair elections
- More awareness and information needs to be publicized to the general public (especially the rural areas) on the uses and the importance of the app to tackle the menace facing the electoral process.

Analysis and Outcome

This study appears to have been an attempt to record and highlight the knowledge, attitudes and beliefs in various aspects of voter behaviour in the electoral exercises held in Meghalaya in 2018. The data of this study will aid greatly in contributing to a much more deeper and a more insightful understanding of the diverse voting patterns and also, perhaps serve as a pointer to areas which require both a qualitative and quantitative improvement in the entire chain of the Enrolment to Elections process in all future electoral endeavours in the state. This study is much more deeper and a more insightful understanding of the diverse voting patterns.

All the recommendations outlined in the study report are practical. Election Commission is encouraging the party worker or common people to take the opportunity to use the media to a larger extent for sharing/providing any election related information. Systematic Voters' Education and Electoral Participation program, better known as SVEEP, is the flagship program of the Election Commission of India for voter education, spreading voter awareness and promoting voter literacy in India [324].

The findings of this reports are useful for the Department of Election Commission to plan the smooth electrolls in the state.

Study Title

Capacity and Functioning of the Khasi Hills Autonomous District Council in Meghalaya, India - A Rapid Policy Note for Furthering Research and Policy Dialogue

Implementing Institution

The World Bank / Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2015

Objective

Understanding of the Khasi Hills ADC (KH-ADC) in Meghalaya in order to identify areas for future debate and policy dialogue.

Study Recommendation

- The KH-ADC is constrained in fulfilling the functions it is mandated to perform.
- Contrary to popular perceptions, it is not only constrained by internal organizational drivers but also by a set of external drivers that are largely beyond its control.
- If the KH-ADC continues on the trajectory it has followed in the past years - without any major reform efforts - its medium term viability and relevance could be seriously threatened.
- In conclusion, the main implication is as follows: if Meghalaya's ADCs are to play the role envisaged by the Constitution, the State Government and the ADCs may need to take more pro-active steps to enhance their communication, trust-building and coordination in addressing selected governance and development challenges.

Analysis and Outcome

The study is useful to better understand the KH-ADC in Meghalaya by identifying key factors that shape its capacity, functioning and viability. The study highlights several issues and lacunae of responsibility, accountability, financial assistance, operations and implementations inter alia administration, authority and management to safeguard the tribal communities.

The KH-ADC's administrative autonomy has been constrained by historical developments and policy and legal provisions at the state and national level. There are several areas of conflict between the ADCs and GoM that need to be addressed to smooth administration of the land. It requires major reforms to remain a viable and relevant institution.

The study highlights several areas that require further in-depth research. This study will be useful for states or areas where the ADC administrative system exists, especially the North-Eastern states and Ladakh. The in-depth research can be carried forward by policy research institutes such as Centre for North East Studies and Policy Research (CNESPR), Jamia Millia Islamia; Special Centre for the Study of North East India, JNU; Meghalaya Institute of Governance (MIG), etc.



Study Title

Functioning of Autonomous Councils in Sixth Schedule Areas of North-Eastern States

Implementing Institution

Action Aid

Project Location/Completion Year

More than one state, 2016

Objective

- Create an autonomous self-governing body to be known as the Bodoland Territorial Council (BTC) within the state of Assam.
- Provide constitutional protection under the Sixth Schedule to the said autonomous body; to fulfil economic, educational, and linguistic aspirations.
- Preservation of land rights, socio-cultural and ethnic identity of the Bodos, and speed up the infrastructure development in the BTC area.

Study Recommendation

- Effective functioning of ADCs can be brought about when the Panchayati Raj model is replicated in certain spheres of the Autonomous District Council model.
- In terms of the scale, a clarity on the role of the ADCs requires immediate attention.
- There is a need to have a clear mapping of the activities undertaken at various levels of the TTAADC as followed in the PR system, like the Village Council and the Block Advisory Committees.

Analysis and Outcome

The study explored various aspects of the functioning of the autonomous councils in different Sixth Schedule areas. It looked at both the achievements and drawbacks of ADCs and studied the functioning at different levels.

Regular and assured financial assistance from governments and efficient monitoring system are two major factors, which will determine the success of such provisions, along with awareness and active participation of the other stakeholders.

Notwithstanding their pitfalls, it has given tribal communities space to govern themselves beyond their villages. They have thus been able to move forward in social and economic development and, at the same time, able to preserve their language, culture, and tradition. In short, there has been development without the loss of identity. The tribes in other parts of India are faced with problems of development as well as identity. Hence, it is worth exploring the extension of such systems in other parts of tribal India.

Regional ministries or departments of the country like MDoNER, NEC, etc. have the potential to take up this issue and oversee the implementations and working of this kind of provision.

Study Title

Social Impact Assessment (SIA) Study: Proposed Land Acquisition for Ministry of Defence in North Sikkim

Implementing Institution

Administrative Staff College of India

Project Location/Completion Year

Sikkim, 2020

Objective

- To gain a good understanding (i.e. profiling) of the communities likely to be affected by the project.
- To identify the Project Affected Households (PAH) to collect their baseline data.
- Provide space for participatory processes and facilitate community discussions about the proposed land acquisition.
- To develop a Social Impact Mitigation Plan (SIMP) that incorporates the mitigation measures, monitoring and institutional arrangements.

Study Recommendation

- The Study strongly recommends strengthening military-local community engagement to promote long-term mutually beneficial and conflict free external environment in the border area
- The Study recommends full hiring charges to be settled for the encroached lands.
- The district administration is recommended to do an audit of the lands and formally acquire the remaining plots that have been left out inadvertently from the proposed acquisition. The Study also recommends acquisition of land and disbursement of the legally mandated entitlements if the requirement of land is for a long-term basis.
- A robust Grievance Redressal Mechanism (GRM) is a critical requirement for addressing the issues emerging from the project/SIMP implementation in a hassle-free manner.
- The mitigation measures proposed in the Social Impact Mitigation Plan (SIMP) includes compensation and specific R & R entitlements as outlined in the 2013 Act.

Analysis and Outcome

The study is one of the uncommon cases of land acquisition by the Indian military from the civil society near the international border on Court's order. The study was undertaken in accordance with the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. The study highlights the dynamics of relationship between the Indian military and the villages especially the societal impact especially, livelihood. The study also highlights exceptional issues of religious and sentimental feelings among the surrounding villages that arise with the settlement of the Indian military in the area.

Overall, the study lauds the positive and largely conflict-free environment that prevails in the project affected area and attributes the same to the mutual supporting/facilitating role played by both the army and community towards each other. The study notes the important support rendered by the army to the local community during accidents, medical emergencies and natural calamities.

The recommendation of the SIA to strengthen the Local-Militarily engagement through proper apparatus has been highly appreciated by the expert group as this decision may productively diffuse tension which has been triggered by delay of compensation ^[325].

This study has been recently completed in 2020, the implementation of the recommendations outlined in the study are yet to be examined.



Study Title

Traditional Self-Governing Institutions in North-East India (with special reference to Sikkim): Rethinking Tribal Self-Governance in India

Implementing Institution

Jamia Millia Islamia, Centre for North East Studies and policy research (CNESPR)

Project Location/Completion Year

Sikkim, 2018

Objective

To acknowledge the effect of self-governing institution in Sikkim with specific reference to Dzumsa of North Sikkim.

Study Recommendation

The study recommends for a self-governing communities and institutions with Ecoregions in Northeast India. Because of the distinctive nature of the tenure systems and structure of self-governing institutions in the region. An ecoregion is a "relatively large area of land or water that contains a geographically distinct set of natural communities that share a majority of their species, ecological dynamic and environment conditions and function together as a conservation unit at a global and regional scales."

Analysis and Outcome

The study deals with Dzumsa as a self-governing institution which remains one of the few tribal institutions which have remained exclusively at the hands of the tribals with limited interferences and interventions. Sikkim, unlike the other North East states, requires a different understanding and approach since Sikkim's ethnic, cultural, linguistic practices are similar to the countries that it shares its border with-Nepal to its West, Bhutan in the East and Tibet (China) but does not share cultural or geographical contiguity with other NE states. This approach of looking at Sikkim from a different perspective would give an understanding and thereby outcomes in the form of policy perspectives to contribute to the overall and holistic reading of North East India's pluralities and needs there from.

The study highlights the importance of such a governance or administrative system in order to preserve the cultural and ethnic diversity of India. The good practices of administration and governance in the region can be emulated by other NE states where the Autonomous District Council (ADC) administrative system is being practiced. The implementation or feasibility study can be carried out by centres such as Centre for North East Studies and Policy Research (CNESPR), Jamia Millia Islamia; Special Centre for the Study of North East India, JNU; Institute of North-East India Studies - Gauhati University, etc.

Study Title

Bearing Witness: The Impact of Conflict on Women in Nagaland and Assam

Implementing Institution

Centre for North East Studies and Policy Research

Project Location/Completion Year

More than one state, 2011

Objective

- To study the nature and type of conflict situations women had lived under in Nagaland and Assam.
- To ascertain the impacts of conflict on women in its various dimensions.
- To examine how women had been able to handle and/or cope with the conflict situation.
- To assess women's hopes and aspirations.

Study Recommendation

- A specialized Institute/Centre should be set up in the area of conflict studies and resolution.
- The villages must be provided with adequate counselling facilities for women victims of conflict, and specialized mental health facilities to identify and tackle cases of PTSD.
- Better education of women and awareness programmes of rights and provisions and facilities available Equally, dissemination of programmes and services needed to be more effective and social stigmas which were hurdles presently for women victims accessing services should be removed or reduced.
- Legal systems should be made more people friendly and less cumbersome.
- Rehabilitation packages either directly or through economic self-help programmes ought to be instituted wherever required for victims of conflict.
- More broad-based studies should be instituted in areas like new trends of conflict in society and how women of today view them.
- Similarly, another study could be carried out on how the young people viewed the events in Naga society today.

Analysis and Outcome

This study has focused on the impact of conflict on women in the two states of Nagaland and Assam and aimed to wide dissemination of research and findings through publications, a documentary film, seminars and the media.

The study seeks to place these issues in the larger context of the challenges of nation building, regional growth and also look at broader issues of laws, the use of state power and the rights of citizens, especially women. Conflicts often destroy and damage social infrastructure like schools and hospitals. Health services and educational institutions are often explicit targets of conflicting groups. Afflicted people lack sufficient food to maintain good health and unable to afford essential medicine even when they can access health services.

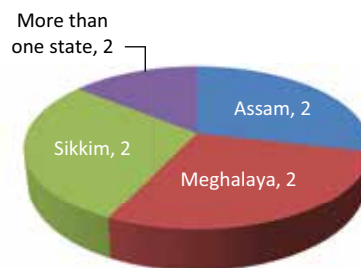
The recommendations outlined in this research are feasible and very useful for the development of this area. It has been observed through reports and news as part of the peace process, All Bodo Women's Welfare Federation (ABWWF) has taken up a number of activities aimed at sustainable peace, primary through capacity building, livelihood generation and economic empowerment such as setting up weaving centres, imparting training in the kitchen, gardening, weaving, dairy farming and similar skill-building activities. They also meet the armed groups to resolve the conflict situation in the region. Nevertheless, these women's organisations are rarely invited by the Government for participating in any peace talks. Member of the organisations opines that they are not officially involved in the peace process of the region ^[313].



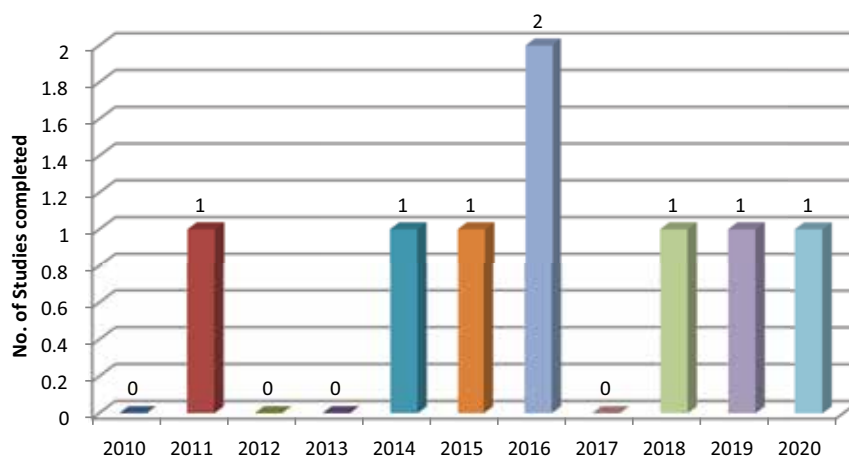
State-wise Summary

In the present study, over 8 study reports have been collected and analysed. These research studies have been carried out in North Eastern Region by various academic and research institutions on law and governance, access to justice, human dignity and well-being, economic and social development, indigenous and tribal laws/ customary law in North Eastern Region during 2010 to 2020.

The numbers of studies included state-wise were: Arunachal Pradesh (NA); Assam (2); Manipur (NA); Meghalaya (2); Mizoram (NA); Nagaland (NA); Sikkim (2), more than one state (1). These studies were conducted during the years 2011, 2014, 2015, 2016, 2019, and 2020.



Studies completed in Law & Governance Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Law & Governance Sector in NER during 2010 to 2020 (Year-wise)

Assam

The current study collated two studies carried out in the state of Assam during the last decade: (1) Study on Pendency of Cases before the Juvenile Justice Boards (JJB) in Assam, and (2) Secondary Data Analysis on Trafficking of Women and Children in Assam.

The first study was commissioned with the key objectives to review the gamut, nature, factors and trends of pending cases before each JJB in Assam and the role of the existing mechanism to address the problem of CCLs (Children in Conflict with the Law). It underlined that the action taken on the recommendations by the stakeholders are slow in pace and partial due to the lack of coordination among the stakeholders. The Hon'ble High Court at Guwahati and JJB have taken various initiatives to sensitize the police and magistrates. The Hon'ble High Court, Guwahati, JJB and concerned NGOs should take the responsibility to implement the recommendations outlined in this study.

The second study involved collation of various secondary datasets available with a range of stakeholders in the State, in order to understand the phenomenon and trends of human/child trafficking from and within Assam, and initiate specific targeted interventions based on this evidence. Assam and other states in the North Eastern Region is the hub of human trafficking to other parts of the country. It has been observed from the studies and secondary data that every year a number of women and children are missing from

the state. The study monitored and revealed key trends of trafficking in women and children in Assam. Based on the study recommendation, the Government of Assam has created and operationalized Anti Human Trafficking Units (AHTUs) in all districts of Assam to effectively combat crimes related to trafficking of persons, especially women and children. In Assam, the problem of human trafficking is reported in the border areas inhabited predominantly by illiterate people often alienated from the mainstream society. The pertinent role of media is also noted to raise awareness, inform and educate on the issues, and mobilize the public against these crimes. Media can also strengthen prevention by warning vulnerable groups.

Meghalaya

The study “KAP (Knowledge Attitude Practice) Endline Survey Report for Citizens of Meghalaya” carried out in 2019, recommended the Election Commission to encourage various stakeholders such as election party workers and civil society in general to maximize the usage of media to a larger extent for sharing/providing any election-related information. It also recommended scaling up its flagship programme SVEEP (Systematic Voters’ Education and Electoral Participation programme) for voter education, spreading voter awareness, and promoting voter literacy in the state. The study finding is useful for the Department of Election Commission to plan the smooth electoral in the state.

The study “Capacity and Functioning of the KH-ADC’s (Khasi Hills Autonomous District Council) in Meghalaya, India - A Rapid Policy Note for Furthering Research and Policy Dialogue” was conducted in 2015. It highlighted several areas that require further in-depth research including several issues and lacunae of responsibility, accountability, financial assistance, operations and implementations inter alia administration, authority and management to safeguard the tribal communities. The KH-ADC’s administrative autonomy has been constrained by historical developments, policy and legal provisions at the state and national level. Major reforms are needed to address several areas of conflict between the ADCs and the Government of Meghalaya for smooth administration of the land.

Sikkim

Social “Impact Assessment (SIA) Study: Proposed Land Acquisition for Ministry of Defence in North Sikkim” was conducted in 2020. The study highlighted the dynamics of relationship between the Indian military and the villages in terms of societal impact, especially with regard to livelihood. It also brought out some of the exceptional issues of religious sentiments among the surrounding villages that arise with the settlement of the Indian military in the area.

The study “Traditional Self-Governing Institutions in North-East India (with special reference to Sikkim): Rethinking Tribal Self-Governance in India Challenges and Opportunities” was carried out in 2018. The study highly acknowledged the effectiveness of self-governing institutions in Sikkim with specific reference to Dzumsa of North Sikkim to preserve the unique cultural and ethnic diversity of India. The good practices of administration and governance in the region can be emulated by other NE states where the Autonomous District Council (ADC) administrative system is being practiced.

Overall Scenario

The study “Bearing Witness: the Impact of Conflict on Women in Nagaland and Assam” was carried out in 2011. It focused on the impact of conflict on women in the two states of Nagaland and Assam and aimed at wider dissemination of its findings through research publications, documentary film, topical seminars, and media. The study sought to place these issues in the larger context of the challenges in nation building, regional growth and also looked at broader issues of laws, the use of state power and the rights of citizens, especially women. Conflicts often destroy and damage social infrastructure such as schools and hospitals. Health services and educational institutions are often explicit targets of conflicting groups. Afflicted people lack sufficient food to maintain good health and are unable to afford essential medicine even when they can get access to health services.

There is need to focus on how to balanced economic, political and Administrative development in NER in this regard, emphasis need to be made to reduce all forms of inequity that exists among different states, within the states and among different sections of people, public servant and social groups.





6.11 RURAL DEVELOPMENT

Study Title

Comprehensive Village Development Plan(CVDP) for Matmara Gaon Panchayat, Lakhimpur District, Assam

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2018

Objective

To develop the villages under Matmara Gaon Panchayat in an integrated manner. These include economic development, infrastructure development, and other aspects of human resource development, i.e., drinking water supply, sanitation, access to energy and credit facility, etc.

Study Recommendation

In total 19 livelihood clusters have been identified based on the primary survey and 40 different activities have been proposed for execution under the CVDP.

Analysis and Outcome

The study has been funded by the State Institute of Panchayat and Rural Development (SIPRD), Panchayat and Rural Development, Government of Assam. The implementing institution has studied socio-economic development of Matmara Gaon Panchayat and has found out the problems associated with the households and livelihoods along with the possible solutions as highlighted by the villagers. Village-wise activity plans were developed for all the revenue villages of the Panchayat considering agriculture, irrigation, water conservation, natural resources, sanitation, migration, livestock, sericulture, fishery, energy for cooking, fishing, bamboo craft, and other associated activities related to livelihood. The study has come out with a comprehensive plan for 30 villages of Matmara Gaon Panchayat. Existing problems and their solutions for carrying out activities in each livelihood clusters have been recommended in the study reports. All the recommendations of the reports are very practical. Through awareness and training programmes, the suggested solutions can be implemented. The implementing agency has also developed a comprehensive budget of ₹2343.80 lakh for implementing different activities, viz., agricultural development, sericulture development, plantation, livestock development, income generation, and capacity development and skill development activities.

Efforts are being made by the state government to prepare an integrated/holistic integrated Gaon Panchayat Development Plan through direct participation of rural people. The Government of Assam has started the process of institutionalizing the participatory Gaon Panchayat Development Planning Process under the title "Amar Gaon Amar Achoni" "Our Village Our Scheme" [327].

Institutions such as State Institute of Panchayat and Rural Development (SIPRD), Assam, and Panchayat and Rural Development Department, Government of Assam are responsible for implementing the recommendations of the study.

Study Title

Evaluation of Preparatory Phase of Karbi Anglong - XII (Lurnongdisa), Karbi Anglong- XIII (Dissobai), Karbi Anglong- XIV (Dilai) Integrated Watershed Management Programme (IWMP)

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

To assess the implementation of the project activities by Project Implementing Agency (PIA) covered under Batch-II projects of 2010–2011 under IWMP

Study Recommendation

- The community hall should ensure maintenance and proper utilization of the facilities.
- PIA should give stress on capacity building of stakeholders such as WC, UG, SHG, etc.
- The Livelihood and production system enhancement action plan should be implemented as per plan to get proper benefit of the project.
- All the issues raised or discussed in watershed committee meeting should be recorded.
- Documentations and photographs of each project against financial progress for future reference.
- Public toilets constructed at private should be ensured to be accessible to all, irrespective of the communities.

Analysis and Outcome

The main objective of the IWMP is to restore ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover, and water. To implement the IWMP in the state, the State Level Nodal Agency (SLNA), Soil Conservation Department, Government of Assam has been identified as the Nodal Agency.

The SLNA is currently implementing 86 projects in all the 27 districts in Assam covering a treatable area of 359,988 Ha during the period 2010–2011.

TERI has evaluated the preparatory phase of 10 projects of Batch II (2010–11) IWMP projects in Karbi Anglong, Assam with a treatment area of 40,143 Ha. Implementation of eight different components of the project has been analysed. Most of the components have been rated between 7 and 9.5, categorized between good, very good and excellent, whereas the component under capacity building programme have been rated under poor category with a rating 4.

Based on the inputs from project investigator, it has been observed that the suggested recommendations are practicable and have been partially implemented. The main reasons for not implementing all the recommendations are—lack of better coordination among various government departments, stakeholders; lack of enthusiasm from target group (like association); need more engagement of social institutions such as NGOs, SHGs, etc.



Study Title

Project Vigyan Sanchar Kendras, Assam

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Assam, 2014

Objective

- Empower and sensitize the rural communities especially youth through the use of science-based IEC interventions.
- Build capacity of rural youth and women on adoption of sustainable practices.
- Promote scientific temper and objectivity among the youth and women leading to skill enhancement.
- Use of science and technology-based communication to strengthen the capacities of individuals for self-sustenance.

Study Recommendation

- The knowledge gained by the participants needs to be reflected in the adoption of practices at the household and community level. The community needs to have access to the requisite resources to practice the learning they have gained in the workshop.
- The training programme for the communities should include a component on the government schemes related to the skill being imparted in the training.
- The training programme on skill development should cover a component of market linkages.

Analysis and Outcome

Project Vigyan Sanchar Kendras, a TERI-DST programme was initiated in the month of April 2012. Under the project, two Resource Centres were established in the state of Assam. Cluster of villages comprising five to seven villages were identified and catered by these two resource centres in the districts. The resource centres known as "Vigyan Sanchar Kendra" provide rural communities an opportunity to access resources, information leading to enhancement of their knowledge and skills. The project was implemented in two districts of Assam namely, Darrang and Kamrup. The project directly targeted the youth and the women in specific and communities in general.

The outcome of the study reveals that the follow-up of any training or skill development programme should be an important activity for the impact measurement and the sustainability of any study, which involves training or skill development programme.

It has been observed that in the recent past, funding organizations have started measuring the impact of the training programmes. Implementing organizations are being asked to submit the proof of the impact of the training or skill development programme.

Study Title

Evaluation Study on Rural Housing Scheme

Implementing Institution

AMC Research Group Pvt. Ltd

Project Location/Completion Year

Meghalaya, 2018

Objective

Housing is one of the basic requirements for human survival. Different housing schemes have been implemented since the time of partition of the country. The study aims to examine the effectiveness of Rural Housing Scheme (RHS)

Study Recommendation

- Apart from distribution of CGI sheets, focus needs to be more on providing grant-in-aid support for construction of houses. There can be a provision of an affordable housing in rural areas and thereby ensuring homestead plots to all rural poor through replacement of the present scheme.
- Even bankable schemes can be launched, so that the funding is available at concessional rates and affordable for rural housing for economically weaker sections (EWS)/below poverty line (BPL).
- The selection procedure needs to be rectified.
- More transparency needs to be there in selection of beneficiaries.
- There is a need for developing well-defined beneficiary selection procedure to cater the needs.
- It is observed that instead of bamboo mat corrugated sheets as a material for construction of houses, aluminium sheets would be a better alternative.
- Monitoring, inspection and supervision needs to be strengthened at all the tiers of administration to ensure that the programmes are executed on time and within cost so that timely corrective actions would be taken in case of any slippage.

Analysis and Outcome

The study has presented information about the implementation of the scheme in the line of beneficiaries who are houseless poor Meghalayan Villagers belonging to the EWS living in the stabilized villages.

Points mentioned in the recommendation of the present study are more focused on strengthening the existing rural housing schemes, however, it has been observed that the Government of Meghalaya, Directorate of Housing under Chief Minister Housing Assistance Programme has already developed a guideline [328] in 2017 wherein all the above recommendations such as banking schemes, beneficiary selection criteria, monitoring, inspection and supervision of the programme have been well defined. Even though, guidelines on Rural Housing Scheme have already been developed by Govt of Meghalaya but a transparent online system should be in place to monitor each step of the RHS for its smooth implementations.



Study Title

Evaluation Study on Asset Created Versus Fund Investment under MGNREGA in Meghalaya

Implementing Institution

Midstream Marketing & Research Pvt. Ltd

Project Location/Completion Year

Meghalaya, 2017

Objective

To conduct a comprehensive assessment in terms of assets creation vs the fund investments during the last five years along with social acceptability and social impact of the scheme across the study districts

Study Recommendation

- Providing job card facility available online.
- Planning for synergy of executed works or programmes with financial year.
- More technical support for bottom-up planning approach of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) executed through the Village Employment Council (VEC).
- Mobile banking unit to take care of this problem till the banks are streamlined to facilitate electronic transfer up to the village levels.
- Maintenance of assets constructed under the MGNREGA.
- Provide speedy internet connectivity at village and block level to ensure smooth functions of MIS.
- Information Education Communication (IEC) activities under the MGNREGS need to be strengthened to motivate both male and female folk for active participation in the programme.
- Inclusion of “maintenance plan and maintenance fund” should be made mandatory at the time of submission of asset creation plan.

Analysis and Outcome

This study has been sponsored by the Directorate of Programme Implementation & Evaluation, Govt. of Meghalaya to examine the implementation of MGNREGS in improving employment opportunities and living conditions of the rural poor of 11 districts of Meghalaya, both in terms of qualitative and quantitative parameters.

All the recommendations mentioned in the report are feasible, provided there is coordination between the state agencies and central government department. The Ministry of Rural Development has developed a comprehensive and transparent digital system for job card. Detailed information about each worker of each village can be monitored through the digital system. However, there is no online provision for applying a job card through online portal at present. Local people have to approach Secretary, VEC to get themselves registered for the job card [329].

The data shown in the online portal of MGNREGA [330] still shows the delay releasing the payment to the daily wage workers. Such delays not only undermine the objective of the employment guarantee scheme but also result in additional burden for workers in the form of search and opportunity costs.

Information Education Communication (IEC) activities under the MGNREGS need to be strengthened in the state. As per the discussion with the local people, it has been observed that annual training programme should be conducted in each block to ensure that the workers know their right to demand wage employment. Beyond raising awareness, interventions at interpersonal level need to be extended to ensure that individuals are converting their awareness into action. Local Block Development Office, Rural Department and local NGOs should come forward to implement the recommendation smoothly.

Study Title

Exploring the Governance of Service Delivery in Meghalaya: Findings from Piloting a Bottom-up Approach

Implementing Institution

Meghalaya Institute of Governance

Project Location/Completion Year

Meghalaya, 2016

Objective

- To develop and pilot a 'bottom-up' approach for better understanding the governance of service delivery in Meghalaya
- To build the capacity of the Meghalaya Institute of Governance (MIG)

Study Recommendation

The findings identified certain gaps or failings in service delivery, which could be reviewed and addressed. These include the following:

In MNREGA, the following issues could be addressed:

- Improve access to job cards within 15 days.
- Improve the number of people accessing work within 15 days.
- Taking measures to ensure that people work the full mandated 100 days; and, raising peoples' awareness of key provisions within the scheme, such as awareness of the unemployment allowance.

In NRHM, the following issues could be addressed:

- Making greater progress on infant and maternal health, such as through ensuring greater field staff and trained attendants for home deliveries and ensuring greater awareness of and access to sub-provisions under NRHM such as the health insurance, clinic day, village health, and nutrition day.

Analysis and Outcome

This report explores how governance issues shape the delivery of basic and poverty-reducing services in the Indian state of Meghalaya. It explores how services are actually delivered on the ground in the context of a complex ecosystem of formalized modern institutions and informal, traditional and customary 'tribal' institutions. There is very limited documented evidence on this issue in Meghalaya.

Based on the inputs from the stakeholders, it has been observed that the recommendations of this report have not been implemented fully in the state due to some administrative reasons in the state. In 2020–21, the demand for work by MGNREGS workers increased by 43% to 133 million people compared to 2019–20, of which 84% were provided some work. The number of person days of work provided increased 1.5 times to 3.9 billion compared to the previous highest 2.7 billion person days in 2018–19, according to government data [331]. Yet, all households, on average, received 52 days of work, as against the promised 100.

The Rural Development Department in the state, MIG, and district authorities in the district are responsible for successful implementation of the schemes.



Study Title

Livelihoods Improvement Project in the Himalayas

Implementing Institution

Independent office of Evaluation (IOE) of
International Federation for Agricultural
Development (IFAD)

Project Location/Completion Year

Meghalaya, 2015

Objective

The project performance assessment (PPA) objectives are to assess the results and impact of the project; and generate findings and recommendations for the design of new projects and the implementation of ongoing IFAD-financed projects in India

Study Recommendation

- *Inclusive targeting*: Ensure the targeting strategy and approach specifically target the poor so that they have access to and benefit from project investments.
- *Synergy and partnerships*: Design must ensure that the mandated body be assigned the appropriate roles and responsibilities during implementation.
- *Policy issues*: To ensure project delivery and long-term sustainability both at design and during implementation, IFAD has a responsibility to support the government and stakeholders to address policy issues.

Analysis and Outcome

This project performance assessment was conducted by Louise McDonald, Evaluation Officer and lead evaluator of IFAD (IOE) to investigate the performance of the Livelihoods Improvement Project in the Himalayas in two distinct States (Meghalaya and Uttarakhand).

The study has focused mainly on improving existing water sources, increasing the availability of rice mills, reducing the time and effort required to fetch water, and shelling rice. The study was effective in reaching its goal and objectives via a critical pathway that first sought to reduce drudgery for rural populations, which freed up time and energy for subsequent engagement in individual empowerment and self-help group (SHG) formation.

The study outcome will benefit the funding organization for developing any new proposal in the rural sector in future. The recommendations of this study are useful for the new upcoming project.

Study Title

Piggery Subsector in Meghalaya: A Review

Implementing Institution

Institute of Livelihood Research and Training

Project Location/Completion Year

Meghalaya, 2014

Objective

To review the piggery sub-sector in Meghalaya

Study Recommendation

- Establish pig feed plants and total mixed ration plant at cluster level to provide low-cost balanced pig feed supply to pig units.
- Promote entrepreneurship-based pig breeding centres in villages.
- Design and implement financial products (Credit/Insurance/leasing) for pig farming.
- Develop area-specific low-cost package of practices (micro plan). A micro plan could be a village or area level plan of feeding based on seasonal cropping, forest produce. This plan needs to be significantly context-specific rather than one recommendation for the whole region.
- Develop village-based cadre to ensure door step delivery of primary health care and extension services.
- Develop a live body weight and grading-based transparent pricing system. Certification of quality grading and healthy pigs.
- Creation of database of saleable pigs in a cluster through mobile-based data collection system.
- Building Pig farmer's organization at village and cluster level.
- Developing participatory learning tools and a learning platform.
- Facilitate private player's role in business linkages.
- Establish Vaccine production centre for swine fever in the state
- Promote Rural Entrepreneurship Development Programme for pig breeding units.
- Establish institutions to train rural youth in livestock nursing and management.

Analysis and Outcome

This study has been conducted by the Institute of Livelihood Research and Training, Meghalaya with support from Meghalaya Basin Development Authority (MBDA), Govt. of Meghalaya. According to the study, in Meghalaya, pig farming is an integral part of the household livelihoods system, however, the domestic production is inadequate to meet the demand for pork. The study has recommended various key processes and interventions, which are very useful to enhance the competitiveness of pig farming in the state. It has been observed in the recent past that the Government of Meghalaya has taken a great initiative under Atmanirbhar Bharat Abhiyan to boost farmers' production and farmers' income in Meghalaya. The Meghalaya Government has launched a ₹220 crore Piggery Mission in 2019 [332]. All the recommendations mentioned in this study will be addressed in the Piggery Mission; it is not a standalone project but part of a bigger project to help farmers boost their income through greater focus on livestock breeding and creating infrastructure for marketing, cold storage, and food processing. Agencies such as National Cooperative Development Corporation (NCDC) and Animal Husbandry and Veterinary and Meghalaya Livestock Enterprises Advancement Society (M-LEADS) are responsible to support the farmers in this direction. 208 Cooperative Societies have been identified for implementation of the Piggery Mission [333].



Study Title

Evaluation Study on “Indira Awaas Yojana (IAY)” in Meghalaya

Implementing Institution

DJ Research and Consultancy Pvt. Ltd.

Project Location/Completion Year

Meghalaya, 2012

Objective

To assess the various important aspects of Indira Awaas Yojana (IAY) in Meghalaya carried out during the last year of 10th five year plan and the first four years of the 11th five year plan

Study Recommendation

- Enhancement of IAY allocation by at least 0.80 lakh
- Disbursement of fund on time
- Selection procedure be rectified as per the current BPL census list
- For a strong monitoring and supervision system
- Transparency in selection of beneficiaries
- Awareness creation about sanitation programmes
- Supply of raw materials in subsidized rates
- Evaluation of the scheme
- Convergence of schemes

Analysis and Outcome

The main objective of Indira Gandhi Awas Yojana (IAY) is to provide house to the people who are unable to build a house for themselves due to being financially weak. IAY is now known as Pradhan Mantri Awas Yojana Gramin. The Government of India wants to meet the target to provide “House for All” by 2022. For the implementation of PM Gramin Awas Yojana, the central government has released the IAY List 2021 to provide facilities under this scheme to the needy families through this scheme.

The recommendations are being implemented by the Government of India as they have to meet the target to provide “House for all” by 2022. Funds for the programme are shared by the Central and the State Govt. in the ratio of 90:10. The new unit cost of assistance under the scheme has been revised to ₹1.30 lakh per house^[334]. A strong monitoring and supervision system is in place. Awareness about the schemes are being created through various channels such as television, internet, social media, etc.

Study Title

Evaluation of the Border Area Development Programme (BADP) in Meghalaya (2003–09)

Implementing Institution

Martin Luther Christian University

Project Location/Completion Year

Meghalaya, 2011

Objective

To analyse the impact of different activities implemented under the BADP

Study Recommendation

- Identifying the 'felt needs' and priorities of the people.
- Effective and proper mechanism for monitoring implementation of schemes such as establishing a Monitoring Committee at district level.
- Funds from the State may be released directly to the District Planning Office. The District Planning Office should be equipped and empowered to release the funds to different implementing agencies.
- Empowerment of District Planning Office for planning, implementation and coordination of schemes under BADP at the district level.
- Review meetings for incomplete works under BADP.
- Steps for erection of signboards/ landmark/ milestone at the sites of BADP work.
- Start awareness programme for better participation.
- Better coordination between the Department of Border Areas, Development Programme and the Local Traditional Institutions for efficient implementation of the scheme at the village level.
- Starting of new programmes for employment and sustainable development such as STD/PCO booth, electrician, radio, TV repairing, tyre repairing, tailoring, wax and candle making, brick-making, traditional arts and handicrafts, fair price shops, restaurants.

Analysis and Outcome

The Border Area Development Programme (BADP) was conceptualized to fill in the gap by providing socio-economic security and sense of belonging to the people living along the International

Border with Bangladesh. The Government of Meghalaya, Directorate of Programme Implementation and Evaluation, Shillong sponsored the study to analyse the impact of different activities implemented under the BADP during 2003 to 2009, by evaluating nine border blocks in Meghalaya selected for the evaluation.

The implementing organization of this study has given his recommendations based on the prevailing situation during 2003 to 2009, but based on the latest reports of BADP it has been observed that many changes have taken place. In Meghalaya, the impact of BADP has been tangible as many roads, additional classrooms, community halls, etc., have been taken up along with providing gainful employment to the border youths ^[335]. The BADP has been allocated ₹784 crore in the 2020–21 fiscal and the money is distributed to the border States and Union Territories (UTs) depending on various criteria such as the length of the international border and population. In 2019–20, ₹825 crore was granted for the scheme ^[336]. hence, it is evident that the Government of Meghalaya has taken many adequate measures to implement the schemes.



Study Title

Chamring Village Community Development Plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

- Demonstrating the preparation of Community Development Plans for natural resource management under NERLP project funded by The World Bank.
- To save the youth from all the evils in the society

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

- Installation of water pump from Mawngping River.
- Enhancement of crop production through soil and water conservation.
- Supply of improved seed varieties.
- Piggery and poultry farming.
- Restoration of Mauhak (bamboo reserve).
- Afforestation

Analysis and Outcome

The North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012, was implemented by the Ministry of Development of North Eastern Region (MDoNER), to improve rural livelihoods especially that of women, unemployed youth and the most disadvantaged people by building community-based organizations and developing partnership with Government and other institutions for knowledge, skill, credit, insurance, extension, and market. The project covered 1,645 villages under 58 development blocks across 11 districts of 4 states of Mizoram, Nagaland, Sikkim, and Tripura. The Project was concluded on 31.12.2019 ^[337].

This study is a part of NERLP, and The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Chamring. The study has recommended various solutions to the existing problem in the village and submitted its report to NERLP for further implementation in the village. This study was conducted in 2014–15, but after 2015 lot of developmental activities have taken place in the North Eastern Region. Activities such as piggery and poultry farming, enhancement of crop production through oil and water conservation, afforestation have been implemented in the state.

This project is under the overall governance of the MDoNER whereas North East Livelihood Promotion Society (NELPS) is responsible for the implementation of the recommendations of the project.

Study Title

Chhanchhuahna khawpui community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

- Demonstrating the preparation of Community Development Plans for natural resource management under NERLP project funded by The World Bank.
- Save the youth from all the evils in the society and to establish an evil-free village (chhanchhuahna-saving, khawpui- city).

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

Analysis and Outcome

The North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012, was implemented by the Ministry of Development of North Eastern Region (MDoNER), to improve rural livelihoods especially that of women, unemployed youth and the most disadvantaged people by building community-based organizations and developing partnership with Government and other institutions for knowledge, skill, credit, insurance, extension, and market. The project covered 1,645 villages under 58 development blocks across 11 districts of 4 states of Mizoram, Nagaland, Sikkim and Tripura. The Project was concluded on 31.12.2019^[337].

This study is a part of NERLP and The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Chhanchhuahna Khawpui. The study has recommended various solutions to the existing problem in the village and submitted its report to NERLP for further implementation in the village. This study was conducted in 2014–15, but after 2015 many developmental activities have taken place in the North Eastern Region. Based on the response received from project investigator, it came into light that the recommendations have been just partially implemented. Activities such as piggery and poultry farming, enhancement of crop production through oil and water conservation, afforestation have been implemented in the state. The community development plan was implemented, which contributed 89.89% of the project cost, while the community contributed 10.11% in terms of unskilled labour^[338].

This project is under the overall governance of the MDoNER whereas North East Livelihood Promotion Society (NELPS) is responsible for the implementation of the recommendations of the project.



Study Title

Kanghmun south village community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

Kanghmun South is a small village with around 130 houses situated in Aizawl. The prime objective of this study is to demonstrate the preparation of Community Development Plans for natural resource management under NERLP project funded by The World Bank.

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

- Construction of market shed
- Mauhak restoration
- Afforestation

Analysis and Outcome

This study is a part of North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012. The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Kanghmun South. The study has recommended various solutions to the existing problem in the village and submitted its report to NERLP for further implementation in the village.

Kanghmun South is a small village with around 130 houses and a population of around 544. This village is located about 110 km away from the state capital, Aizawl, it is under the Lunglei Rural Block, Lunglei District.

Based on the response received from project investigator, it has been observed that the recommendations of this study have partially been implemented. Activities such as piggery and poultry farming, enhancement of crop production through oil and water conservation, afforestation have been implemented in the state ^[338].

This project is under the overall governance of the MDoNER whereas North East Livelihood Promotion Society (NELPS) is responsible for the implementation of the recommendations of the project.

Study Title

Lailak village community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

Lailak, a small village situated in the Darlawm block of Aizawl District. The village has formed a CDG for implementation of NERLP in Lailak. The group is formed with the objective to plan the livelihood development of the village.

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

- Proposed the link road be constructed in the remaining 7 km
- Restoration of bamboo population by planting local variety of bamboo in the existing place
- Soil conservation and water harvesting in the catchments of several rivers, streams running across their agri-horticultural land needs to be done.

Analysis and Outcome

This study is a part of North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012. The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Lailak of city Aizawl. The study has recommended various solutions to the existing problem in the village and submitted its report to NERLP for further implementation in the village.

The study is very useful for the development of socio-economic conditions of the residents of village Lailak. The study has come out with some recommendations which are very helpful for the respective department or funding department to implement the project. The Lailak village is more than a century old village with 143 households. It is around 100 km from the capital city of Aizawl.

As per the response received from the project investigator and village heads, it came into light that only few recommendations have been implemented but still there is more scope of work that needs to be implemented.

The following agencies are responsible for the implementation of the recommendations and development in rural areas:

- Department of Rural Development, Mizoram
- Directorate of Agriculture, Mizoram
- Department of Horticulture, Mizoram
- Department of Environment, Forests & Climate Change, Mizoram
- Land Resources, Soil & Water Conservation, Mizoram



Study Title

Lamherh village community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

Demonstrating the preparation of Community Development Plans for natural resource management under NERLP project funded by The World Bank

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

Special focus of recommendations was on:

- Water scarcity of the village needs to be solved
- Planting of locally useful varieties and species of bamboo in Mauhak

Analysis and Outcome

This study is a part of North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012. The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Lamherh of city Aizawal. The study has recommended various solutions to the existing problem in the village and submitted its report to NERLP for further implementation in the village.

The study is very useful for the development of socio-economic conditions of the residents of village Lamherh.

As per the response received from the project investigator and village heads, it came into light that only few recommendations have been implemented but still there is more scope of work that needs to be implemented.

The following agencies are responsible for the implementation of the recommendations and development in rural areas:

- Department of Rural Development, Mizoram
- Directorate of Agriculture, Mizoram
- Department of Horticulture, Mizoram
- Department of Environment, Forests & Climate Change, Mizoram
- Land Resources, Soil & Water Conservation, Mizoram

Study Title

Luangpawm village community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

Luangpawm village is a small village situated on the Eastern part of Aizawl District. The CDG has six committee members and around 70 members from different households. The group is serving as a think tank of the village and is formed with the objective to plan the livelihood development of the village.

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites. Special focus of recommendations was on agri-link road for sustainable development.

Analysis and Outcome

This study is a part of North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012. The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Luangpawm of city Aizawl. The study has recommended various solutions to the existing problem in the village and submitted its report to NERLP for further implementation in the village.

The study is very useful for the development of socio-economic conditions of the residents of village Luangpawm.

As per the response received from the project investigator and village heads, it came into light that recommendations have been partially implemented but still there is more scope of work that needs to be implemented. It was also noticed that due to lack of fund and poor coordination among the stakeholders many recommendations could not be implemented.

The following agencies are responsible for the implementation of the recommendations and development in rural areas:

- Department of Rural Development, Mizoram
- Directorate of Agriculture, Mizoram



Study Title

Muallungthu village community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

To plan the livelihood development of the Muallungthu, a small village located about 17 km from the capital city Aizawl

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

Special focus of recommendations was on:

- The existing water tank constructed through MGNREGA needs to be repaired and maintained, so as to use it to its full capacity.
- Terracing at the large scale should be done in the proposed area. This will prevent soil and water runoff during rain and prevent crop damage.
- Soil conservation and water harvesting in the catchments of several rivers, streams running across their agri-horticultural land needs to be done.
- Mauhak can be enriched with plantation of required species and varieties of bamboo.

Analysis and Outcome

This study is a part of North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012. The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Lamherh of city Aizawl. The study has recommended various solutions to the existing problem in the village and submitted its report to NERLP for further implementation in the village.

The study is very useful for the development of socio-economic conditions of the residents of village Lamherh.

As per the response received from the project investigator and village heads, it came into light that only few recommendations have been implemented but still there is more scope of work that needs to be implemented.

The following agencies are responsible for the implementation of the recommendations and development in rural areas:

- Department of Rural Development, Mizoram
- Directorate of Agriculture, Mizoram
- Department of Horticulture, Mizoram
- Department of Environment, Forests & Climate Change, Mizoram
- Land Resources, Soil & Water Conservation, Mizoram

Study Title

Mualthum north village community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

- The objective of this study is to plan the livelihood development of the Mualthum north , a small village located in Aizawl.
- Mualthum North is a village located in Lunglei block of Lunglei District.The village has formed a Community Development Group (CDG) for implementation of NERLP in Mualthum North. The CDG has 3 Office Bearers with 10 members

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

Special focus of recommendations was on:

- Rainwater harvesting tank in the village
- Planting of bamboo sapling
- Installation of PVC water storage tank
- The area under the supply reserve is depleting over the past 10 years. The trees and other forest products will be soon history and therefore, afforestation at a very large scale needs to be undertaken.

Analysis and Outcome

This study is a part of North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012. The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Mualthum North of city Aizawl. The study has recommended various solutions to the existing problem in the village and submitted its report to NERLP for further implementation in the village.

The study is very useful for the development of socio-economic conditions of the residents of village Mualthum North.

As per the response received from the project investigator and village heads, it came into light that recommendations have been partially implemented but still there is more scope of work that needs to be implemented. It was also noticed that due to lack of fund and poor coordination among the stakeholders many recommendations could not be implemented.

The following agencies are responsible for the implementation of the recommendations and development in rural areas:

- Department of Rural Development, Mizoram
- Directorate of Agriculture, Mizoram
- Department of Horticulture, Mizoram
- Department of Environment, Forests & Climate Change, Mizoram
- Land Resources, Soil & Water Conservation, Mizoram



Study Title

Phairuangkai village community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

To plan the livelihood development of the Phairuangkai, a small village located in Aizawl

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

Special focus of recommendations was on:

- Water pump from the Chauchi River
- Since the elevation of Chauchi River is slightly lower than the village, heavy duty water pump is needed
- To prevent water runoff construction of check dam is needed.

Analysis and Outcome

This study is a part of North East Rural Livelihood Project (NERLP), a World Bank aided project launched in 2012. The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Phairuangkai of city Aizawl. The study has recommended various solutions to the existing problem in the village and submitted its report to NERLP for further implementation in the village.

The study is very useful for the development of socio-economic condition of the resident of village Phairuangkai.

As per the response received from the project investigator and village heads, it was came into light that recommendations have been partially implemented but still there is more scope of work that needs to be implemented. It was also noticed that due to lack of fund and poor coordination among the stakeholders many recommendations could be implemented.

Following agencies are responsible for the implementation of the recommendation and development in rural areas:

- Department of Rural Development, Mizoram
- Directorate of Agriculture, Mizoram
- Department of Horticulture, Mizoram
- Department of Environment, Forests & Climate Change, Mizoram
- Land Resources, Soil & Water Conservation, Mizoram

Study Title

Rangte village community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

Rangte is a small village having around 150 houses with a population of around 809. This village is located in the South West part of Mizoram and is situated under Lungsens Block of Lunglei District. The group is formed with the objective to plan the livelihood development of the village.

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

Analysis and Outcome

This study is a part of North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012. The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Rangte of city Aizawal. The study has recommended various solutions to the existing problems in the village and submitted its report to NERLP for further implementation in the village.

The study is very useful for the development of socio-economic conditions of the residents of village Rangte.

As per the response received from the project investigator and village heads, it came into light that recommendations have been partially implemented but still there is more scope of work that needs to be implemented. It was also noticed that due to lack of fund and poor coordination among the stakeholders many recommendations could not be implemented.

The following agencies are responsible for the implementation of the recommendations and development in rural areas:

- Department of Rural Development, Mizoram
- Directorate of Agriculture, Mizoram
- Department of Horticulture, Mizoram
- Department of Environment, Forests & Climate Change, Mizoram
- Land Resources, Soil & Water Conservation, Mizoram



Study Title

Sunhluchhip village community development plan

Implementing Institution

The Energy and Resources Institute

Project Location/Completion Year

Mizoram, 2015

Objective

Demonstrating the preparation of Community Development Plans for natural resource management under NERLP project funded by The World Bank

Study Recommendation

The study has recommended a model of community development plans for replications in the project sites.

Analysis and Outcome

This study is a part of North East Rural Livelihood Project (NERLP), a World Bank-aided project launched in 2012. The Energy and Resources Institute, New Delhi has done a comprehensive study on various socio-economic aspects of village Sunhluchhip of city Aizawl. Sunhluchhip is a village under Darlawn Block in Aizawl District. The village has formed a Community Development Group (CDG) for implementation of NERLP in Sunhluchhip.

The study has recommended various solutions to the existing problems in the village and submitted its report to NERLP for further implementation in the village.

The study is very useful for the development of socio-economic conditions of the residents of village Sunhluchhip.

As per the response received from the project investigator and village heads, it came into light that recommendations have been partially implemented but still there is more scope of work that needs to be implemented. It was also noticed that due to lack of fund and poor coordination among the stakeholders many recommendations could not be implemented.

The following agencies are responsible for the implementation of the recommendations and development in rural areas:

- Department of Rural Development, Mizoram
- Directorate of Agriculture, Mizoram
- Department of Horticulture, Mizoram
- Department of Environment, Forests & Climate Change, Mizoram
- Land Resources, Soil & Water Conservation, Mizoram

Study Title

State development report of Mizoram

Implementing Institution

National Institute of Public Finance and Policy

Project Location/Completion Year

Mizoram, 2012

Objective

To assess the constraints faced by the Mizo economy, both sectorally and globally

Study Recommendation

- Development of irrigation facilities
- Road network and AgriLink Road
- Telecommunication facilities
- Water harvesting system: proposal to construct 5 in each village at the cost of ₹5 lakh each
- Rural electrification: Proposals include the setting up of “hydroger”, i.e., low cost hydel power generators
- Setting up of processing unit: Six biomass dehydration units—processing units for fruits, tung, bamboo
- Setting up tissue culture lab
- Rural godowns proposed to be constructed in 750 villages
- Banking facilities and micro-credit
- Satellite remote sensing and GIS for NLUP

Analysis and Outcome

This study was undertaken by the National Institute of Public Finance and Policy and commissioned by Planning Commission, Government of India.

This study provides a brief overview of the Mizo economy and society. Each of the individual chapters in the report focuses on one selected aspect or sector and develops a strategy for that sector.

Though there are no clear recommendations mentioned in the report but the report has proposed activities under (New Land Use Programme) NLUP programme in the following areas: agriculture, horticulture, animal husbandry, fisheries, forestry and minor industries and services in order to ensure the projected returns. This report has discussed issues on various sectors (viz., human development, fiscal health of the state, agricultural & allied sector, etc.) and developed strategy and approach for the development of the state.

The following organizations are responsible for the implementation of the strategies and recommendations mentioned in the report.

- Planning and programme implementation
- Irrigation and water resources
- Land resources, soil, and water conservation
- Labour Employment, Skill Development & Entrepreneurship (LESDE)
- Social welfare and tribal affairs
- Environment, forest and climate change
- Rural development



Study Title

Detailed project report for establishment of Abiogenesis Centre for performing arts and crafts

Implementing Institution

Abiogenesis Society

Project Location/Completion Year

Nagaland, 2017

Objective

- To promote and preserve the fast fading rich cultural heritage of North East Region by providing performance opportunities for artists to perform live on the stage of D' Art Hall and be able to record live on events managed by professionals.
- Provide facilities for artists, producers and scholars who want to record and preserve folk songs, folklores and epic films and documentaries through audio and video formats and at the same time providing the important live practical projects through these events for the trainees at the Centre at Nuton Bosti of Dimapur.

Study Recommendation

- Establish a Centre and Support Network for Sustainable Arts and Culture
- Space to demonstrate, document, visualize and perform local stories
- Provide training and develop new skills in art and sustainability
- Provide opportunities for artists and creative industry professionals
- Provide employment and volunteering opportunities
- Explore the potential of creativity as solution to sustainability
- Create a unique performance and gathering space for the arts community
- Bring different arts-based organizations together to facilitate sharing of existing resources
- Become a model for Sustainable Creative Community Development

Analysis and Outcome

Abiogenesis Centre for Performing Arts and Crafts is a project for multi-skill development and training centre in the field of entertainment and at the same time promotes and preserves the fast fading rich cultural heritage of North East Region. This project was funded by NEC.

Based on the inputs from the project investigators, it has been observed that all the planned activities have been implemented. It has also been noticed that for sustainable development of the existing project there is a need of effective coordination among all stakeholders. The disbursement of the fund is also one of the reasons for planning and functioning of the project. The project investigator also indicated the delay in the last installment of the fund.

North Eastern Council is playing a vital role in promoting and preserving the cultural heritage in North East region. Apart from NEC, there are other local NGOs who are also responsible for the development in this sector.

Study Title

Livelihood analysis of vulnerable groups (differently abled) under MGNREGS

Implementing Institution

National Institute of Rural Development and Panchayati Raj, Centre for Wage Employment & Livelihoods

Project Location/Completion Year

Tripura, 2020

Objective

- To study the participation profile of differently-abled people in the MGNREGS
- To study the livelihoods of differently-abled people with and without MGNREGS
- To analyse types of works assigned among various categories of differently-abled people
- To suggest measures for assignment of relevant works among different categories of differently-abled people to ensure their higher participation.

Study Recommendation

- Mobilizing the implementing agency on equity and inclusiveness of differently-abled people in all MGNREGS activities, especially for stakeholders such as Gram Rozgar Sahayaks (GRS), community mobilizers, elected representatives, social audit coordinator, junior engineer, etc.
- MGNREG Act may be amended to make mandatory provisions to include differently-abled people in every working group, as per the availability of the differently-abled population. Special Gram Sabha needs to be conducted for the differently-abled to enrol them under MGNREGS and provide exclusive job cards.
- Rozgar Diwas needs to be focused on mobilizing the differently-abled and list their demands, as the households are scattered in the North Eastern Region. Skill development programmes need to be implemented to encourage farm and off-farm activities/entrepreneurs among the differently-abled under NRLM. This will enable the widow-headed household with a differently-abled sibling.

Analysis and Outcome

This study has been conducted by National Institute of Rural Development and Panchayati Raj (NIRDPR), Hyderabad. The study has also focused on some lacunas such as personal care of children, better care of infants, negative attitude of non-disabled workers which seeks kind attention of the MGNREGS officials and related service provider to ensure better participation and continue the success of the state in providing highest person-days to the rural and vulnerable poor.

This study has highlighted many issues which prove to be hindrance in the implementation of the new schemes or projects; hence the learning of this study is very useful for the smooth implementation of new projects. Better coordination among the stakeholders and state government is required to implement the recommendation mentioned in the study.

There are several GoI programmes facilitated for the benefit of differently-abled people to promote livelihood opportunities. Some of the programmes like NRLM, MGNREGS and PMEGP, and schemes of the Ministry of Micro, Small & Medium Enterprises (MoMSME), NHFDC (National handicapped Finance and Development Corporation), etc., were implemented. Besides, there are other available alternatives in enhancing livelihood skills (exploring farm and non-farm based employment) and options for the differently abled. The gap in employment between differently-abled people and non-disabled people has increased in the past decade, which is a major cause of concern. The economic boom failed to make an impact on the employment of PWDs.



Study Title

Report on status and prospects of IT/ITeS Sector in NER

Implementing Institution

Spectrum Planning (India) Ltd

Project Location/Completion Year

More than one state, 2016

Objective

To examine the existing IT/ITeS/ESDM infrastructure and to prepare a roadmap for the development of the sector in the North Eastern Region

Study Recommendation

- Formation of 'North East IT Development' Authority.
- It is essential that NER develops at least 2 IT Parks at the earliest.
- The state governments have to prepare data bank covering various aspects. These will ensure speeding up the IT/ITeS business drive and avoidance of false start.
- Given the nature of governance in NER states, it is recommended to adopt Single Window Clearance for IT/ITeS investments.
- Operating on 'Hub and Spoke' model is suggested for consideration by Indian MNCs and large corporates.
- NAC test (NASSCOM Assessment of Competence test) is given wide publicity and students are encouraged to appear for NAC, which is a well-developed certification and benchmarking programme for employment in IT industry.

Analysis and Outcome

The findings of this study are useful for planning and development of IT infrastructure in North Eastern region. Development in IT infrastructure in North Eastern region plays a vital role in the socio-economic development of rural areas.

It has been noticed that there are several GoI programmes facilitated for the benefit of differently-abled people to promote livelihood opportunities. Some of the programmes like NRLM, MGNREGS and PMEGP, and schemes of the Ministry of Micro, Small & Medium Enterprises (MoMSME), NHFDC (National Handicapped Finance and Development Corporation), etc., were implemented. Besides, there are other available alternatives in enhancing livelihood skills (exploring farm and non-farm based employment) and options for the differently abled.

Recommendations of this study have been partially implemented. The state-of-the-art STPI centre, covering 18,137 sq. ft, in Kohima has been established in 2021 [339]. This STPI centre is envisaging to host as a Centre of Entrepreneurship in IT Applications in Graphic Design, where start-ups, students and innovators can utilize the facility for research and development of new innovative solutions. STPI Centre at Agartala was established in 2017.

NASSCOM Assessment of Competence test (NAC) has been enacted in Meghalaya since 2008 as an industry standard assessment and certification programme to ensure the transformation of a "trainable" workforce into an "employable workforce" hence creating a robust and continuous pipeline of talent for the BPO sector [340].

The Department of Information & Technology in every state is responsible for developing the IT infrastructure in the state.

Study Title

Socio-economic development policies for Manipur and Nagaland: strategies for strengthening the framework

Implementing Institution

Public Policy Research Centre

Project Location/Completion Year

More than one state, 2015

Objective

To provide an analysis of the current condition of development and security policies in Nagaland and Manipur, identifying the loopholes in the implementation on the ground and suggesting solutions to the same via an integrated policy framework to help optimize and improve economic and social conditions in the states.

Study Recommendation

The policy framework is categorized under governance, infrastructure, and development and security.

- **Governance:** The North Eastern Council which acts as an advisory body and has since the North Eastern Council (Amendment) Act 2002 been reduced to a nodal agency for disbursing funds for projects in the North Eastern states, needs to have its review, conflict resolution and security coordination functions restored. The relationship between the Central government and state governments needs to be renewed. The focus in Manipur and Nagaland must be on the structures and processes that need to be put into place or improved, rather than the funds that are requested.
- **Infrastructure and Development:** The overlaps in benefits provided by the state governments and NEIIPP need to be sorted through. This will prevent the rampant misappropriation of funds from an otherwise sound and beneficial policy. Vocational training institutes are required in both Manipur and Nagaland in order to develop industry-specific skills in the workforce of both states.
- **Security:** Assimilation of surrendered or captured underground cadres of insurgent groups. Border security needs to be taken up as a priority along the Eastern borders of Nagaland and Manipur. Regular intelligence sharing and maintaining open channels of communication.

Analysis and Outcome

This study has explored the issues and problem areas that are hindrance to the development of Nagaland and Manipur. This study has outlined an integrated policy framework that will help institutions and administrators to work together in order to boost the economic, social and political performance of Nagaland and Manipur. The policy intervention suggested under three broad categories, viz., Governance, Infrastructure and Development, and Security have been partially implemented. In the recent past, it has been observed that State Government and Central Government have taken many initiatives in the direction of infrastructure development and security of the region [341].

This study has pointed out the security concern in this region as Manipur's border with Myanmar is 398 km, but only 40 km have been fenced so far. Border disputes always trigger protests and opposition by local groups. This has compelled the government to halt the project at some locations.

Agencies responsible for implementation:

- North Eastern Council
- The Ministry of Development of North Eastern Region
- Public Works Department



Study Title

Social assessment and tribal development network

Implementing Institution

Consulting Engineers Services (India)
Limited, New Delhi

Project Location/Completion Year

More than one state, 2011

Objective

The main objective of the study was to identify strategies for targeting, mobilizing, consulting, benefitting and empowering the key project stakeholders, especially women and youth from vulnerable poor households.

Study Recommendation

Various points under the key social strategies, tribal development frameworks, gender strategy, social impact screening and mitigation, grievance redressal, and capacity building have been recommended in this study for NERLP project.

Analysis and Outcome

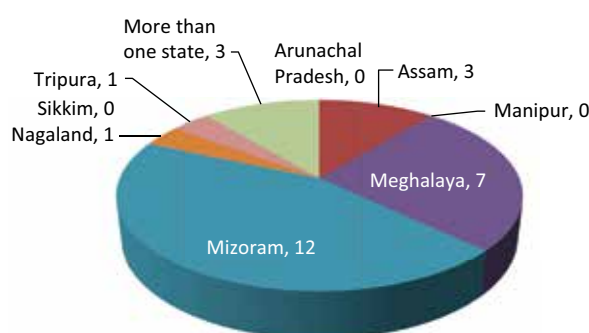
This study has done a social assessment in the four North Eastern States, i.e., Mizoram, Nagaland, Sikkim, and Tripura. The social assessment includes an overview of the socioeconomic and institutional dimensions of poverty, vulnerability and exclusion in the project area, and provides recommendations.

The social assessment study indicates higher poverty, vulnerability and social exclusion among the women, specially tribal women, women-headed households, single women households, small and marginal farmers, vulnerable tribal groups like Reang in Tripura, Lepcha and Bhutias in Sikkim, Scheduled Castes and other backward castes in Sikkim, limited transport services and connectivity, lack of information, low awareness and illiteracy, etc.

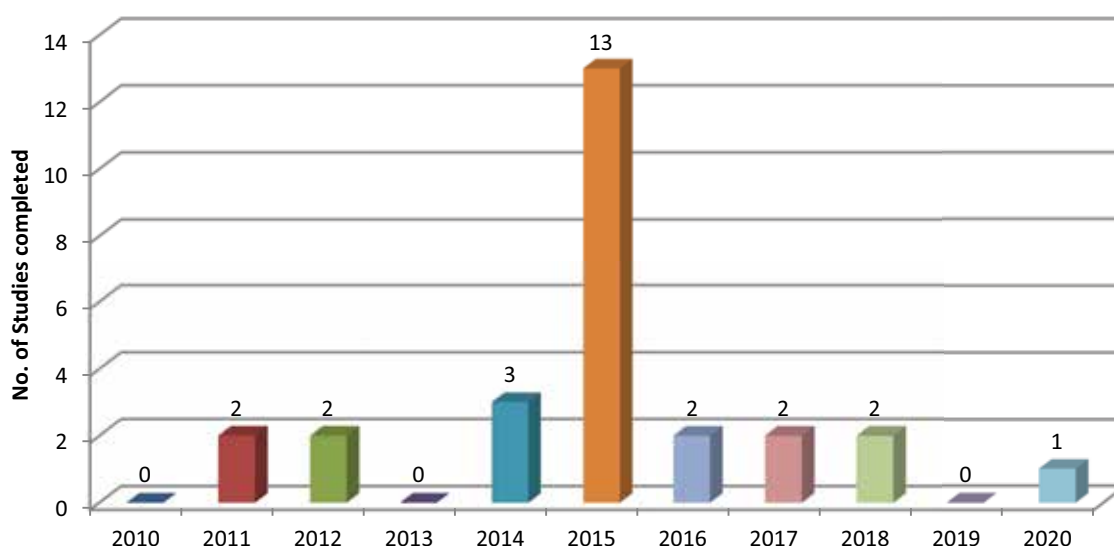
The social assessment strategies indicated in this study is a baseline study, which proved to be very useful for implementing the project NERLP. Based on The World Bank's report [342] it has been observed that the project was started in 2011 and has been successfully implemented in 2019, in few instances partial impact of the strategies have been noticed. Socio-economic development of any region is a continuous process hence there is a need to implement more such studies and projects for the development of the society.

State-wise Summary

In the present study, over 27 study reports have been collected and analysed. These research studies have been carried out in the North Eastern Region (NER) by various academic and research institutions on Rural Development sector. Keeping the collected study reports on Rural Development sector in view, it has been observed that Mizoram received the maximum number of studies (12), followed by Meghalaya (7), Assam (3), Nagaland (1), Tripura (1), Sikkim (0), Arunachal Pradesh (0) and there are 3 study reports which focus on more than one state. If we see the year-wise trend of completed studies, it has been observed that 13 studies have been completed in 2015, which is the highest during 2010 to 2020. For the development in the rural sector in the NER, there is a strong need to allocate more projects in rural sector in the years ahead.



Studies completed in Rural Development Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Rural Development Sector in NER during 2010 to 2020 (Year-wise)

Assam

Assam is blessed with very rich natural resources, which, if exploited to their full potentialities, can raise its economy to much higher level of development. As per 2011 census data, 68.84% of the total population lives in rural India and in Assam, 87% of the total population lives in rural areas (Census of India Report, 2011). The State Government has been giving special thrust for the elimination of rural poverty as well as upliftment of the economic condition of people in rural areas.



In the present study, three (3) reports have been collected and analysed that focus on rural community development, livelihood and water resource management in the rural areas of Assam. All the three studies have been carried out by The Energy and Resources Institute (TERI). In one of the study report, comprehensive village-wise activity plans have been developed for all the revenue villages of the Panchayat considering agriculture, irrigation, water conservation, natural resources, sanitation, migration, livestock, sericulture, fishery, energy for cooking, fishing, bamboo craft, and other associated activities related to livelihood. All total 19 livelihood clusters have been identified based on the primary survey and 40 different activities have been proposed for execution under comprehensive village development plan.

There is another study that focuses on Integrated Watershed Management Programme (IWMP) implemented by the State Level Nodal Agency (SLNA), Soil Conservation Department, Government of Assam. In this study, TERI has conducted evaluation of the preparatory phase of Batch II (2010–11) IWMP projects for Karbi Anglong district of Assam in 2014. The Government of India has launched another scheme in 2015 that is known as Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)[2], which is an amalgamation of Accelerated Irrigation Benefit Programme (AIBP) of the Ministry of Water Resources, River Development & Ganga Rejuvenation (MoWR, RD&GR), Integrated Watershed Management Programme (IWMP) of the Department of Land Resources (DoLR) and the On Farm Water Management (OFWM) of the Department of Agriculture and Cooperation (DAC).

It has been observed that the rural communities are always deprived of the opportunities to access the resources and information that can lead to enhancing their knowledge and skillsets. Keeping this in view, a model of “Vigyan Sanchar Kendras” was initiated in April 2012 by TERI, which was funded by the Department of Science & Technology. Under this project, two resource centres were established in the state of Assam. Cluster of villages comprising 5–7 villages were identified and catered by these two resource centres in the districts. For the sustainability and implementation of such projects, few challenges have been observed, viz., limited budget is a major challenge, access to facilities in the resource centres and maintenance of the operations is another challenge, and continuous engagement of the stakeholder groups, especially the youth in the activities of the project is a major challenge.

Meghalaya

In the present study, seven (7) study reports have been collected and analysed. These studies have primarily focused on livelihood and infrastructure, housing schemes, and rural employment in the rural areas of Meghalaya. In one of the project “Evaluation of the Border Area Development Programme (BADP) in Meghalaya” 195 villages located in five districts of Meghalaya under nine blocks were studied. The implementing organization of this study has given its recommendations based on the prevailing situation during 2003 to 2009, but based on the latest reports of the BADP [3] it has been observed in Meghalaya, the impact of BADP has been tangible as many roads, additional classrooms, community halls, etc., have been taken up along with providing gainful employment to the border youths. [3] There are two study reports, which focus on rural housing schemes, in one of the study report, evaluation of “Indira Awaas Yojana (IAY) in Meghalaya” has been done in 2012. The Government of India has revamped the Indira Awaas Yojana (IAY) as Pradhan Mantri Awaas Yojana-Gramin (PMAY-G) w.e.f. 2016–17 to realize the vision of “Housing for All by 2022”. As per the Press Information Bureau report [4] released on December 14, 2021, in the rural area of Meghalaya, 21,340 houses have already been sanctioned against the target of 42,932 houses. A comprehensive study has been done on rural housing scheme in another report. The recommendations/findings of both the reports are very useful for successful implementation of the present housing schemes in rural areas such as PMAY-G.

Mizoram

In the present study, twelve (12) study reports have been collected and analysed. Out of 12 study reports, 11 study reports are mainly focusing on community development plan in 11 different villages in Mizoram, viz., Chamring, Chhanchhuahna Khawpui, Kanghmun South, Lailak, Lamherh, Luangpaw, Muallunthu, Mualthum North, Phairuankai, Rangte, and Sunhluchhip. Comprehensive studies have been carried out by TERI under the North-East Rural Livelihood Project (NERLP) during 2015. The study team has recommended various solutions to the existing problem in the above mentioned villages and submitted its report to NERLP

for further implementation in the villages. These studies have been conducted in 2014–15, but after 2015 lot of developmental activities have taken place in the NER. Activities such as piggery and poultry farming, enhancement of crop production through oil and water conservation, afforestation have been implemented in the state.^[5] There is another study report

Although rural areas in Mizoram have been progressing, there are some challenges and barriers which hinder the process of development. To tackle these problems, effective implementation of rural development schemes is needed. An active involvement of the rural people in decision making, planning & implementation, monitoring & evaluation, and sharing the benefits of the development is necessary. Village Councils must be empowered and strengthened to implement various Government schemes. Village people must be sensitized about the schemes and programmes for better result.

Nagaland

Nagaland is a land of unique culture and traditions. Nagaland is known for its exquisite bamboo and cane products, weaving, and wood carving. Dance and music are essential parts of Nagaland's culture. Many tribes and races live in Nagaland together and as such there are different traditional dances and music in the state. The music of Nagaland is characterized by folk songs and music accentuated by traditional instruments.

In the present study, only one study report has been collected and analysed. This study report has primarily focused on multi-skill development and training centre in the field of entertainment and fast fading cultural heritage of the NER. This project has been funded by North Eastern Council (NEC) to establish Abiogenesis Centre for Performing Arts and Crafts for multi-skill development and to support network for sustainable arts and culture with a basic objectives to provide—training and develop new skills in art and sustainability, employment and volunteering opportunities, and to explore potential of creativity as solution to sustainability.

Based on the inputs from the project investigators, it has been observed that all the planned activities have been implemented. It has also been noticed that for sustainable development of the existing project there is a need of effective coordination among all stakeholders. The disbursement of the fund is also one of the reasons for planning and functioning of the project. The project investigator also indicated the delay in the last installment of the fund.

Tripura

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is an important source of economic and employment support for persons with disabilities (PwD) in rural areas. In the present study, one study report has been collected and analysed, which primarily focuses on livelihood analysis of vulnerable groups (differently-abled) under MGNREGA. The study reveals that though the participation of differently-abled persons in the scheme is very low, yet their participation is gradually increasing day by day which depicts a positive picture. The awareness level of the differently-abled persons has increased due to their participation in employment. The employment provided by the scheme makes them more financially secured, aware of their rights and entitlements, and enable them to interact with various officials, negotiate the wage rate, participate in various local-level institutions and share ideas, which in turn, enrich their self-dignity and have brought down the negative attitude of the family and society.

This Study has highlighted many issues which prove to be hindrance in the implementation of the new schemes or projects; hence the learning of this study is very useful for the smooth implementation of new projects. Better coordination among the stakeholders and state government is required to implement the recommendation mentioned in the study.

Despite several Government of India's programmes to facilitate the benefit of differently-abled persons to promote livelihood opportunities the gap in employment between differently-abled and non-disabled persons has increased in the past decade, which is a major cause of concern.



Overall Scenario

Three (3) projects that have been carried out in more than one state related to rural development sector have been covered under the present study to understand the constraints and opportunities for development in rural sector in the NER.

One of the studies was conducted in 2016 by Spectrum Planning (India) Ltd and funded by North Eastern Development Finance Corporation Ltd. (NEDFi). The main objective of the study was to examine the existing IT infrastructure and to prepare a roadmap for the development of the sector in the NER. The findings of this study are useful for planning and development of IT infrastructure in the NER. Development in IT infrastructure in the NER plays a vital role in the socio-economic development of rural areas. Recommendations of this study have been partially implemented. The state-of-the-art STPI centre, covering 18,137 sq. ft, in Kohima has been established in 2021. This STPI centre is envisaging to host as a Centre of Entrepreneurship in IT Applications in Graphic Design, where start-ups, students and innovators can utilize the facility for research and development of new innovative solutions. STPI Centre at Agartala was established in 2017.

Another study report has explored the issues and problem areas that are hindrance to the development of Nagaland and Manipur. This study has outlined an integrated policy framework that will help institutions and administrators to work together in order to boost the economic, social and political performance of Nagaland and Manipur. This study has pointed out the security concern in this region as Manipur's border with Myanmar is 398 km, but only 40 km have been fenced so far.

In the third study report, a social assessment of the four North Eastern States, i.e., Mizoram, Nagaland, Sikkim, and Tripura has been done. The social assessment includes an overview of the socio-economic and institutional dimensions of poverty, vulnerability and exclusion in the project area, and provides recommendations. The social assessment strategies indicated in this study is a baseline study, which proved to be very useful for implementing the project NERLP. Based on The World Bank's report ^[6] it has been observed that the project was started in 2011 and has been successfully implemented in 2019, in few instances partial impact of the strategies have been noticed. Socio-economic development of any region is a continuous process, hence, there is a need to implement more such studies and projects for the development of the society.

- Details available at https://arunachalplan.nic.in/html/docs/1_profile_arp.pdf
- Details available at <https://irrigation.assam.gov.in/portlets/pradhan-mantri-krishi-sinchayee-yojana-pmksy>
- Report of the Directorate of Border Areas Development 2013-2015. Details available at <https://megbad.gov.in/pdf/Border%20Area%20Report%202013-2015.pdf>
- Details available at <https://rural.nic.in/en/press-release/houses-sanctioned-under-pmay-gramin>
- NERLP Quarterly Newsletter 2017. Details available at <http://nerlp.gov.in/notice/pdf%20newsletter.pdf>
- North East Rural Livelihoods Project (NERLP). Details available at <https://projects.worldbank.org/en/projects-operations/project-detail/P102330>

There are several GoI programmes facilitated for the benefit of differently-abled people to promote livelihood opportunities but still the gap in employment between differently-abled people and non-disabled people is a major cause of concern in the region. A proper plan of action needs to be prepared in order to resolve this issue.



6.12 SCIENCE AND TECHNOLOGY

Study Title

Floating Technology Grows Hope for Better Future: Climate Resilient Agriculture in Majuli District of Assam

Implementing Institution

South Asian Forum for Environment

Project Location/Completion Year

Assam, 2017

Objective

- To standardize a stable and farmer-friendly hydroponic tray cultivation method for sustainable primary productivity during periods of ecological hazards.
- To identify a set of local cash crops for sustained fail-safe growth in the hydroponic system.

Study Recommendation

- There should be different personnel monitoring the interventions in upper and lower Majuli. This will enable the management of sites in a manner that ensures their success.
- There are needs for interventions like heat management in the context of the cage culture.
- Extend the interventions to other sites, and such replication will focus on the development of floating rafts as seed beds with a special focus on organic red rice, which is being promoted by the government.

Analysis and Outcome

The study demonstrated the use of floating farm beds for farming on the island. The method encourages no-tillage and organic farming. It also demonstrated other benefits of floating farms such as requiring less space than conventional farming and do not need pesticides. The project is undertaken with the intention of assessing the state of the interventions at all the project sites in the backdrop of severe floods that affected Majuli island in July and August 2017. The interventions carried out till date involved the installation of total of 26 floating rafts at six sites covering both upper and lower Majuli.

The site wise outcomes of the interventions are given. The study gives an understanding of impact of climate change on the environment and livelihood. It also provides an understanding how new technologies are developed to adapt to climate changes. The technique is not only helpful for this island but also for low-lying areas in other parts of the country that suffer crop loss and other damages due to floods.

Overall, there needs a careful management and follow up of the actions taken. Besides, it also require more funding. The government should step in and offer logistical and other support to the farmers, as setting up floating agriculture is a costly affair ^[344].

Study Title

Applications of Remote Sensing and GIS in Sericulture Development (Phase II) for North Eastern Region

Implementing Institution

North Eastern Space Applications Centre

Project Location/Completion Year

More than one state, 2018

Objective

To identify potential sites for mulberry, eri muga, and tasar in 20 selected districts of North Eastern Region (NER) using multicriteria GIS analysis.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

This study has tremendous application for the development of sericulture in the North Eastern Region. This study is continuation of the previous work carried out for 108 districts representing 24 states of India.

In this study, potential sites for mulberry, eri muga, and tasar were explored in 20 selected districts of North Eastern Region using multicriteria GIS analysis. Among the states, Assam is found to have maximum suitable areas (149,442 ha covering seven districts) that can be brought under mulberry sericulture. This is followed by Nagaland (27,648 ha covering three districts), and Meghalaya (171,208 ha covering two districts). Among non-mulberry sericulture, Assam and Meghalaya have the highest suitable areas in terms of muga in the selected districts (196,212 ha and 82,524 ha, respectively).



Study Title

Identification of Low-Cost Molecular Markers for Detection of Nucellar Embryos and Zygotic Embryos in Rough Lemon and Khasi Mandarin from North East India

Implementing Institution

Gauhati University

Project Location/Completion Year

More than one state, 2016

Objective

- Identification of markers differentiating zygotic and nucellar plantlets in rough lemon and Khasi mandarin.
- Genetic diversity analysis of rough lemon germplasm from North East India.

Study Recommendation

- The identification of some universal primers and amplicons linked with polyembryony is a unique finding. The finding of zygotic and nucellar seedlings by molecular profiling is an easy and cost-effective technique. It should be further established with controlled pollination experiments.
- Refined work may guide for the construction of SCAR markers and distinct primers for this significant polyembryonic trait in citrus.
- Polyembryony trait varies broadly from species to species with environmental effect. So, it is important to develop region-specific markers.

Analysis and Outcome

The study will be highly beneficial for rough lemon and Khasi mandarin farmers. Part of a few recommendations implemented is known to have positive impact.

The universal primers identified in the study are important for the detection of polyembryony trait of *C. reticulata* (Khasi mandarin) species of this region. Three ISSR and three RAPD markers were able to distinguish the seedlings according to their developmental origin within the natural seed propagated population without the knowledge of sources of pollen parents or any control over them. All total seven amplicons were identified with these six primers those are effective in zygotic and nucellar discrimination.

Study Title

Characterization of *Xanthomonas oryzae* pv. *oryzae* Strains from North West and Eastern Regions for Screening for Xop Like Type III Effectors to Investigate Its Role as Virulence Determinants to Induce Blight in Rice

Implementing Institution

Indian Agricultural Research Institute/
Central Agricultural University, Meghalaya/
Nagaland University

Project Location/Completion Year

More than one state, 2015

Objective

- To isolate and characterize the Xop effectors in Xoo strains.
- To investigate the role of Xop effectors in virulence of Xoo.

Study Recommendation

- The latest scenario of Xoo race indicated the predominance of race 4 among the six races identified from 13 rice-growing states of north-western and north-eastern part of India. The rice R-genes Xa4, Xa11, xa13, and Xa21 were found to be stable, suggesting that these genes could be used as promising candidates for the resistance breeding programme.
- The total composition of Xop-T3SS effectors in Indian Xoo race 4 has been determined. This T3SS effector database will be useful for studying effector mediated pathogenesis in rice-Xoo system.
- All the 21 Xop effectors are dependent on T3SS-translocation; this understanding would certainly help while studying the role of the effectors during infection process in rice.
- Mutants induced significantly higher callose depositions than the wild type indicated the possible role of Xop effectors in the suppression of cell-wall associated PTI response of rice.
- The transcript expression analysis of PTI marker genes further validated the possible role of Xop effectors as suppressor of PAMP-triggered immune response in rice during infection.
- The transiently expressed effector proteins in *Nicotiana benthamiana* as well as in onion led to insight about the exact site of their localization within the plant cells. This information is relevant, particularly in envisaging the function of the effectors, as T3SS effectors localized differently depending on their function.
- Deletion of Xop effectors (xopAB, xopF, xopR) caused significantly higher accumulation of O₂ and H₂O₂. This suggested that ROS accumulation, an immune response of plant to pathogens attack, was compromised due to the deletion of the effectors from Xoo. This insight clearly hinted us that Xoo engage T3SS effectors, particularly Xop, for successful disease development through suppressing ROS-mediated immune response of rice.

Analysis and Outcome

Rice constitutes a major staple food in the North East Region. The study is very important to understand blight in rice that causes substantial loss in harvest. The study demonstrated the presence of 21 Xop-T3Es in the most virulent race 4 and determined the T3SS-dependent translocation of these effectors.

Further research of the given recommendations can be carried forward by agricultural research institutes such as IARI, Central Rice Research Institute, and other state agricultural institutes or departments.



Study Title

Study on Wild Edible Plants and Documentation of Ethnobotanical Knowledge of Utilization Practices Associated with Different Tribes of Arunachal Pradesh

Implementing Institution

Arunachal Pradesh State Council

Project Location/Completion Year

Arunachal Pradesh, 2016

Objective

To study wild edible plants and document the ethnobotanical knowledge of utilization practices associated with different tribes of Arunachal Pradesh.

Study Recommendation

- Database created from this study may be used for further study by researchers, SHGs, and NGOs.
- SHGs and NGOs may do value addition to some selected wild edible plants through cottage industries.
- A study to ascertain the nutritional value of the plants.
- Start research on plant breeding, tissue culture on various wild edible species for conservation. Cultivation of wild edible plants by local farmers in abandoned jhum lands.
- Antimicrobial properties of plant species can be further explored leading to the development of drugs for use as therapy against various diseases.
- Scientific and sustainable exploration of these wild edible plants also having ethnomedicinal utilization is suggested for commercial utilization.

Analysis and Outcome

The study highlights that wild edible plants play an important role of supplementary diet for the local tribal in the region. The study also reveals the rich biodiversity and the scope future research in the genetic diversity, conservation and horticulture. In addition, the study shows that wild edible plants are important part of local economy and livelihood of many poor villagers [343]. The study was conducted in most of the districts of Arunachal Pradesh, including the different geographical zones and indigenous groups. About 70 wild plant species used as foods have been recorded and 58 were identified from their vernacular names and ethnobotanical information recorded. Ethnobotanical knowledge of utilization, practices on wild edible plants associated with different tribes have been recorded and documented. Database of the wild edible plants screened through field survey have been prepared incorporating all the information gathered viz., parts used as food, habitat, availability etc.

Some of the prominent wild plants consumed by the indigenous people of Arunachal Pradesh are *Plantago major*, *Musa sp.*, *Houttunya cordata*, *Zingiber mioga*, *solanum species*, *Zanthoxylum rhetsa*, *Litsea cubeba*, *Pouzolzia hirta*, *Clerodendrum colebrookianum* etc.

Apart from the studied anti radical activity, the methanolic extracts of some plants samples were found to have anti-bacterial activity.

During the course of implementation of the project, linkages were developed with State Forest Research Institute, Botanical Survey of India, etc among others.

Study Title

New Technology Centre at Imphal

Implementing Institution

Ernst and Young

Project Location/Completion Year

Manipur, 2019

Objective

The objective of this DPR is to evaluate the feasibility of the proposed MoMSME TC at Imphal. This includes assessment of the market need in the region as well as across India, technology and skillset requirement, amount of investment required, and construction needed.

Study Recommendation

- Regular maintenance and repair work shall be undertaken throughout the TC over the period of time.
- Fire extinguishers shall be placed throughout the TC.
- Electrical wiring in the premises would be regularly checked and repair should be undertaken wherever required.

Analysis and Outcome

The Technology Centre (TC) at Imphal is proposed in the aromatic and medicinal plant sector, with an emphasis on cultivation and processing, including extraction of fragrant raw materials. The focus areas of the TC will include innovation and development, processing and value addition, quality testing and assurance, and training. The TC will provide consulting services across these verticals to cultivators, aspiring entrepreneurs, and MSMEs. The TC will make a concerted effort to reach out to potential entrepreneurs and MSMEs for providing these services. TC will contribute towards skilling youth to make them employable in industry by designing courses relevant to them. Courses will be in various aspects of cultivation and processing of fragrant raw materials. In addition, the TC will also provide training in CAD/CAM to students in the area in order to hone their skills in design and manufacturing, thereby increasing their employability.



Study Title

Development of Green Nanocomposites Based on Natural Resources

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2012

Objective

To develop nanocomposites from jute fibre and soy flour.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

Research in green nanocomposites has developed over the period due to rising environmental concerns and depleting petrochemical resources. It resulted in significant interest in bio-renewable polymer-based, environmentally friendly green composites. In the study various bio-degradable polymer such as starch, soy protein, whey protein, wheat gluten, zein, polyhydroxy butyrate-co-valerate (PHEV), etc, have been used with bio-fibres (like jute, hemp, flax, ramie, etc.), as matrix and reinforcing materials to form eco-friendly product with minimum impact on the environment. The study may throw some light on natural polymer interaction at nano level. It can be used as a substitute for conventional polymers and composites which are mostly of synthetic nature.

The impressive and versatile properties of biopolymers are their abundant availability, light weight, antimicrobial and biodegradable nature for use in the development of novel polymer composite materials ^[353, 354]. The study offers an alternative, sustainable and eco-friendly technology building material. Application in the realm of energy storage, environment and biomedicine is observed ^[355].

Study Title

Development of Nanocomposite Materials from Waste Plastics and Non-conventional Plant Materials Available in the Forests of Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2011

Objective

To develop nanocomposite materials from waste plastics and non-conventional plant materials available in the forests of Assam.

Study Recommendation

- The study shows that treatment of wood with various nanomaterials significantly improved the mechanical properties, UV resistance, thermal stability, water resistance, biodegradability, etc.
- The study shows a good prospect in wood industries and also recommends further exploration as an alternative in construction industries.

Analysis and Outcome

The study addresses environmental and health issues in modern manufacturing sector. It almost demonstrates the potential to recycle or reuse waste plastics and other non-conventional plants. In the study Wood polymer composite (WPC) was developed by using solution blended high density polyethylene (HDPE), low density polyethylene (LDPE), polypropylene (PP), poly (vinyl chloride) (1:1:1:0.5) and wood flour prepared from *Nal (Phragmites karka)*, a type of non-conventional plant materials. The properties of the composite were improved by the use of clay. WPC developed with organically modified clay showed superior properties compared to the composite developed with unmodified clay. Maximum improvement in properties was obtained by the addition of 3phr clay

The use of bio-compatible, non-conventional materials in different engineering applications is not only ecologically viable but also it is economical and saves conventional resources^[356]. As on November 2021, the recommendations have not been implemented. However, it has been suggested for a study in pilot scale as well as at industrial scale.

The concern developer of the composite along with plastic industries is potential agencies for the application and production.



Study Title

Geochemical Mapping in Toposheet No. 83E/14 Covering Parts of Lower Subansiri and Kurung Kumej Districts of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2019

Objective

To generate geochemical elemental baseline data for use in managing and developing natural resources; for application in environmental, agricultural, human health, other social concerns and also to search for hidden mineral deposits.

Study Recommendation

- The incidence of higher anomalies of Σ REEs (841.89 ppm) over granitoid gneiss in the north-eastern part near Boa village and in the southern part of the toposheet near Hapoli town and Manipolyang village (702 ppm) can be investigated by large-scale mapping. But higher anomalies (1073.26 ppm) near the Tale valley where sampling was done in a 4 km × 4 km grid should be studied in detail to evaluate its occurrence.
- U values in the study area vary from 1.55 ppm to 21.01 ppm, and Th values range from 6.15 ppm to 122.93 ppm. The concentration of U and Th greater than the threshold limit (12.15 ppm and 51.29 ppm, respectively) in the eastern part of the study area, which may be taken up for further exploration by the AMD.
- The high levels of As (more than the threshold limit of 10.53 ppm) in the north-western part of the study area near the Nyorbung village had been identified and could be contributed possibly by insecticides and pesticides being used in agriculture and may be studied in detail.

Analysis and Outcome

The study will help to understand the geochemical composition of the areas. In the study, a total of 144 composite stream sediment samples were collected, processed, and submitted to the Chemical Division North Eastern Region (NER) for analysis. The geology of the study area, including both lithology and structures, has been updated. The mapped area exposes the litho-units of the Bomdila Group of Palaeo-Proterozoic and Hapoli Formation of Quaternary Sediments.

The analytical data of 47 oxides/trace element of stream sediment/slope wash samples are interpreted and presented in this interim report. The analytical data for package A (XRF) and package H (ICP-MS) of 144 stream sediment samples and 18 soil samples and analytical data of package A (EC, TDS, TH, major anions, and cations), B (minor and trace elements), and C (Hg, B, and F) of nine water samples have been analysed. The geochemical contours of major oxides and trace elements have been prepared on ArcGIS based on the IDW interpolation method.

The elemental dispersion maps of the oxides show that the elevated values in the study area are observed over the Khetabari Formation and Ziro Gneiss Formation.

The Be values for most part of the study area were below the threshold value (5.17 ppm). The entire area Hf value (4.46 ppm to 116.36 ppm) is higher than crustal abundance and the threshold value for the study area.

The results of analysis and interpretation of stream water from toposheet no. 83E/14 show that the water is suitable for domestic purposes when compared with the prescribed limit of BIS. A critical analysis of the data for the Water Quality Index (WQI) reveals that the drinking water is of good quality and was slightly polluted.

GSI and AMD are the potential agencies to carry forward/execute the given recommendations.

Study Title

Final Report on Specialized Thematic Mapping in and around Sangram Dangba Area with Special Emphasis on Pb-Zn Mineralization in Kurung Kumey District of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To elucidate the stratigraphy, nature of granites, gneisses, and tectonic set-up with special emphasis on base metal and associated precious metal mineralization.

Study Recommendation

- The carbonaceous phyllite band exposed at Talangriang, which contains considerable values of gold and vanadium, needs to be studied in detail.
- Adjoining phyllitic rocks in the Miuri area are also to be studied in detail to understand the control of gold occurrences.
- The younger granite exposed in between Zero point and Sangram has to be studied in detail along with the determination of age of emplacement.

Analysis and Outcome

This study is important for the exploration of lead and zinc in the area. The study is a specialized thematic mapping on the 1:25,000 scale taken up in FS 2017-18 in the Sangram-Dangba-Pakba-Pungrung-Miuri areas of the Kurung Kumey district of Arunachal Pradesh.

These areas of Arunachal Pradesh consist of Ziro Gneiss and the metasedimentary sequence of Pungrung Formation, both part of the Bomdila Group. Ziro Gneiss occupying the south of Pungrung Formation consists of migmatitic biotite gneiss, garnet-bearing migmatitic biotite gneiss, and garnet-bearing sillimanite gneiss. The study area has undergone at least three phases of deformation.

Sulphide mineralization is common in the phyllite, carbonaceous phyllite, and quartz mica schist and is visible along narrow leached zones, at places capped by gossan.

Bed rock samples collected for analysis yielded high 40 chromium, TiO₂ concentration, and gold values up to 96 ppb. Carbonaceous phyllite of the Talangriang area yielded vanadium up to 634 ppm and Zn up to 382 ppm and gold values up to 179 ppb.

GSI and Ministry of Mines are seen as the potential agencies to execute the recommendations.



Study Title

Geochemical Mapping in Toposheet No. 83E/11 Covering Parts of Lower Subansiri and Papum Pare Districts of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To generate a geochemical database of Degree Sheet 83E of Arunachal Pradesh State using multi-elemental analyses of stream sediment samples.

Study Recommendation

The study recommends that the area with high vanadium values should be taken for detailed investigation and a point anomaly with 68 ppm uranium may also be investigated.

Analysis and Outcome

This study is significant to understand the geochemical composition of the area with respect to mineral prospect. A total area of 683 sq km was covered with the collection of 127 stream sediment/slope wash samples, nine each soil (R and C) samples, and 09 water samples, and nine heavy mineral samples. The area of toposheet 83E/11 represents an undulating terrain with a maximum elevation of 2364 m (Biru Putu) and a minimum elevation of 500 m near Hoz. The Panyor River with its tributaries—Niyarchi, Po Pabung, Pitch Pabung, and Paring—drains part of the Lower Subansiri and Papum Pare districts. The overall drainage pattern is dendritic to sub-dendritic (lithology controlled). Structurally controlled trellis and sub-parallel drainage patterns are developed at a few locations. The sampling sites are found covered by dense forest areas. At a few places, the streams are channelized to cultivated land in populated areas. The rock types belonging to the Khetabari Formation and Ziro Gneiss of Bomdila Group and the Bichom Formation of Gondwana Group are exposed in the area. Geochemical contour maps have been prepared and presented along with basic statistics for 47 elements. Analytical result for different elements varies from 3–117 ppm for Cu, 33–494 ppm for Cr, 02–193 ppm for Ni, 1–55 ppm for Co, 02–193 ppm for Pb, 10–259 ppm for Zn, 2–68 ppm for U, and 3–53 ppm for Sn. Higher values are recorded in garnetiferous mica-schist, quartzite and granite gneiss near Mangio, Hullo and Kamcha area. Comparison of the duplicate samples with their original shows significant variation of Ba, Zr, Cr, and Rb in trace elements and Ce, La, and Nd in REE.

The geochemical database will be used for the search of hidden mineral deposits, soil fertility assessment, human and animal health, establishing valid environmental baseline and understanding the chemistry of the environment. The GSI and Ministry of Mines are capable agencies to carry forward the recommendations.

Study Title

Geochemical Mapping in Toposheet Nos. 82 L/16 and 83 I/13 Covering Parts of East Siang and West Siang Districts, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To generate a baseline geochemical elemental database of Arunachal Pradesh using multi-elemental analyses

Study Recommendation

Further study in the Pang-in area considering the tungsten anomalous values ranging from 591 ppm to 1466 ppm.

Analysis and Outcome

The study is significant to understand the mineral resources of the area. In this study, a total area of 816 sq km was covered with the collection of 170 stream sediment/slope wash samples on 2 × 2 km grids in general.

The rock types belonging to the Bomdila Group, Boleng Group, Abor Group, and Siwalik Group are exposed in the area. Geochemical contour maps were prepared and presented for Aalo with basic statistics for 61 elements. Comparison of the major oxides of the duplicate samples with their original shows variation in only SiO₂ values, whereas other oxides in both original and duplicate samples are similar. Among the trace elements, Ba, Zr, Cr, Rb, and V results show significant variation.

The values of Regolith and C-horizon samples for all the 09 samples were plotted and interpreted. All the 09 samples show either depletion or enrichment in different major oxides, trace elements, and REE in Regolith and C-horizon, respectively. Stream water analysis has indicated that the samples have pH ranging from 7.45 to 8.58 and conductivity in the range of 112–458 μS/cm. The pH, conductivity, TDS, bicarbonate, and trace elements are below the BIS limits.

In the present study area, the toxic elements like Ba, Pb, Co, Cr, Cu, Zn, and Be show high values in the areas around Aalo, Kombo, Tadun, Pang-in, and Beye.

The geochemical maps will be used for the search of hidden mineral deposits, soil fertility assessment, human and animal health, establishing valid environmental baseline, and understanding the chemistry of the surface environment. The GSI can continue to carry forward the given recommendation.



Study Title

Geological Mapping with the Aid of Remote Sensing and Photogeology in Inaccessible Areas of Toposheet Nos. 82H/6, 10, 14 in Parts of Upper Subansiri of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To prepare a geological map of the unmapped areas on the 1:50,000 scale with limited field checks.

Study Recommendation

- Systematic geological mapping, on semiexpedition basis, may be proposed in the area for refining the detailed geology and structure of the area.
- Indications of Cu mineralization in the form of malachite and azurite stains were seen on the surface of biotite granite gneiss, near Yarlong (check post) and hence suggested for more sampling in search for Cu.

Analysis and Outcome

This study will be helpful to understand the mineral resources and geology of the area. In this study, a total of 1200 sq km unmapped area falling in the toposheet nos. 82H/6, 10, and 14 was mapped with the help of photogeological and remote-sensing techniques with limited field checks wherever possible. The study identified different litho-units, A, B, C, D, and E, of tourmaline granite, quartzite/biotite gneiss, ky-sill-grt-qtz-feld biotite gneiss, gt-ky-silli-bt gneiss, and schistose quartzite, respectively, belonging to the SeLa Group of rocks based on the continuation of lithologies from the adjacent earlier mapped areas.

During the field checks, an area of about 2.2 km was studied in the Yarlong area (Indian Army check post) along the road section, where Litho D is interpreted as biotite granite gneiss and is mainly composed of feldspars and quartz, together with dark minerals of which the most abundant is the biotite.

A thin section of biotite granite gneisses exhibits typical gneissic fabric and perthitic texture with mineralogical composition consisting of K-feldspar (30–35%) and plagioclase feldspar (30–40%) with quartz (20–30%) and mainly biotite, hornblende as accessory minerals. Malachite and azurite stains indicate possibility of Cu mineralization in biotite granite gneiss near Yarlong (check post).

The GSI is a capable institution to carry forward the recommendations.

Study Title

Geological Mapping with the Aid of Remote Sensing and Photogeology in Inaccessible Areas of Toposheet Nos. 82O/8, 11, 12, 15, and 16 in parts of Dibang Valley District of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To prepare geological maps of unmapped areas on the 1:50,000 scale with limited field checks.

Study Recommendation

- The accuracy of the geological map has low confidence level because of very limited field checks in a highly inaccessible terrain that is enveloped with a thick surface cover of soil, alluvium, vegetation, and snow, which severely restricts the usefulness of PGRS methods. The data must be used with consideration to the limitations.
- A systematic geological mapping is suggested on an expedition basis. After taking forest clearance and defence permission, a project may be proposed in the area for refining the detailed geology and structure of the area.
- Tectono-magmatic studies of granitic intrusions for their economic potential may be carried out keeping in view that these rocks have similar geochemistry and tectonic setting as the granitic rocks of the Gangdese batholith, which hosts several porphyry type deposits of Cu, Mo, and Au in Tibet.

Analysis and Outcome

The project has been taken up with the objective to prepare a geological map of the unmapped terrain by using photogeology and remote-sensing techniques. The mapped area consists of rocks of the Lohit Granitoid Complex compositionally ranging from leucogranites, granite, granodiorite, and diorite intruded by quartzo-feldspathic and quartz veins. The area possesses an undulatory topography with steep to moderate slopes and is a highly dissected rugged terrain with very dense forest cover. The highest elevation is 5480 m above MSL, while the lowest elevation is near 1000 m above MSL. Most of the study area is above the snow line (3500 m above MSL). Dri and Mathun are the major rivers in the study area having thick quaternary deposit on both the riverbank.

Geochemically, the granitoids of the Lohit Granitoid Complex of the study area are peraluminous, high K calc-alkaline to calc-alkaline, I-type predominantly granitic to granodioritic in composition.

The study will be helpful to understand the geology of the area. It can also be used for mineral exploration in the region. For the given recommendations of further research, the GSI can continue by putting a proposal.



Study Title

Geological Mapping with the Aid of Remote Sensing and Photogeology in Inaccessible Areas of Toposheet Nos. 91C/3, 4, 8, 12 in parts of Dibang Valley District of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To prepare geological maps of unmapped areas on the 1:50,000 scale with limited field checks.

Study Recommendation

- The accuracy of the geological map has low confidence level because of very limited field checks in a highly inaccessible terrain that is enveloped with a thick surface cover of soil, alluvium, vegetation, and snow, which severely restricts the usefulness of PGRS methods. The data must be used with consideration to the limitations.
- A systematic geological mapping on an expedition basis may be proposed in the area for refining the detailed geology and structure of the area.
- Tectono-magmatic studies of granitic intrusions for their economic potential may be carried out keeping in view that these rocks have similar geochemistry and tectonic setting as the granitic rocks of the Gangdese batholith, which hosts several porphyry type deposits of Cu, Mo, and Au in Tibet.

Analysis and Outcome

The study is of significance to understand the environment and geology of the area. It may be used for other developmental purposes. For the purpose of the study, an area of 1300 sq km has been mapped by PGRS studies. The studies were carried out using aerial photographs, digital satellite data of IRS P6 LISS III, and SRTM DEM data.

On the basis of photo-recognition, only one litho-assemblage belonging to the Lohit Granitoid Complex has been deciphered. During limited field check, this litho-assemblage was observed to consist of granodiorite gneiss, granite, and diorite. Several lineaments have been recognized in aerial photos. They generally trend NW-SE, NE-SW, and WNW-ESE. Geochemically, the granitoids of the Lohit Granitoid Complex of the study area are peraluminous to metaluminous. The distribution of these rocks ranges from granite-granodiorite-diorite and is a factor of pre-plate collision and syn-collision and has mixed origin involving both crustal component as well as mantle material.

Concerning the given recommendations, the GSI may carry forward by seeking a new funding.

Study Title

Geological Mapping with the Aid of Remote Sensing and Photogeology in Inaccessible Areas of Toposheet Nos. 91D/5, 8, 9, and 10 in Parts of Dibang Valley, Lohit, and Anjaw Districts of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To prepare a geological map of the unmapped terrain using photogeology and remote-sensing techniques with limited field checks.

Study Recommendation

Based on the present regional geological mapping (RGM) carried out, one specialized thematic mapping is recommended to:

- Establish proper stratigraphic sequence,
- Study metamorphism of various litho-units giving rise to tectonic and metamorphic history with respect to the evolution of the Himalayas,
- Study granite, its evolution and origin from magma and REE potential in granites.

Analysis and Outcome

The study is important for understanding the land, geology, and mineral exploration of the region. In this study, a total of 1600 sq km unmapped area of toposheet nos. 91D/5, 8, 9, and 10 was covered using remote-sensing techniques during FS: 2017-18. The area under investigation comprises metasedimentary from the Dibang group of rocks, which are classified as Ithun, Hunli, and Tidding Formations (with calcareous bands and basic intrusive) and granodiorite-diorite complex (Lohit Granitoid Complex). The Hunli Formation conformably overlies the Ithun Formation with gradational contact.

The metasedimentary rock shows different phases of deformation of which the D1 deformation resulted in regional metamorphism ranging from green schist facies (Hunli Formation) to garnet amphibolite facies (Ithun Formation).

As the rock gets exposed (decompression and reduction in temperature), the various litho package experienced retrograde metamorphism resulted from earlier metamorphism. These are evident from the formation of biotite in amphibolite grains, saussuritization of feldspar and formation of biotite/muscovite within garnet.

The given recommendations can be carried forward by the GSI itself.



Study Title

National Geochemical Mapping in Toposheet No 83E/8 Covering Parts of East Kameng and Papum Pare Districts of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To provide high-quality multipurpose environmental geochemical baseline data for 68 elements in a variety of media.

Study Recommendation

- The area is much to be researched and mapped (unclassified Siwalik); the contact zones of Khetabari Formation and Ziro Gneiss are of geological interest from the economic point of view.
- The area studied was covered by representative stream samples but still faces the challenges of inaccessibility and remoteness.
- Further relevant detailed studies are to be followed for enhancing geological understanding.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for mineral exploration in the region. A geochemical mapping (GCM) was carried out in the 690 sq km of toposheet 83E/08 on the 1:50000 scale covering parts of Papum Pare and East Kameng Districts of Arunachal Pradesh. The objective is to provide high-quality multipurpose environmental geochemical baseline data for 68 elements in a variety of media. The geochemical data are based on the analysis of stream sediments, stream water, R and C-horizon of soil.

Cobalt, chromium, nickel, and copper show high concentration in the areas of contact between metasedimentary and granitic gneiss. Cobalt ranges from 4 to 36 ppm with a mean of 16.21 ppm; chromium ranges from 35 to 230 ppm with a mean of 102.12 ppm; nickel ranges from 4 to 61 ppm with a mean of 17.62 ppm; and copper ranges from 0.50 to 193 ppm with a mean of 24.12 ppm. Silicon oxide high and aluminium oxides low were observed in quartzite and sandstone domain.

The study is not only a potentially powerful exploration technique but also for its implications to environment, agriculture, health, and societal concerns.

The GSI can further carry forward the given recommendations.

Study Title

Regional Neotectonic Studies for Delineation/Identification of Active Fault along the Himalayan Frontal Thrust (HFT) at the Foothills of Assam–Arunachal Himalayan in Parts of Papum Pare and Lower Subansiri Districts, Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To study the active tectonic process of the fault segment.

Study Recommendation

- The study reveals the indirect evidences of neotectonism in the study area.
- The analysis of past seismicity within a buffer zone of 300 km shows that the area is at the centre of major tectonic domains of the North East India like the Assam–Meghalaya Plateau, including the Mikir Hills in the south, the Great Himalayas in the north, the Mishmi Block in the east, the Manipur Fold Belt and the Indo-Burma range in the south-west. Besides from known structural discontinuities already mapped, there are hidden subsurface lineaments/ faults along which evidences of deformation have been noted in the quaternary sediments.
- Therefore, such features, both faults and lineaments, need to be studied out in details along certain zones/sectors showing significant neotectonic features. Detailed studies along such zones/sectors on large-scale mapping with integrated geophysical study may be carried out for detail delineation in terms of dimension, extension, and depth of the fault/faults in those areas.

Analysis and Outcome

The study is important for understanding the geology, land, and earthquake of the region. In order to identify and delineate active faults and to understand the active tectonic process of the fault segment, the nature and type of movement, contemporaneous deformation and their seismo-tectonic significance along the Himalayan Frontal Thrust (HFT), Regional Neotectonic studies were carried out in parts of toposheet 83 1/2, 1/3, 1/6, and 1/7 falling in the Papum Pare and Lower Subansiri districts of Arunachal Pradesh.

Geomorphologically, the Sub-Himalayan Siwalik in the north of the area trending ENE–WSW to NE–SW with varying elevation exhibits a rugged undulatory topography with deep incised valleys and close-spaced drainage. Seven sub-basins have been demarcated for the study of morphometric analysis using various stream attributes/features and parameters. A lineament study was carried out to understand the tectonic regime and tectonogeomorphic responses and correlate with regional structure in the area. For delineating the structural disposition of the litho-units/surfaces, the identification of any discontinuity and presence of any neotectonic activity in the area, geological mapping of 220 sq km on the 1:25000 scale and 6 L. km profile section/terrace mapping was done.

The study area falling in the sesimologically active domain has been receiving frequent earthquake tremors of tectonic origin since past. The recorded earthquake in Assam basin has been traced as far back as 1869 AD of 7.5 magnitude. Among the large earthquakes in this region were the events in 1897 (>8 magnitude), 1947 (7.7 magnitude), and 1950 (8.7 magnitude). The earthquakes of 1947 and 1950 have their epicentres in Arunachal Pradesh. The 1950 earthquake occurred with its epicentre in the Mishmi Block was within 200 km from the study area. As a result, drastic changes in the landscape by faulting, fracturing, subsidence, upliftment, and catastrophic changes in the fluvial regime were inevitable.



Study Title

Report on Geological Mapping with the Aid of Remote Sensing and Photogeology in Inaccessible Areas of Toposheet Nos. 78M/10, 11, 15, 82H/3, 4, 83A/13, 83B/1, 83I/13 in Parts of Tawang, Kurung Kumey, West Kameng West Siang, and East Siang Districts of Arunachal

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2018

Objective

To prepare a geological map of the unmapped area on the 1:50,000 scale and to collate it with the already mapped adjacent area.

Study Recommendation

- Further mapping on large scale in 78M/10, 11 and 15 and 83 B/1 will help to understand the interrelationship among the litho-units. Subsequently, collection of samples for determination of age will help to understand the stratigraphy as well as tectonics of the region.
- A study of the base metal located in and around New Lumla–Bleting section, which falls in TS Nos. 78M/10 and 11, in terms of economic viability as well as structural disposition is recommended.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes. A systematic geological mapping project was taken up to geologically map the above-mentioned areas covering 1700 sq km on the 1:50,000 scale with the help of photogeological and remote-sensing techniques. A geological map, a geomorphology map, a drainage map, a lineament map, and a digital elevation model were prepared from the study of geocoded sheets, toposheet, SRTM data using the ArcGIS software. Four litho-units were interpreted in the area comprising parts of toposheet 78M/10, 11, and 15 using digital imagery. Litho-units A and B of TS 82H/3 and 4 have been interpreted as Bomdila Gneiss of Bomdila Group and quartzite, biotite gneiss, pegmatite, and quartz mica schist belonging to the Galensiniak Formation of Se La Group, respectively. Litho-units A and B of TS 83A/13 have been interpreted as quartzite, biotite gneiss, pegmatite quartz mica schist belonging to Galensiniak Formation of Se La Group of Se La Group and Bomdila Gneiss of Bomdila Group, respectively. A photo-interpreted map of TS 83B/1 comprises 6 litho-units. A photo-interpreted map of TS 83I/13 also comprises six litho-units. These two were extrapolated from the geological map of adjacent and identified as arenaceous units.

Structurally, the general strike of the mapped area is NE-SW with moderate to steep dips towards northwest.

From an economic point of view, during the field check along the Lumla–Bleting section, limonitization is observed in the carbonaceous phyllite of Lumla Formation belonging to the Bomdila Group. Gondwana coal occurs as a lensoidal bodies with maximum thickness of 0.2 m. In the area mapped, Gondwana coal in the study area often grades into shaly coal or coaly shale. Occurrences of coal and shaly coal have been recorded near the Kalaktang–Amatula section. It is also observed that due to subsequent deformation/thrusting effect, the coal has been crushed, sheared, and powdered.

Study Title

Remote Sensing and Photogeology-Aided Geological Mapping in Unmapped Terrain in Parts of Anjaw District of Arunachal Pradesh (TS Nos. 91 H/3, H/4, H/8, and 92 E/5) on 1:50,000 Scale.

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2017

Objective

To prepare a geological map of the unmapped terrain by using photogeology and remote-sensing techniques.

Study Recommendation

- Photogeological mapping with limited field checks in the study area indicates that the area is lithologically and structurally complex.
- The area is a high-altitude zone where the mountain peaks are permafrost regions. Therefore, an expedition mapping is recommended to carry out a detailed study of the evolution of the granites.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes. The project has been taken up with an objective to prepare a geological map of unmapped terrain by using photogeology and remote-sensing techniques. The study area forms parts of Survey of India toposheet nos. 91 H/3, H/4, H/8, and 92E/5 in Anjaw District, Arunachal Pradesh, bordering China and Myanmar. The mapped area falls in the Trans-Himalayas part of the Mishmi Hills.

The mapped area comprises Lower Cretaceous to Palaeocene rocks of the Lohit Granitoid Complex represented by the lithologies of migmatites granites, mostly tonalitic and leucogranite, intruded by pegmatite and quartz veins. The petrochemical study reveals that the granite is of alkali granite, which is of peraluminous type. The quaternaries occupy the valley along the Lohit River. It is represented by the unsorted boulder deposits forming high river terraces and alluvium deposits.

A total of 25 samples have been collected for petrochemistry. The average chemical composition of the granite has SiO_2 , Al_2O_3 , Fe_2O_3 , Na_2O , K_2O , CaO , and MgO as 71.65%, 14.50%, 2.47%, 4.18%, 3.04%, 2.17%, and 1.22%, respectively. The geochemical classification indicates it to be alkali granite.

The molecular proportions expressed as weight percentages of Al_2O_3 , Na_2O , K_2O , and CaO applied mainly to granitic lithology indicate it to be of Peraluminous type as $\text{Al}_2\text{O}_3 > (\text{Na}_2\text{O} + \text{K}_2\text{O} + \text{CaO})$, which is $14.50 > 9.39$.

Four samples of stream sediment were collected for the analysis of heavy minerals. Hornblende and magnetite were the common mafic minerals. Sphene, rutile, garnet, and zircon were the heavy minerals observed from the sample of stream sediments.

The GSI can further carry forward the recommendations of the study.



Study Title

Remote Sensing and Photogeology-Aided Geological Mapping in Unmapped Terrain in Parts of Subansiri and Siyom Valley of Arunachal Pradesh

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2017

Objective

To prepare a geological map of the unmapped area on the 1:50,000 scale.

Study Recommendation

The study recommends that an expedition mapping on the 1:50000 scale in TS 82L/7 and 82L/14 will bring out the varieties of litho-units in the areas.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes. A systematic geological mapping project was taken up to cover the above-mentioned areas covering 1400 sq km with the help of photogeological and remote-sensing techniques. The study area is located in the north central part of Arunachal Pradesh and forms a part of West Siang, East Siang, and Upper Siang districts.

Physiographically, the study area of TS 82L/7 is encompassed in the higher Himalayan belt and constitutes the north-western part of MCT, and that of TS 82L/14 lies along the northern boundary of Siang Window.

The PGRS study includes preparation of a drainage map from the SOI Toposheets 82L/7 and 82L/14, structural/lineament map from IRS P6 LISS III Geocoded as well as digital satellite data. A total of 60 aerial photographs comprising 10 strips of Task Numbers 166-A have been studied under the stereoscope.

During the photogeological study of the areas covered within TS 82L/14, four broad litho-units were distinguished. It is bounded in the west by a litho-unit exhibiting discontinuous sharp-crested ridges, which are confirmed to be schist and quartzite in field. In the western end of the map, the litho-unit gives a dark tone, separated from the other litho-units by their continuous linear, sharp-crested ridges and competent nature of rocks. The drainage pattern in this litho type exhibits trellis type of pattern.

In TS 82L/7, the structural features observed are entirely diastrophic. Gneissic foliation in biotite gneiss, augen gneiss, and garnetiferous-sillimanite gneiss is the regional fabric observed and trends mostly WNW-ESE. In TS 82L/14, the structural features observed are primary as well as diastrophic. Secondary foliation in quartzite, quartz-chlorite schist, basalt and partings in limestone is the regional fabric observed in the area. The strike of this regional foliation swings from NE-SW to NW-SE. Two generations of secondary foliation are recorded in metabasalts.

The GSI can further carry forward the recommendations.

Study Title

Remote Sensing and Photogeology-Aided Geological Mapping in Unmapped Terrain in Parts of Lohit and Anjaw Districts of Arunachal Pradesh (Toposheet Nos. 92A/9, 92A/13, 92E/1, and 92E/2)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2017

Objective

To prepare a geological map on the 1:50,000 scale to fill up the gaps in the existing knowledge of lithostratigraphy and structure of the area.

Study Recommendation

- An expedition mapping on the 1:50,000 scale in TS 92A/13 areas will bring out different litho-units present in the area. Subsequently, geochronology of diorite as well as granite unit will help to understand the stratigraphy as well as tectonics of the region.
- A study of shear zones located north and south of Yasong village on the 1:25000 scale will bring out the structural history of the region.
- A detailed study of marble bands located north of Yasong village is recommended to assess the economic viability as well as structural disposition.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes. Study of aerial photographs comprising seven strips of Task Numbers 380-E and multi-temporal satellite data from IRS-P6, LISS III Geocoded FCC and IRS P-6, LISS III has been carried out to prepare the pre-field photogeological map of SOI Toposheets 92A/9 (Part), 92A/13 92E/1, and 92E/2.

In the toposheet TS 92A/9, the rock types consist of chlorite schist with limestone, garnetiferous mica-schist, and assemblages of granite, granodiorite, and diorite. Photo-interpreted map of 92A/13 is composed of mainly two litho-units. Litho-unit A has higher reflectance with sparse sub-dendritic drainage pattern and relatively broad ridge and valley pattern. This litho-unit is observed in eastern and western flanks of the map. Litho-unit B is relatively dull and occupied by dense dendritic drainage pattern and narrow ridge and valley pattern. Photo-interpreted map of TS 92E/1 and 92E/2 is composed of two litho-units. Litho-unit A has sparse sub-dendritic drainage pattern and higher reflectance, whereas litho-unit B has N-S oriented trellis drainage pattern and coarse texture. The structural features observed in TS 92A/13 are entirely diastrophic. Gneissosity in diorite gneiss and biotite granite is the regional fabric observed in the area. Sulphide minerals, viz. pyrite and chalcopyrite, are observed within quartzo-feldspathic and pegmatite veins intruding in the country rock. Pyrite crystals are also observed within marble bands. Four bands of crystalline marble are mapped north of Yasong village.

The GSI can further carry forward the given recommendations.



Study Title

Geochemical Mapping in Lesser Himalaya in Parts of East Siang District

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2014

Objective

To generate geochemical elemental baseline data of Arunachal Pradesh using multi-elemental analyses.

Study Recommendation

- A general recommendation is also made here for the inaccessible rugged Himalayan terrain. The geochemical sampling work in the state of Arunachal Pradesh may be taken up on expedition/semiexpedition basis and the collection of samples may be done on basin/sub-basin pattern instead of grid pattern due to inaccessibility of the area.
- In the chemical analysis results of 121 water samples, some chemicals indicated higher value than BIS tolerance value, but as the results indicated less than value, it may be recommended that the chemical content of water of the study area is not harmful.

Analysis and Outcome

This project was taken up with an objective to generate geochemical elemental baseline data of Arunachal Pradesh using multi-elemental analyses. The elemental distribution maps were prepared for 44 elements using the Surfer 8 software on the basis of results of 200 nos. SSS for Package A and Package H. Statistically interpreted maps are prepared using the chemical analytical data received for water sample W (A) with respect to BIS tolerance value for various chemical compositions of the water sample collected from the study area. It indicates that from the drinking point of view, the water samples of the study area are not harmful when compared with the BIS data.

The pH value of all the water samples ranges from 6.90 to 7.80. All the pH values are very close to that of pure water. The electrical conductivity of water ranges from 42 $\mu\text{S}/\text{cm}$ to 153 $\mu\text{S}/\text{cm}$, which indicates the presence of dissolved solids in the water. The temperature of the water sample varies from 18.10°C to 21.10°C. Dissolved oxygen in the water samples ranges from 5.33 mg/l to 6.98 mg/l.

Total hardness as CaCO_3 (ppm) of the water samples ranges from 20 ppm to 60 ppm. Only one water sample falls in the soft water category and rest are moderately soft. The Fe^{++} content in the water samples ranges from <0.1 ppm to 0.1 ppm. Arsenic content in all the samples was found to be <10 ppb. Sodium and chlorine content in the water samples varies from 0.6 ppm to 6 ppm and 3 ppm to 6 ppm, respectively.

Alkalinity of the samples (HCO_3^-) varies from 20 ppm to 68 ppm. The value of total dissolved solids in water samples ranges from 25 ppm to 92 ppm.

The geochemical maps will be used for searching hidden mineral deposits, managing and developing natural resources, and for environmental, agricultural, human, and animal health issues.

Study Title

Final Report on Specialized Thematic Mapping in Parts of West Siang and Upper Subansiri Districts, Arunachal Pradesh and Appraisal of Associated Carbonate Rocks

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Arunachal Pradesh, 2013

Objective

To ascertain the detailed lithostratigraphy and boundary relationship between Siyom Group and Ragidoke Formation from Central Arunachal Pradesh with special emphasis on the detailed study of associated limestone and dolomite bands and to make out their extent and quality.

Study Recommendation

- The ironstone boulder occurrences in the different localities as mentioned earlier seem to be of local concentrated part within a high iron bearing carbonaceous phyllite and quartzite rather than occurring in a continuous significant band.
- To understand the vertical extension and their continuity, geophysical investigations can be carried out.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes. Specialized thematic mapping on 1:25000 RF was taken up in parts of West Siang and Upper Subansiri districts of Arunachal Pradesh during Field Seasons 2010–12 and 2012–13 in pursuance of the item no. STM/NER/SAP/2010/003 of Geological Survey of India, North Eastern Region. The main objective of the item is to ascertain the detailed lithostratigraphy and boundary relationship between Siyom Group and Ragidoke Formation from Central Arunachal Pradesh with special emphasis on the detailed study of associated limestone and dolomite bands and to make out their extent and quality. The item also includes petrological studies and geochemical analyses to know the characteristic of the different units. The total target area covered is 975 sq km.

The study shows that the Siyom rocks have metamorphosed to amphibolite facies, while those of Ragidoke show lower green schist facies of metamorphism. The geochemical classification of Siyom quartzites indicates that they are mostly sub-arkosic with a few samples of arkosic, wacke, and shale class while those of Ragidoke are mainly wacke and shale. A total of 13 limestone/dolomite bands were demarcated during the study. These bands reported here are found to be lensoidal in nature, which may be due to the multiple episodes of deformations. The total deposit of these limestones is estimated to be 11.37 million tonnes.

Categorization of these limestone deposits under the UNFC scheme may be given as 334 of UNFC code. Out of this, 1.59 million tonnes are of SMS grade, 8.92 million tonnes are cement grade, and 0.86 million tonnes are of low grade.

The GSI can carry forward the recommendations of the study.



Study Title

Specialized Thematic Mapping in Assam–Meghalaya Gneissic Complex and Shillong Group of Rocks in Area around Nellie-Umpanai-Area Nagaon and Karbi Anglong District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2019

Objective

- To study the contact relationship between Basement Gneissic Complex and Shillong Group of rocks, their deformation and metamorphism.
- To characterize granite and gneisses of Assam–Meghalaya Gneissic Complex.
- To search for tungsten (W) associated mineralization.

Study Recommendation

The rocks of AMGC, the khondalite gneiss, contain graphite occurring as one of the inclusions. Sulphide minerals, mainly pyrite and chalcopyrite, were noticed as disseminations within the meta-rhyodacite and porphyritic granite. Keeping in mind the complex structural disposition of the area, one RP item could be taken up by some experienced structural geologist to particularly solve the problem of structural disposition of the area. One G4 item could be taken up in north-western part in and around Amdubghat to further study the possibility of sulphide and graphite mineralization.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes. The work comprises specialized thematic mapping on the 1:25,000 scale in parts of toposheet nos. 83B/08 and 83C/05 covering an area of 220 sq km in parts of Karbi Anglong and Nagaon districts, Assam. Characterization of gneisses results in the finding of new litho-units that were not addressed in previous works, i.e. khondalite, biotite gneiss, and quartzo-feldspathic gneiss of AMGC acts as basement for the Shillong Group of rocks.

The basement in the study area is overlain by volcano-sedimentary sequence of the Shillong Group. Quartzite, phyllite and meta-rhyodacite, meta-tuff, quartz-sericite schist, and intraformational conglomerates are main litho-units representing Shillong Group of rocks in the study area. The meta-rhyodacite and metatuff of Shillong Group are new findings. Two types of quartzites have been observed in the area: massive type and friable type. Meta-rhyodacite is fine grained, black coloured, hard, and compact. Around 150–200 m thick band of meta-rhyodacite was encountered near Asukunji village. Intraformational conglomerate has been observed within the Shillong Group of rocks near Asukunji and Spiting villages.

The study area has undergone multiple phases of deformation. Fine dissemination of sulphide mineralization was observed in porphyritic granite, meta-rhyodacite, and mafic dykes. Fine dissemination of scheelite mineralization is observed in meta-rhyodacite.

The GSI can carry forward the recommendations.

Study Title

Geochemical Mapping in Parts of Toposheet No. 78 O/5 and Parts of 83B/16 in Kamrup, Nagaon, and Karbi Anglong Districts, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

To generate regional geochemical database as a part of the National Geochemical Mapping Programme (NGCM) in toposheet no. 78O/5 and parts of 83B/16 covering parts of Kamrup, Nagaon, and Karbi Anglong districts of Assam and parts of West Khasi Hills district.

Study Recommendation

- REE showing very high anomalous value in areas west of Plamgaon in TS No. 83B/16 may be probed to ascertain the cause of the anomaly and to investigate any potential source of REE.
- In TS No. 78O/5, high REE values in the four blocks—NW of Beorongding block, south of Bhotpur-NW of Rajkhamal (Mayang Hill RF) block, east of Barduar-Patgaon block (Maitakhar R.F.), and south of Mawdem block—may be investigated by high-density stream sediment sampling and large-scale mapping.
- The anomalous values of zirconium in the porphyritic granite in the hills west of Sanyasipara in TS No. 78O/5 may be probed.
- The analytical results of Th show that all the samples have values higher than the median value with seven samples showing values higher than the upper limit of the Standard Global Soil Composition range. The porphyritic granite in Boko hill (South of Bhadulipara) may be probed. The hill south of Patgaon and NE of Boerongding may also be investigated.
- All the samples in TS No. 78O/5 are showing Hf values more than the upper limit of Standard Global Soil Composition range. The anomalous high value of 495.28 ppm reported in the pink porphyritic granite from the hill south-west of Sanyasipara may be investigated.
- Flouride has recorded a high value of 800 ppm in areas west of Hayangthal in the north-western part of the study area. This area may be investigated for possible fluoride contamination.
- In TS 83B/16, sample no 133 shows 1481.51 ppm of W falling in Rengbeng Juri, east of Haya TG (Kathiatoli). Strongly recommended for further studies on W in and around this area for identifying the source rock for possible W mineralization.



Analysis and Outcome

A total of 192 stream sediment samples, 8 alluvial soil samples (SS), 9 C-horizon (C-H) soil sample, 10 duplicate samples, 9 XRD samples, 9 heavy mineral and 8 petrological samples, 24 stream water samples (post- and pre-monsoon) were collected from Toposheet Nos. 78O/5 and 83B/16 and processed strictly following the SOP guidelines.

The rock types exposed in the area are Precambrian Gneissic Complex (covering approximately 90%) and the rest being quaternary sediments. The Precambrian rocks occurring in Toposheet No. 78O/5 consist mainly of grey banded gneiss (hornblende plagioclase gneiss), migmatite, and granite. On the other hand, the various litho-units exposed in toposheet no. 83B/16 include granite, granite gneiss, and metasediments of the Shillong Group.

In TS 88O/5, three anomalous zones of Th showing values greater than the upper limit of Standard Global Soil Composition (SGSC) are observed in Bhadilupara (74.00 ppm), NW of Beorongding (76.00 ppm), and north of Patgaon (68.00 ppm). An anomalous zone with very high value of Zr is observed in the porphyritic granite in areas south of Sanyasipara (10,513 ppm). Fluoride shows high concentration values in south of Mawdem (944 ppm). In TS No. 83B/16, high concentrations of Rb, Th, and Y were observed in the Plamgaon area. Zn and Cu also show anomalous concentration in the south of Dirabati (Thija Parbat).

Stream water analysis for post- and pre-monsoon shows pH values ranging from 5.07 to 7.62, indicating alkaline affinity. The water sample values fall in the desirable limits as per BIS standard, and the water is considered fresh and suitable for drinking and irrigation. Fluoride values are in the permissible limits as per WHO standards.

Study Title

Geochemical Mapping in Parts of Toposheet No. 83B/16 in Nagaon and Karbi Anglong Districts, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

To generate baseline geochemical data that has wide-ranging utilities in the fields of resource development, agriculture, medical geology, and environment.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes. A geochemical mapping was carried out in parts of toposheet no. 83B/16 in Nagaon and Karbi Anglong districts of Assam with the objective of generating baseline geochemical data that has wide-ranging utilities in the fields of resource development, agriculture, medical geology, and environment. The study area comprises rocks of Assam–Meghalaya Gneissic Complex, Shillong Group, younger intrusive granites of Neo-proterozoic to early Paleozoic age, and Quaternary sediments. Petrographic study of biotite granite gneiss indicates gneissic foliation defined by alternate felsic and mafic layers.

Higher concentration of arsenic values from 0.50 to 14.09 ppm was reported around Nabhanga, Jugijan, and Jamunamukh areas. The highest values of total REE were reported (665 ppm) over granite gneiss of AMGC in the east of Dengaon village in the north-eastern part of the study area. Zirconium has a very strong correlation with Hf and a positive correlation with SiO_2 . In the soil samples of the study area, SiO_2 is higher in the R-horizon than in C-horizon.

Heavy minerals were collected from stream sediment samples and a study was carried out. Identified heavy minerals are zircon, garnet, rutile, epidote, amphibole, and pyroxene. Analytical results of water sample show all the parameters fall under the desirable limit for drinking water as per the BIS standard. The assessment of the suitability of groundwater for irrigation was done, which shows the water is suitable for irrigation.



Study Title

Geochemical Mapping in Parts of Toposheet No. 83G/1 of Nagaon District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

To generate geochemical elemental baseline data for use in managing and developing natural resources, for application in environmental, agricultural, human health, other social concerns and also to search for hidden mineral deposits.

Study Recommendation

- Based on the updated geological maps, it is further recommended to study the contact relationship between fossiliferous limestone of Shella Formation and granitoids in the C1 quadrant (north of Kolordung, Koilajan, Sarkey Basti areas) for the better understanding of the two different tectonic groups.
- It is also recommended to study the nature and geochemistry of smoky quartz veins recorded within the granitoids exposed at Ganeshpukhuri and to find traces of similar veinlets in the surrounding and adjacent topographical sheets as it is composed of specs of sulphides and graphite, which is suspected for tin, tungsten, and molybdenum.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes. In this study, geochemical mapping has been carried out in the topographical sheet no. 83G/1 covering the parts of Hojai, Karbi Anglong, and Dima Hasao districts, Assam.

The main media of sampling are stream sediment/slope wash, soil (R and C horizons), and flowing stream water. These three media of sampling reflect geogenic composition, weathering process, and interaction about geosphere and hydrosphere, respectively. The area exposes the rocks of Assam–Meghalaya Gneissic Complex, which is overlain by tertiary sedimentary rocks comprising Jaintia, Barail, and Surma Groups.

At Ganeshpukhuri, the sheared granitoid rock was observed, which is highly weathered and composed of quartz, plagioclase, kaolinite, muscovite, and iron oxides. The quartz vein, which is cutting across the granites and pegmatite in the section, is smoky, which imparts graphite and a few euhedral crystals of pyrite and magnetite with suspected tungsten mineralization. At Teliahati, pink granite was observed, which is coarse grained and composed of quartz, plagioclase, K-feldspar, and biotite reported for the first time.

The pH values of water samples range from 6.6 to 7.4, indicating acidic to neutral character. The hydrochemical parameters of the water of the study area were compared with the prescribed limit of BIS (1991) and WHO (2006), and the values were within the permissible limit.

The GSI can carry forward the recommendations.

Study Title

Geochemical Mapping in Parts of Toposheet Nos. 83F/6, 7, 10, and 11 Covering Parts of Golaghat, Nagaon, and Karbi Anglong Districts, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

To generate regional geochemical database as a part of the National Geochemical Mapping Programme (NGCM) in parts of toposheet nos. 83F/6, 83F/7, 83F/10, and 83F/11 in Karbi Anglong, Nagaon, and Golaghat districts of Assam.

Study Recommendation

- Thorium shows high values of 83 ppm, 211 ppm, and 143 ppm in TS 83F6, 10, and 11, respectively, which are higher than the maximum range value provided by SGSC. It has been observed over Mylleim granite in and around Phulagaon Kromchha, Ramphigaon, Ghenggaon, and Kohora in TS No. 83F/6; Bijuligaon and Geleki in TS No. 83F/10; and Sarbang in TS No. 83F/11. So a detailed investigation of thorium may be recommended in these areas.
- REE shows high concentration than the maximum range value provided by SGSC. It is recommended that a detailed investigation may be carried out in the area for targeting any REE mineralization. The relative higher concentration found in over Mylleim granite in and around Kohara No. 3, Ramtharan and south of Haloa area in TS No. 83F/6 and around Geleki, Lachchigaon and Masangaon in TS No. 83F/10; Sarbang and Tarjangaon in TS No. 83F/11; Granite gneiss of Assam–Meghalaya Gneissic Complex in and around Anglang and Kalinggaon in TS 83F/7.



Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes and mineral exploration. In this study, a geochemical mapping was taken up in parts of Karbi Anglong, Nagaon, and Golaghat districts of Assam.

The litho-units of the area comprise rock types belonging to Assam–Meghalaya Gneissic Complex of Archaean to Proterozoic age, metasediments of Shillong Group of Palaeo-Mesoproterozoic age, and intrusive Myllem Granite of Neo-proterozoic to Early Palaeozoic age, occupying the hilly part of the area and Quaternary alluvial sediments occupying the hill slopes and vast valley portion.

In TS 83F/6, higher values of La (206.16 ppm), Ce (357.06 ppm), Pr (44.7 ppm), Nd (234 ppm), Eu (3.27 ppm), Sm (27.26 ppm), Gd (25.88 ppm), Tb (4.89 ppm), Dy (33.74 ppm), Ho (7.26 ppm), Er (26.21 ppm), Tm (5.3 ppm), Yb (34.90 ppm), and Lu (5.84 ppm) than the maximum range value provided by SGSC were observed over Myllem granite in and around Kohara No. 3, Ramtharan and south of Haloa area.

In TS No. 83F/10, higher values of La (650 ppm), Ce (1152.60 ppm), Pr (152.50 ppm), Nd (511.89 ppm), Eu (11.71 ppm), Sm (87.28 ppm), Gd (70.79 ppm), Tb (9.49 ppm), Dy (54.35 ppm), Ho (10.77 ppm), Er (33.97 ppm), Tm (5.3 ppm), Yb (36.66 ppm), and Lu (6.77 ppm) than the maximum range value provided by SGSC were observed over Myllem granite in and around Geleki, Lachchigaon, and Masangaon.

In TS No. 83F/11, higher values of La (352 ppm), Ce (636 ppm), Pr (83.9 ppm), Nd (287 ppm), Eu (4.02 ppm), Sm (57.2 ppm), Gd (56 ppm), Tb (9.12 ppm), Dy (61.5 ppm), Ho (11.08 ppm), Er (37.8 ppm), Tm (7.4 ppm), Yb (41.5 ppm), and Lu (7.61 ppm) than the maximum range value provided by SGSC were observed over Myllem granite in and around Sarbang and Tarjangaon.

In TS 83F/7, higher values of Ce (182.26 ppm), Pr (22.81 ppm), Nd (88.87 ppm), Gd (15.38 ppm), Tb (2.31 ppm), Dy (13.99 ppm), Ho (3.03 ppm), Er (9.58 ppm), Tm (1.82 ppm), Yb (11.22 ppm), and Lu (2.03 ppm) than the maximum range value provided by SGSC were observed over Granite gneiss of Assam–Meghalaya Gneissic Complex in and around Anglang and Kalinggaon.

Study Title

Geochemical Mapping in Toposheet No. 83 C/09 in Karbi Anglong District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

To create a geochemical database using multi-elemental analyses of 68 elements.

Study Recommendation

- From elemental distribution, maps were made. It is observed that zirconium shows high value in stream sediment as well as in soil samples with the highest value being 3482 ppm. Hence, further investigation can be made for the element zirconium and also for 254 barium.
- In the south-eastern corner of the study area, near Mukim and Ameit village, rare earth element values are comparatively high. The total REE content near the Mukim village is 1504 ppm, which is the highest value recorded in the study area. Thereby, the areas can be taken up as future scope for detailed work.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes and mineral exploration. In this study, an area of 700 sq km has been covered, and 182 stream sediment samples, soil and water samples, rock samples for petrographic study, and samples for heavy mineral study were analysed.

Petrographic studies of thin sections show the presence of hornblende and titanite in granite, along with zircon apatite as accessories. A study of heavy mineral samples reveals the presence of an abundant quantity of zircon, apatite, and sphene in most of the samples. Garnet and tourmaline are also present in lesser quantity. A few grains were identified as monazite, cordierite, sillimanite, rutile, allanite, and ilmenite in the samples prepared for heavy mineral study.

The study can be used for targeting potential zones of economic minerals, betterment of agricultural facilities, sustainable development, and medical issues.

The GSI can further research the given recommendations.



Study Title

Geochemical Mapping in Toposheet No. 83C/14 in Dima Hasao and West Karbi Anglong Districts, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

To generate a geochemical elemental baseline database in the area as part of the National Geochemical Mapping Programme for use in developing and managing natural resources and various other social concerns.

Study Recommendation

- The anomalous value in stream sediment samples which were collected from Mawriyap and Sarucha villages in northern parts of toposheet has total rare earth elements ranging between 55 ppm and 3621 ppm.
- La constitutes 7.89 to 748.73 ppm. Uranium content varies from 1.17 to 48.00 ppm. This area can be taken as G4 item for REE investigation.

Analysis and Outcome

The study is important for understanding the environment and geology of the region. It may also be used for developmental and agricultural purposes and mineral exploration.

In this study, a total of 209 samples were collected covering an area of 698 sq km in toposheet no. 83C/14, including nine Regolith and nine C-horizon soil samples on each 5' x 5' grids, and stream water samples were collected from nine sites.

The area comprises Archean to Proterozoic rocks of the Assam–Meghalaya Gneissic Complex. In the case of water samples, the pH of all quadrants falls within the desirable limit as per BIS limit and fit for consumption or agriculture. Similarly, TDS and major elements like Ca, Mg, Na, K, HCO₃, NO₃, and P₂O₅ and some of the trace elements all fall within the desirable limit as per BIS and WHO limits, suggesting that they are not contaminated and are suitable for drinking, irrigation, and industrial purposes. The distribution pattern in oxides and trace elements suggests close affinity of certain group of oxides and trace elements controlled by lithology of the terrain.

Anomalous occurrences of rare earth elements (Σ REE) in stream sediments are concentrated in granitic gneiss near Charchim, Gilangso, and Phanglangso villages in north-west parts of toposheet no. 83C/14. The stream sediment samples contain total rare earth elements (REE + Sc and Y) in the range of 57.79995 to 1468.484 ppm with an average value of 259.7457 ppm. The highest value of La is 306.63 ppm and that of Ce is 564.84 ppm. Σ LREE values range between 43.93 ppm and 1263.52 ppm with an average value of 204.65 ppm, and Σ HREE values range between 13.87 ppm and 240.15 ppm.

Study Title

Interim Report on Geochemical Mapping in Toposheet No. 83c/10 in Karbi Anglong District, Assam and East Jaintia Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

- To generate geochemical baseline data of 68 elements.
- To search mineral deposits.
- To create geochemical map of different elements for the entire country.
- To establish valid environmental baseline for planning long term.

Study Recommendation

- The anomalous value in stream sediment samples which were collected from Mawriyap and Sarucha villages in northern parts of toposheet has a total rare earth elements (TREE) range between 55 ppm and 3621 ppm. La constitutes 7.89 to 748.73 ppm with a mean of 113.18 ppm.
- Cerium content varies from 15.04 to 1493.28 ppm with a mean of 223.41 ppm. Uranium content varies from 1.17 to 48.00 ppm with a mean value of 10.26 ppm against the upper continental crust value of 1.5 ppm. This area can be taken as G4 item for REE investigation.

Analysis and Outcome

This study can help to delineate the regional trends of elemental distribution for targeting mineral anomalies. The work comprises geochemical sampling on the 1: 50,000 scale in parts of TS No. 83C/10. The proposed area in parts of TS No. 83C/10 is categorized as the OGP area and is bounded by Karbi Anglong District, Assam and East Jaintia Hills District, Meghalaya.

A total of 182 samples of composite stream sediments, 09 R-horizon and 09 C-horizon soil, 09 waters, and 09 duplicate were analysed.

A highest value of zircon (2386 ppm) was observed in the NE part of toposheet near Mokoilum village over Myllem granite. Some of the notable values are Cr (297 ppm), Rb (506 ppm), Th (199 ppm), and Ba (1444 ppm).

In the study area, the pH of most of the water samples varies from 6.4 to 7, which shows that water is acidic to neutral in nature. In general, the surface and shallow groundwater is mainly acidic, soft with less mineral content. The granitic terrain shows slightly lower pH values than the water in gneissic and quartzitic terrains. The concentrations of metal and non-metal pollutants are well within the permissible limit of ISI. By and large, the surface water and groundwater are suitable for drinking as well as irrigation.



Study Title

Interim Report on Geochemical Mapping in Toposheet No. 83F/2 in Sonitpur, Nagaon, and Karbi Anglong Districts, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2018

Objective

- To create a geochemical database using multi-elemental analysis (68 elements). An objective of this database is to search for hidden mineral deposits.
- It is also used to infer the kind of geogenic disease if any, which has direct connection with the chemistry of soil and water.

Study Recommendation

The study recommended to carry out a detailed study on classifying the acidic volcanic rocks and updating the stratigraphic position of the same by specialized thematic mapping coupled with geochronological studies.

Analysis and Outcome

The project involved geochemical mapping on the 1:50,000 scale covering 664 sq km, including the collection of 166 stream sediment samples from the first- or second-order streams, nine Regolith and 'C' horizon, five XRD, nine stream water, and nine heavy mineral samples in a 5×5 grid.

The area under study exposes the litho-units of the Shillong Group, younger granite plutons, and quaternary sediment. The Shillong Group is represented by an intercalated sequence of quartzite and phyllite, meta-rhyodacite and meta-rhyolite porphyry.

The area exposes distinct variation in the secondary dispersion pattern of elements between the alluvium of Brahmaputra and granitoids and acid volcanic rocks. The major oxides such as silicon and potassium oxide show depleted values in the Brahmaputra alluvium, whereas the same is enriched in the granitoids. The higher values of rare earth elements observed in the Brahmaputra alluvium were highly controlled by the presence of heavy mineral concentrates, which includes ilmenite, biotite, zircon, apatite, and monazite and the same were reflected in the binocular microscope in the course of heavy mineral studies. The higher values of rare earth elements in the granitoids in the south-west portion of the study area may be attributed to the presence of zircon, monazite, and apatite present in the granitoids of the Assam-Meghalaya Gneissic Complex.

The pH values of water samples range from 6.4 to 6.8, indicating acidic to neutral character. The hydrochemical parameters of the water of the study area were compared with the prescribed limit of BIS (1991) and WHO (2006) and showed that the values were within the permissible limit. The concentration of some of the heavy metals like Ni, Cr, Cu, and Zn shows slight enrichment in the samples collected from the Kaziranga National Park, which may have adverse effect on wildlife.

Study Title

Geochemical Mapping in Toposheet No. 83F/3 and in Parts of 83F/4 Karbi Anglong and Nagaon Districts, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2016

Objective

To generate a regional geochemical database as a part of the National Geochemical Mapping Programme (NGCM) in toposheet no. 83F/3 and parts of 83F/4 in Karbi Anglong and Nagaon districts of Assam.

Study Recommendation

- REE is showing very high anomalous value in Thanak Parbat and Arnambe Pahar in the pink/grey porphyritic granite of Myllem granitoid. This porphyritic granite occurring mainly in the southern part of the study area may be probed to ascertain the cause of the anomaly and to investigate any potential source of REE.
- High REE values are also observed in the south eastern part of the study area in the pink/grey biotite granite gneiss of Assam-Meghalaya gneissic complex. Further investigation for potential source of REE in this area is also encouraged.
- Relatively anomalous high concentration zone of Sc, MgO, Co, Cu, Ni & V in northwest of Tako pahar, Maleng Ranphargaon and Man Rangpigaon in the quartzites of Shillong group of rocks, an anomalous zone of Cr at Rlon Pahar in the northern part of the study area in the rhyolite porphyry and metatuff and Y at Sambte Terangaon may be noted for any future investigation.

Analysis and Outcome

The study will be helpful in identification of target areas for mineral exploration, managing and development of natural resources, applications in environment, soil fertility, animal and human health, agricultural activities.

Relatively higher concentration values of Co, V, Cu, Ni, Sc, Va and TiO₂, is observed. Pb, Rb and Th are showing relatively higher concentration values in Rongkongthirgaon and Arnambe Pahar. High values of Ba, Sr, Na₂O, Ga, MnO, MgO, CaO are observed in the south eastern corner of the study area. High concentration value of Th, K₂O, Zr, Al₂O₃, MgO is observed from the porphyritic granite in the south western corner of the study area.

High concentration of REE observed in the study area confined to the pink/grey porphyritic granite of Myllem granitoid in the southern and north western part of the study area.

Stream water analysis results shows that the pH values ranges from 7.61 and 8.1 indicating alkaline affinity. The pH values of all the collected samples are within the permissible limit of 6.5 to 8.5 prescribed for drinking water by BIS (2012).

Overall, prospecting of REE is promising in the pink/grey porphyritic granite of Myllem granitoid, whereas other trace elements do not show promising results.

The recommendations can be further carried forward by GSI for further study.



Study Title

Geochemical Mapping in Toposheet No. 83F/8 and in Parts of 83F/4 Karbi Anglong and Nagaon Districts, Assam

Implementing Institution

Geological Survey of India, State Unit: Assam

Project Location/Completion Year

Assam, 2016

Objective

To generate a regional geochemical database as a part of the National Geochemical Mapping Programme (NGCM) in toposheet no. 83F/8 and parts of 83F/4 in Karbi Anglong and Nagaon districts of Assam.

Study Recommendation

- Higher anomalies of REE ($\Sigma\text{REE} = 1126 \text{ ppm}$) and Hf (148.61 ppm) are seen around Dambaksa. The higher values of REE might be due to the presence of gneiss, granitoids, or pegmatite veins in the area, as La (243 ppm), Ce (404 ppm), and Pr (59.39 ppm).
- Sm (43.20 ppm), Gd (37.60 ppm), Tb (6.35 ppm), Dy (34.67 ppm), Er (21.40 ppm), Tm (3.41 ppm), Yb (21.39 ppm), Lu (3.22 ppm), and Hf (148.61 ppm) are higher than both their corresponding maximum value in SGSC and background significant anomalous values.
- Further study can be taken up for REE and Hf concentration in and around Dambaksa (TS 83F/8) if necessary.

Analysis and Outcome

The study is important for mineral exploration and developmental purposes in the region. This report deals with the distribution of 46 elements in the region. From the evaluation of the geochemical data, it appears that only SiO₂ and Zn values in stream sediment samples have normal distribution. Cr and Ga have weak or nearly normal distribution, and the remaining elements show deviation from normal distribution in K-S test. The median values of Al₂O₃, Y, Zr, Nb, Cr, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Yb, Hf, Ta, and V in stream sediment samples have more than their corresponding median values of the Standard Global Soil Composition (SGSC). Except Zr, La, Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Er, Yb, Lu, Hf, and U, all the elements have values well within their range in the SGSC. All the analysed stream sediment samples yield Hf and Lu values more than their corresponding maximum values of the SGSC. The maximum values of most of elements—Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Lu, and Hf—are given by C-horizon sample collected from the south of Barsing Rahang (TS.83F/8) where geologically granite gneiss is exposed.

Study Title

Preparation and Characterization of Peroxo-Metal Compounds and Studies on Their Biological Significance in Cellular Signalling

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2015

Objective

To prepare and characterize peroxo-metal compounds and study their biological significance in cellular signalling.

Study Recommendation

Following leads have been identified from the study:

- The polymeric metal compounds of vanadium, molybdenum, and tungsten synthesized are first known examples of non-competitive inhibitors of phosphates. They may serve as excellent selective probes of the non-competitive site of the model systems investigated.
- PAAV can induce growth arrest in cancerous cells like A549 (CDFD).
- Peroxo vanadium and peroxo niobium compounds have been established as uncompetitive inhibitors of calcineurin, which are at least 10 times stronger inhibitors to H₂O₂, the natural inhibitors of calcineurin.

Analysis and Outcome

The study highlights the role of peroxo-metal compounds in cellular signaling has demonstrated by several studies such as Metal Peroxo Complexes of Thorium (IV) [348}, Manganese Complexes [349]. This study also demonstrated that diperoxovanadate (DPV) can induce features of senescence in mouse fibroblast. Further it also demonstrated that peroxovanadium compound polyacrylic acid sodium salt peroxovanadate (PAAV) is more catalase resistant and a stronger oxidant than DPV. When peroxovanadate is anchored to polyacrylic acid (PAPV becomes highly potent inhibitor of growth of lung carcinoma cells in mouse.

This study demonstrates potential application in medicine.



Study Title

Report on the Systematic Geological Mapping on 1:50,000 Scale in Toposheet Nos. 78j/1, 5 and 13, 78n/1, 5, 9 and 13 in Kamrup, Goalpara, and Darrang District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2014

Objective

- To prepare a geological map of the terrain on the 1:50,000 scale in gap areas for updating the compiled geological map.
- To delineate lithostratigraphy and morphostratigraphy of the area.
- To evaluate the effects of neotectonic elements.

Study Recommendation

- The contact between the Siwalik Group and Quaternary is very difficult to delineate on the surface. So it is required to be further studied with subsurface data. However, the study area is inaccessible due to dense reserve forest and adverse ground reality.
- Thick piles of quaternary sediments need to be studied in detail in the study area so that the different horizons could be properly logged and dated with various dating techniques.

Analysis and Outcome

During the field work, in addition to the mapping of 950 sq km as per the NQT, 40 sediment samples have been collected and processed and 40 petrological samples and 10 PCS samples were analysed. Geomorphologically, the area is divided into (1) the vast alluvial plain of the Brahmaputra, (2) the Piedmont plain, and (3) the hilly terrain of the Himalayas.

Geologically, the study area comprises rocks of the Siwalik Group and the Quaternary sediment. The Quaternary sediment has been classified into five morphostratigraphic units, namely, Corramore, Chapar, Sorbhog, Hauli, and Barpeta Formations. The Siwalik Group of rocks comprises an alternate sequence of whitish grey, soft friable, immature siltstone; whitish grey to dark grey claystone; and splintery shale. The bedding of the siltstone of Siwalik varied from N80°W to N30°E with a 30–60° dip towards north. Mud crack and irregular fractures are also present in the claystone and siltstone.

The sediment of the Corramore Formation of the study area shows the graphic mean value ranging from 2.508 ϕ to 2.783 ϕ . The sediment of the Chapar Formation of the study area is fine sand, moderately well sorted, strongly positive skewed, and leptokurtic in nature in which the central portion of the curve is better sorted than the tail portions. The Sorbhog Formation of the study area is very well sorted to well sorted nature of sediments, fine sand having strongly positive skewness, and platycurtic to leptokurtic nature of curves. The sediment of the Barpeta Formation of the study area is well sorted nature of sediments, fine sand having strongly positive skewed, and mesokurtic, which is a normal nature of bell-shaped curve.

Study Title

Specialized Thematic Mapping to Decipher Lithological Sequence and Structural Set-Up in Western Part of Batguri Area in Erstwhile Goalpara District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2014

Objective

- To prepare a specialized thematic map of the area on the 1:25,000 scale.
- To decipher lithological sequence and structural set-up of the area.
- To obtain a preliminary appraisal of mineralization of rare earth elements and Tungsten.

Study Recommendation

- The pegmatite veins intruded into granite to the SE of Kachudola show HREE more than LREE. The maximum concentration of uranium (U) is 20.32 ppm and garnet minerals.
- This may be taken for detailed investigation for HREE and uranium mineralization, while garnet for gemstones.

Analysis and Outcome

The study would be helpful to understand the lithography and mineral composition to the area. An area of 300 sq km was mapped in the western part of Batguri area in the erstwhile Goalpara district, Assam. The rock types encountered are banded magnetite quartzite (BMQ), mica-schist, amphibolite, biotite gneiss, granites, pegmatite veins, and quartz veins with the descending order of antiquity. The interrelationships of all the litho-units in the area are studied. The banded magnetite quartzite (BMQ) occurs as a thin linear band and is associated with amphibolites. The primary sedimentary structure in metasedimentary rocks is mainly bedding. The secondary structures in the area include the deformational/tectonic fabrics like foliation, lineation, folds, faults, joints, and minor faults.

Based on the petrographic study, the amphibolite is identified as ortho-amphibolite.

The presence of two micas (i.e. muscovite and biotite) and garnet in mica-schist indicates metasedimentary rock or pelitic protolith. The mineral assemblages in mica-schist, amphibolite, and biotite gneiss indicate that they were metamorphosed up to amphibolites facies.

Twenty-two bed rock samples (BRS) were collected from several locations across the pegmatite intruded into amphibolite, biotite gneiss, and granite and also from granite to know the REE and other mineralization.

GSI along with regional institutions or universities with specialization in earth science or geology are potential agencies to carry forward the recommendations.



Study Title

The Feasibility Stage Geotechnical Investigation for Kulsī Multipurpose Project, Kamrup District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2014

Objective

Construction of a 60 m high and 468 m long main rock fill/ concrete dam across river Kulsī near village Ukiam in Kamrup district of Assam.

Study Recommendation

- Taking into account the site topography, geological conditions, functional requirements, and satisfactory operation of the project on long-term basis, the following modifications were suggested in the project layout:
- The main dam on the Kulsī river at the proposed dam axis should be concrete gravity type or composite type with a concrete gravity spillway.
- The dam toe power house is proposed on the left bank.
- The release water from the power house to be directed to irrigation tunnel/ channel.

Analysis and Outcome

The project envisages the construction of a 60 m high and 468 m long main rock fill/ concrete dam across the Kulsī river near the Ukiam village in the Kamrup district of Assam. Three saddle dams are proposed near Chikadonga, Doledonga, and Majengabari to contain the reservoir. On completion, the project will generate 57 MW of electricity, irrigation about 40,000 Ha of cultivable land, control/ moderate flood in 43,000 ha of land, besides drainage improvement in a considerable area.

The dam site and saddle dams are occupied by Archaean granites gneisses beneath a thick mantle of residual soil. The bed rock is pink and grey granite gneiss with crude foliation defused by compositional bonding. Surface exposures are scanty. The rock is moderately to highly weathered. Fresh rocks are hard, compact, and strong.

An analysis of the subsurface exploration data has established the tentative depth of cut off at the intake area to be from 12 m to 15 m. However, the iron staining and broken cores are found up to the depth end of bore hole. At the power house, 37 m to 40 m will be the tentative depth of cut-off ranges. However, water leakage with iron staining was found up to the end of the bore holes depth. At stilling basin, the cut-off depth ranges from 17 m to 19 m, and at the regulator point, it is 28 m to 30 m.

Study Title

DPR-Stage Geotechnical Investigations of Kulsī Multipurpose Project, Kamrup District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Assam, 2013

Objective

To provide geotechnical inputs through site-specific geological studies to the project authorities.

Study Recommendation

- Based on the lateral extent of amphibolitic body, if any, the necessary treatment to make the foundation monolithic may be carried out during the project execution.
- Considering the seismic status of the area, suitable seismic parameters may be adopted during the designing stage of the dam and other engineered structures.

Analysis and Outcome

The Kulsī Multipurpose Project envisages the construction of a concrete gravity dam across the Kulsī river (a south bank tributary of Brahmaputra) near the Ukium village, Kamrup district, Assam (Photo 1). The project is proposed to have a 62 m high concrete gravity dam with a power house located at the toe of the dam to generate 58 MW of hydel power (Plate 2).

The surface material at the proposed dam site consists of debris/boulders of granite gneiss with light brown to grey silty clay. The river bed is covered by river borne material (RBM) comprising riverine sand with rolled boulders. The project area exhibits variants of granite gneisses with foliation varying from NW-SE to NE-SW with 40° to 70° easterly dips. An exposure of granite gneiss is identified at around 200.0 u/s of the dam axis on the left bank. The rock is pink, medium to coarse grained, hard, compact, and fresh to slightly weathered (W0-W1). The traverses along the section lines at 25.0 m u/s, 25.0 m d/s, 50.0 m d/s, 75.0 m d/s, and 100.0 m d/s from the dam axis on 1:1000 scale have indicated that both the abutments are covered by debris, whereas the river bed is covered by the RBM. The rock mass characterization of the site rock was carried out using RMR, which indicated that the rock mass is of fair category (RMR = 59, class III).

The proposal of founding the concrete gravity dam at the proposed site seems feasible, based on the site geological/rock mass condition, topography, etc. The Brahmaputra Board, the Hydro-power Department, and the Irrigation Department of Assam may take the initiative of implementing the recommendations.



Study Title

Geochemical Mapping in Parts of Thoubal, Chandel Districts of Manipur in TS 83L/03

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2019

Objective

To generate a baseline geochemical database in parts of Thoubal and Chandel districts of Manipur.

Study Recommendation

The following two recommendations have been suggested out of the study:

- Spin off mineral investigation item in and around Khudengthabi area, east of Lokchao river, for Ni, Cr, and other associated mineral commodities.
- Systematic mapping of Paleogene sediments in the study area to classify the unclassified Disang sediments and Barial sediments based on litho-assemblage of shale, siltstone, and sandstone in correlation with the stratigraphic status in North East India. Sedimentary facies classification based on the fossil assemblage, sedimentary structures, etc.

Analysis and Outcome

The study will be helpful in the identification of target areas for mineral exploration, managing and development of natural resources, applications in environment, soil fertility, animal and human health, and agricultural activities. During the investigation, 156 stream sediment samples, 18 soil samples (9 each of soil C and R horizons), and 9 stream water samples were collected to assess the geochemical potentiality of the study area to focus further on mineral investigation.

The Manipur–Nagaland Ophiolite Belt is exposed in the eastern margin of the area. The north-western part of the study area, along the river valleys of Sekmai and Maha, is covered by Quaternary alluvial deposits; ultramafics of the Ophiolite belt towards the south in the south-eastern part of the study area. Fossils of pelecypods, gastropods, and plant leaf imprints were also recorded in the Disang sediments. Wave ripple marks have been observed very commonly in the shale units of the Disang Group.

Stream sediment samples showed higher concentration of Ni and Cr in the south-eastern part of the area where Ophiolite rocks are exposed. Distribution of tin (Sn) is normal, but a relatively higher concentration of Sn is detected in the areas occupied by Disang sediments occurring in the northernmost extremity than the other parts of the study area.

Copper concentrations of 785 ppm (R-horizon) and 670 ppm (C-horizon) in and around Sita-kampang area may lead to severe toxicity as per the WHO and CCME-1996 reports. Rest of the soil samples did not reflect any significant results. Stream water samples of the study area are well within the permissible limits of WHO and are safe for potable use for human as well as animals.

Study Title

Report on Geological Mapping with the Aid of Remote Sensing and Photogeology in Inaccessible Areas in Parts of Tamenglong, Senapati, Ukhrul, and Chandel Districts of Manipur with the Help of Remote-Sensing Studies on 1:50,000 Scale

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2018

Objective

- To prepare a geological map of the above unmapped areas.
- The present study area comprises 14 small unmapped patches in different parts of the extreme corners of Manipur, falling in the areas of Tamenglong, Senapati, Ukhrul, Kamjong, and Chandel.

Study Recommendation

With limited field checks and inaccessibility condition, it was difficult to identify the details of mineralization zones in the present study. This needs to be conducted.

Analysis and Outcome

The study shows important application in mineral exploration, addressing land use, planning and development activities, and environmental concerns. The study area falls in the tectonic domains of (i) Manipur Ophiolite belt and (ii) Inner Palaeogene fold belt. The study reveals other lithological details, stratigraphy, and other geological structures and formations. The study area falling in the parts of TS No. 83 K/ 12 would be of significant importance in the view of metamorphism and mineralization.

GSI may further take up the recommendation for research.



Study Title

Remote Sensing and Photogeology-Aided Geological Mapping in Unmapped Terrain in Parts of Chandel District, Manipur on 1: 50,000 Scale (Parts of TS No. 83L/4 and 84I/1)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2017

Objective

To prepare a geological map of the unmapped areas on 1:50,000 scale with limited field checks.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

This study has application in mineral exploration, land use, planning and development in the area. The present study area falls in the tectonic domains of (i) Manipur Ophiolite belt and (ii) Inner Palaeogene fold. The area is well exposed by the Upper Disang Formation of Disang Group of rocks and Barail Group of rocks in its western part, whereas the eastern half of it is exposed by Ophiolite suite of rocks, viz. dismembered ultramafic bodies, Oceanic Pelagic Sediments, and ultramafics unit (tectonic mélanges). A few chromite floats or roll boulders are observed in the ultramafic exposed south-east of Maipi village. Sulphide mineralization in the tectonized shale is also observed in the form of roll boulders.

GSI may further do research to determine the mineralization area.

Study Title

Systematic Geological Mapping in Parts of Chandel and Churachandpur Districts, Manipur

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2013

Objective

To prepare a geological map on 1:50,000 scale, to work out the lithostratigraphy and structure and to search for mineral occurrences.

Study Recommendation

The dimensions and grade of the limestone bodies are found to be appreciable besides good accessibility. Therefore, a detailed investigation may be initiated by means of L.S.M, detailed sampling, and scout drilling to ascertain the true dimensions of the limestone bodies.

Analysis and Outcome

The study has significant application in mineral exploration, land use and development planning, etc. The mapped area comprises tertiary sedimentary rocks belonging to upper Disang Member and associated flysch sediments. All together 25 limestone bodies in the form of exotic blocks have been located in the area. The limestone bodies are of varying dimensions from 2 to 100 m thick. Heavy minerals (opaques) like pyrite, haematite have been also observed in the area.

The GSI can further take up the given recommendation.



Study Title

Meso-scale (1:10,000) Landslide Susceptibility Mapping along Tongseng-Sonapur-Kuliang Road Sector of NH-6 (Erstwhile NH-44), East Jaintia Hills, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2020

Objective

Characterization of the landslide mechanism and evaluation of causal relation of potential geofactors with landslides through high-density field observation points. Knowledge based assigning of ratings to the classes of selected geofactors.

Study Recommendation

- Natural landslides and tension cracks are observed along the north and north-east facing the upslopes of Tongseng village.
- Contour draining is recommended to minimize aggravation and retrogression of the tension cracks and thereby minimize potential damage to plantation.
- Potential flow convergence and infiltration of surface water can reactivate the debris slide affecting the road below. Therefore, a contour drain is recommended to channel the water to the nearby streamlet in the south of the landslide. A gabion wall is recommended at the toe of the slope. In addition, the upslope of the Sonapur village is characterized by widespread debris and, therefore, any slope profile modification should be accompanied by an adequate drainage system.
- The slope is characterized by steeply dipping alternation of thinly bedded sandstone and shale with pockets of weathered zone with high propensity of slope failure. In order to prevent further slope instability, a gabion wall with adequate lined hillside drainage is recommended to prevent toe erosion.
- Slope instability is observed on the facet number 55 characterized by the preponderance of colluvium and assorted debris from past slope movements. Benched gabion wall is recommended at the toe of the slope and accompanied by a lined side drain.

Analysis and Outcome

The study has effective application for planning and development. In addition, it can also be used for natural disaster mitigation plans.

A total of 10 km² of study area is divided into 703 slope facets as mapping unit and categorized as overburden and rocky slope facets. The susceptibility map after classifying the total estimated susceptibility values for each facet into varying degrees of landslide susceptibility shows very low class covering 0.12 km² (10 facets), low class covering 3.2 km² (239 facets), moderate class covering 5.3 km² (298 facets), high class covering 2.2 km² (151 facets), and very high class covering 0.08 km² (5 facets). The output susceptibility map generated will enable the users or planners to more effectively deal with potential landslides along the road corridor.

The recommendations are facet specific and may be addressed by the concerned administration, PWD and civil engineers.

Study Title

A Report on Compilation of Existing Baseline Information for First Level Seismic Hazard Assessment of Shillong Urban Agglomeration Area, East Khasi Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2016

Objective

To demarcate the areas into different zones based on the degree of landslide susceptibility and identification of areas for future developmental activities.

Study Recommendation

- The preparation of surficial geological mapping of the gap area to delineate the disposition/distribution of slope-forming material like colluviums, weathered zone, quarry dumps, etc.
- Estimation of fundamental frequency and site amplification factor by ambient noise survey by deploying digital microearthquake (DMEQ).
- Estimation of shear wave velocity (V_s) using the estimated fundamental frequency (f_0) and the overburden thickness (H) using the relation of Dobry et al.
- Analysis and processing of historical and instrumental earthquake data from different sources like IMD, USGS, Seismo-tectonic Atlas (GSI, 2000), etc. and preparation of an earthquake catalogue.
- Free to build houses as one likes and where one likes should be regulated, if necessary through a land-use regulatory act, especially in high-hazard zones.
- A geological clearance system may be adopted as mandatory before any construction activity.

Analysis and Outcome

This study implies the importance of understanding the seismic hazard of the study area since the response to input earthquake ground motion is expected to vary depending upon the nature and distribution of different geological set-ups. The collected information will be used for taking up the second level of seismic hazard assessment study using suitable attenuation relations to arrive at a comprehensive seismic hazard assessment of the area for disaster mitigation and urban planning.

The given recommendations have to be further studied by the GSI except recommendation 4, which has to be checked by the Shillong municipalities and administration.



Study Title

Final Report on Photogeological Mapping in Parts of Meghalaya with the Help of Remote-Sensing Studies on 1:50,000 Scale (6 Toposheets)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2015

Objective

- To prepare a geological map of the unmapped area along the international border with Bangladesh on 1:50,000 scale.
- To establish the lithostratigraphy and structure, collect evidences of faulting/neotectonic activity in the field.

Study Recommendation

- Detailed field work could not be carried out in the study area due to insurgency and inhospitable terrain conditions. It is, therefore, suggested that systematic geological mapping should be carried out to refine the stratigraphy and structural features of the area.
- High-resolution palaeontological study (micro palaeontology) is imperative in this area to establish a detailed biostratigraphy. This will provide a better insight into the stratigraphy of this area as well as the environment of deposition.
- Very good sedimentological sections are present in the area where detailed facies analysis may be taken up as a research project to unravel the depositional process and palaeoenvironment.
- Keeping in view the economic potential of native sulphur occurring as encrustation in silty-clay bed in the DC hill section of Baghmara, it is suggested that this sulphur-bearing horizon of Simsang Formation should be separately mapped on the 1:10,000 scale to determine the spatial extension of this horizon.
- Detailed geophysical studies need to be carried out to unravel the dynamic tectonic history of the Dawki Fault. Evidences of neotectonic activity/palaeoseismic events are present in the study area. Hence, this area is suitable for active fault studies. In addition, OSL/thermo luminescence dating of samples from the sections showing penecontemporaneous deformation and liquefaction may be carried out to precisely date the palaeoseismic events.

Analysis and Outcome

The present study reiterates the significance of remote-sensing tools coupled with limited field verification in carrying out geological mapping at a faster pace, particularly in inaccessible terrain not covered by the systematic geological mapping. The study can be applied for determining land use, studying forest, planning and development, and other environmental concerns.

Three broad geomorphic units have been identified in this area based on the genesis of landforms: structural, denudational, and fluvial landforms. The area exposes a wide variety of rock types ranging from Archean to Tertiary period. Archeans in this area are known as Assam–Meghalaya Gneissic Complex (AMGC) comprising granite gneiss intruded by dolerite sills and dykes, pegmatites, and quartz veins.

Economically viable clay containing a good amount of montmorillonite and illite has been discovered in the study area.

The given recommendations can be carried forward by the GSI.

Study Title

Interim Report on Geochemical Mapping in Meghalaya Gneissic Complex in Parts of Jaintia and East Khasi Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2014

Objective

The objective of the work is aimed towards generating a geochemical elemental baseline database in the area as part of the National Geochemical Mapping Programme for use in developing and managing natural resources and various other social concerns.

Study Recommendation

- The pH values, except in the north-west of the toposheet no. 83 C/07, show the water is acidic (<6.5) and is not fit for consumption by humans and animals. Also the ecology of plants and other water life has been affected, which is attributed to coal mining and other OB dumps waste. In such cases, the solution is treating this OB dumps waste with lime, which is available locally and to tap drinking water from other areas particularly from the north-west since as per the WHO and BIS limits, the water is uncontaminated and suitable for drinking, irrigation, and industrial purpose.
- The entire area of Lad-Rymbai, Sutnga to Suchen villages can be considered for environmental and geomorphological studies in view of random coal mining activities and coal dumping, which has adversely affected water quality, soil, agriculture, and aquatic life, also leading to subsidence and high siltation clogging rivers and streams.

Analysis and Outcome

The study can be useful in developing and managing natural resources, especially mineral resources, and various other social concerns. The geochemical mapped area exposes rocks of the Assam–Meghalaya Gneissic Complex represented by migmatite belonging to Archean to Proterozoic age, and Myllem granite represented by granitoid belonging to the Neo-proterozoic to Lower Palaeozoic age. These are overlain by thick blankets of sedimentary cover sequence of Jaintia group belonging to Palaeocene to Eocene age with a profound unconformable relationship in between.

The groups of elements (composited stream sediments) that show strong similarity in the distribution patterns are as follows: (i) SiO_2 , TiO_2 , and Cr; (ii) Al_2O_3 , Fe_2O_3 , K_2O , P_2O_5 , Th, and Y; (iii) Sr and V; and (iv) CO, Cu, Th, and Y.

The following REE elements (composited stream sediments) show strong positive correlation in the cluster field: (i) La, Ce, Nd, Sm, and Gd; (ii) Dy, Ho, Yb, Lu, Er, and Tm; (iii) Pr, Eu, and Tb; and (iv) U, Be, Ta, and Ge.

The following groups of major oxides occur in clusters as they show strong similarity in the distribution patterns: (i) Mg^{++} , Fe^{++} , T.H as CaCO_3 and EC (ii) SO_4 and P_2O_5 .

The given recommendations should be implemented by the district administration with the help of GSI.



Study Title

Interim Report on Geochemical Mapping in Toposheet No. 83C/03 in Parts of East Khasi and Jaintia Hills Districts, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2014

Objective

To generate geochemical baseline data for use in managing/developing natural resources and its application in environmental, agricultural, public health, and other societal concerns.

Study Recommendation

- High values of thorium (869 ppm) have been concentrated in ferruginous sandstone lying adjacent with granitic gneiss south-east of Leshka Myntdu hydel project near Sushen village. Follow-up work accompanied by detail petrography and petrochemical studies can be taken up in this region.
- The entire stretch of Skentalang-Jarain-Umladkhur-Dam Dim north-east of Amlarem area can be considered for environmental studies in view of the overall impact of coal quarries on water and aquatic life. The water around these areas is acidic and highly charged with iron contents.

Analysis and Outcome

This study has use in managing/developing natural resources and its application in environmental, agricultural, public health, and other societal concerns. The study area is exposed to various litho-units such as granite gneisses, granite/granitoid, amphibolites, quartzite, altered pyroxenite, and amphibolites of Sung Alkaline Complex, Cretaceous sandstone, and Tertiary sandstone with coal, shale, and conglomerate. The quartzite and Tertiary sandstones are the two dominant litho-units spread across the major parts of the area.

The groups of elements that show strong similarity in the distribution patterns are as follows: (i) Na₂O, K₂O, and TiO₂; (ii) Fe₂O₃, P₂O₅, MgO, MnO, and CaO; (iii) Nb, Zr, and Y; and (iv) Ni, Co, V, Cu, Cr, and Sc.

The following REE elements show strong positive correlation in the cluster field: (i) La, Ce, Nd, Sm, and Gd; (ii) Dy, Ho, Yb, Lu, Er, and Tm; and (iii) U, Be, Ta, and Ge. All these elemental distributions are controlled mainly by the geology of the terrain and mobility of the elements.

The following group of oxides and trace elements shows close affinity: (i) SiO₂ and Na₂O; (ii) Al₂O₃, MnO, and P₂O₅; (iii) MgO, CaO, and K₂O; (iv) Ba, Rb, Sr, and Th; (v) Ni, Cr, Co, Zn, Cu, and V; (vi) Y, Zr, and Nb.

The water samples fall within the ambits of BIS and WHO limits implying no contamination and suitable for drinking, irrigation, and industrial purposes.

The first recommendation can be implemented by GSI, while the second recommendation should be implemented by the department of environment and water resources with the help of GSI.

Study Title

A Report on the Feasibility Stage Geotechnical Investigation for Upper Khri Diversion Project, West Khasi Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

- To construct an 83.0 m high composite dam across the Khri river to divert ~9 cumecs of water from the Khri basin to the Umtru basin to augment the power generation at Umium-Umtru Stage-IV (Plate 2).
- To provide geotechnical inputs (by means of site geological survey).

Study Recommendation

- It is recommended that the weir site is required to be explored through a borehole (B.H-1, El ~ 631.0 m) going down either 2/3rd height of the dam or 10.0 m into the fresh rock, whichever is later to assess the foundation condition.
- Two boreholes (B.H-2, El ~632.5 m and B.H-3, El ~655.0 m) are recommended in left abutment and two boreholes (B.H-4, El ~632.5 m and B.H-5, El ~655.0 m) in right abutment going down either 2/3rd height of the dam or 10.0 m into the fresh rock, whichever is later, are recommended to know the nature of subsurface rock mass conditions.
- One borehole (B.H-6, El-630.0 m) going down 10.0 m into the fresh rock is recommended for the energy dissipation structure.
- One borehole at the centre of forebay tank (B.H-7) going down 10.0 m into the fresh rock is recommended to know the nature of subsurface rock mass conditions.
- Two boreholes (B.H-8 and 9) below the centre of each unit in power house site down 5 m below the T.B.L may be drilled to assess the subsurface nature of the rock mass conditions.
- Cyclic percolation tests in ascending order for 3.0 m test section in five cycles should be carried out in each borehole to know the permeability of the rock mass exposed at the foundation/abutments.

Analysis and Outcome

This study has several bearings on the environment, wildlife, and livelihood of the people in the project area. Several geotechnical tests were performed that directly affect the concerned project. In addition, it has application planning and development, agriculture among others.

The geological mapping along the water conductor system on the 1:2500 scale has revealed that most of the area is covered by overburden material and limited exposures of bed rock (i.e. granite gneiss). The geological mapping on 1:1000 scale at weir site and along water conductor system on 1:2500 scale has revealed that most of the area is covered by overburden material and limited exposures of granite gneiss. Whereas, the geological mapping in power house area on 1:200 scale revealed the presence of medium to coarse grained granite.



Study Title

Gravity-Magnetic Mapping in Parts of West Khasi Hills District, Meghalaya (Toposheet 780/2)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Meghalaya, 2013

Objective

To delineate subsurface geological structures and generate gravity and magnetic maps during the Field Season Programme 2012-13 in parts of West Khasi Hills district, Meghalaya falling in toposheet 780/2.

Study Recommendation

Detailed gravity-magnetic studies may be carried out in the area around the Myniar village to verify the continuity and strike extension of the magnetic body as depicted in analytical signal magnetic map.

Analysis and Outcome

This study has significant importance in mineral exploration in the area. Several gravity-magnetic tests were performed to delineate the geological structures and features of the study area. The study indicates gravity values varying from -8 mGal in the south-eastern part around the south of Nongmawklam to -36 mGal in the north-western part further northwest of Talukhola, indicating deepening of basement towards north-western part of the study area. High-intensity magnetic anomaly with its peak around Myniar indicates the presence of magnetite-rich rocks in this area.

The given recommendation may be further researched by the GSI.

Study Title

Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Toposheet Nos. 84B/09 and 84B/13, Lunglei and Saiha Districts, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2019

Objective

- To prepare a landslide inventory database using high-resolution remote-sensing data, archival information, and field inputs.
- To prepare a spatial database for geofactors of landslide.
- To categorize the hillslope of the study area in terms of land.

Study Recommendation

- If end users intend to use only the susceptibility map for land-use planning, then no public or personal utility projects should be considered in highly susceptible areas, strict building safety regulations should be followed in moderate susceptible areas, and constructions with simple slope stability measures be allowed in low susceptible areas.
- Management of solid waste should be monitored, and domestic sewage from houses in the settlement areas should be properly channelized.
- The dumping of solid waste from settlements upslope on the Luangmual–Lungsen road enhances landslide occurrence.
- A detailed investigation of these slides will help in better understanding of the causal factors along with the stability assessment of the slope. Slope failures along the road cuts can be minimized by the maintenance of road side drainage with culverts, slope moderation by benching, and hardening of material by a suitable plantation.
- The construction of contour drainage or hillside drainage to channelize the surface run-off and sealing of cracks in areas where excessive infiltration and seepage is present; therefore, necessary planning must be undertaken for the proper discharge of the surface run-off. Quarrying at a safe distance away from the important road corridors and proper management of excavated waste material will minimize the risk of damage to infrastructures and loss of life.
- The susceptibility map showing the potential landslide initiation areas should not be used alone for planning. The susceptibility map is actually meant for regional application. Hence, a detailed site-specific study may be duly conducted before planning and execution of the civil construction works.

Analysis and Outcome

The study has important applications in planning and development and disaster management. A total of 146 landslides were studied in the field with 42-point-geo-parametric data including 75 debris slides, 40 rock slides, 16 rock falls, and 15 soil slides. The susceptibility score map was grouped into three susceptibility classes: the high susceptibility class corresponds to about 16.97% (242.90 sq km), moderate susceptibility 29.89% (427.79 sq km), and low susceptibility class corresponds to about 53.13% covering an area of 760.31 sq km.

The given recommendations can be implemented by the civil engineering department, PWD, contractors with supervision or input from GSI.



Study Title

Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 84 A/10 and 14, Aizawl, Serchhip, and Mamit Districts, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2016

Objective

To demarcate landslide-susceptible zones on 1:50,000 scale, a landslide susceptibility mapping of 1423 sq km area in parts of Aizawl, Mamit, and Serchhip districts was taken up under the annual programme of GSI.

Study Recommendation

- If a disaster strikes, then loss would be immense if buildings are not safely and properly located. The only economical way of reducing “at least” the loss of life is by making people aware of the inherent risk.
- Therefore, it is recommended that more priority should be given in increasing awareness among people through the Community Based Disaster Management Programme (CBDMP), and villages or communities located in and around high-hazard areas should be given priority in holding CBDMP.
- The awareness should include information about the potential danger, its identification, and its communication; the physical significance of hazard and inherent uncertainties; ways to reduce landslide risk and other available local mitigation options.

Analysis and Outcome

The study provides the qualitative estimate of landslide susceptibility of the study area. The results are of important societal value and can provide inputs for regional land-use planning and planning of risk reduction strategies.

The landslide susceptibility maps indicate that about 18.82% (267.88 sq km) of the areas are grouped under high susceptibility. The moderate susceptible zones constitute about 28.66% of the study area covering about 407.83 sq km, while the low susceptible zone corresponds to 52.52% of the study area covering about 747.35 sq km, respectively.

The given recommendation can be implemented by municipality and district administration under the guidance of GSI.

Study Title

Specialized Thematic Mapping in Parts of Toposheet No. 84a/10 in Aizawl District, Mizoram

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2014

Objective

- To build the stratigraphy and sedimentation history.
- To prepare facies map.
- To work out the depositional environment.
- To search for mineral occurrence if any.

Study Recommendation

- It is recommended that the detailed lithostratigraphic mapping should be carried out for searching of Upper Bhuban Sandstone throughout Mizoram state. At places, hard and compact sandstone/siltstone of Middle Bhuban Member is being quarried in Aizawl city and further quarrying activity will disturb the rock stability in the area leading to the landslide hazard.
- Therefore, it is recommended that, the quarrying activity should be immediately stopped in Aizawl city, to prevent landslide hazards.

Analysis and Outcome

The study has important application for planning and development and land use in the area. The area exposes a monotonous sequence of sandstone, shales, and siltstone and their intermixture. The stratigraphic succession in the area is Middle Bhuban Member overlain by Upper Bhuban Member of Surma Group of rocks of Miocene Age.

Lithological assemblage and primary sedimentary structures indicate that the Bhuban Formation of rocks of the area were deposited in near shore as well as in shallow to moderately deep marine environment without any major hiatus. No major mineral of economic significance has been found in the area.

The first recommendation may be carried out by GSI, whereas the second recommendation should be implemented by the district administration.



Study Title

Photogeological Mapping in Parts of Mizoram State

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Mizoram, 2013

Objective

To prepare a geological map of the hitherto unmapped areas of Tripura–Mizoram Fold Belt (TMFB) using aerial photographs and other remotely sensed data along with limited field checks to establish their lithostratigraphy, structure, and to identify economic mineral deposits.

Study Recommendation

The eastern part of the study area is mostly inaccessible because of dense forest, deep valleys and ridges, and the prevailing law-and-order situation and extremist problems. Mapping through expedition may be taken up particularly in the eastern part of the area to work out the structural configuration, stratigraphy, and also to identify the source of hard rocks for construction purposes.

Analysis and Outcome

The application of remote-sensing technique in geological mapping has proved to be a robust tool especially in North East India where the terrain is inhospitable.

Lithology exposed in the study area includes Middle Bhuban, Upper Bhuban, Bokabil, and alluvium.

A photo index of the study area was prepared by overlapping aerial photographs systematically assembled to form an array of continuous pictorial representation of a terrain using uncontrolled photo mosaic method. This provides an overview of the terrain in photo interpretation and to gather information about the nature and distribution of materials and features occupying the terrain.

The given recommendation may be further researched by the GSI.

Study Title

Geochemical Mapping in Parts of Kohima, Phek, Zunheboto, and Wokha Districts of Nagaland in Toposheet No. 83 K/5

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2019

Objective

To generate a geochemical database of degree sheet 83K as part of National Geochemical Mapping Programme of Nagaland state using multi-elemental analyses.

Study Recommendation

The elemental patterns coincide with the bedrock geology in the two distinct physiographic units, i.e., the Doyang valley and the Zunheboto-Khumnubato ridge and assuming any applied implication in the present scenario will not be justified.

Analysis and Outcome

This study has application in several fields, including natural resource development and management, agriculture, medical geology, environmental sciences, etc. The rocks of Disang Group are found in the study area. The study observed a distinct geochemical distribution of ferromagnesian and non-ferromagnesian elements in the area between the Lower and Upper Disang Formation. Greater levels of ferromagnesian elements in the sediments derived from Upper Disang Formation may imply a greater role of mafic source in its provenance. The distribution of the total rare earth elements shows a NE-SW trend in the central part of the area over Upper Disang Formation.

The water of the area is slightly basic (pH 7.4 to 8.4). The hydro-chemical facies of surface water of the area is found to be magnesium bicarbonate type.



Study Title

Geochemical Mapping in Toposheet No. 83K/01 in Kohima and Wokha Districts, Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2019

Objective

To generate a geochemical database of degree sheet 83K for the distribution of 68 elements and prepare geochemical dispersion maps of these elements.

Study Recommendation

- The contact relation between the Barail and Disang Groups of rocks is ambiguous, which posed as a constraint in the demarcation of litho-units classification. The previous workers gave different connotation regarding contact relation. The study area falls is part of the Inner Paleogene fold belt. In this connection, it is very important to have control over the structural history of area, but it is not fully established. At this juncture, it is recommended that further studies may be taken up to look into more detailed studies as it deems fit with regard to the above-mentioned points.
- The occurrence of coal in Jenam Formation of Barail Group that is sub-bituminous to bituminous in nature, which is exposed at 1.3 km NW of Logwensungu, en-route to new land road. It is, therefore, recommended that further investigation may be taken up for potentiality and feasibility.
- Dimension stone (sandstone) is extensively quarried in the study area. Therefore, it is recommended that further studies may be taken up to look into its feasibility, hardness, and durability for various constructional purposes.

Analysis and Outcome

The study has significant application in mineral exploration, land use, planning, and development activities and agricultural practices in the region. Several geological and geochemical analyses were performed in the study.

Fossil fuels such as coal and the massive sandstone, which is used as dimension stones, were observed during the study.

Study Title

Geochemical Mapping in Toposheet No. 83K/7 in Parts of Ukhrul and Senapati District, Manipur and Phek District, Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2019

Objective

To generate a geochemical elemental baseline database in the area as part of the National Geochemical Mapping Programme for use in developing and managing natural resources and various other social concerns.

Study Recommendation

Recommendation has not been outlined in the report.

Analysis and Outcome

The study has significant application for mineral exploration, address planning, and developmental activities. In the study, 157 composite stream sediment samples, 8 composite duplicate stream sediment samples, 8 water samples, and 16 soil samples (8 each from R- and C-horizon) and 5 petrography samples were collected. Geologically, the area forms a part of the Inner Palaeogene fold belt and Ophiolite fold belt of Manipur and Nagaland.

Total rare earth elements (TREE) range between 60 ppm and 277 ppm. La constitutes 16 to 63 ppm. The highest value of Cr (402 ppm) was observed in the western part of toposheet near Kodom Khunou village. A high value of Ni (208 ppm) was observed in the central part of the toposheet near Chingjai village. A high value of Zn (131 ppm) was observed in the NW part of the toposheet near Liyai Khullen village. In the study area, the pH of most of the water samples varies from 6.9 to 8.2, which shows that water is alkaline to neutral in nature.



Study Title

Geochemical Mapping in Toposheet No. 83K/3 in Parts of Senapati District of Manipur and Phek District, Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2019

Objective

To generate a geochemical elemental baseline database in the area as part of the National Geochemical Mapping Programme for use in developing and managing natural resources and various other social concerns.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

In the study, several geological and geochemical tests were performed. The study has significant application for mineral exploration, address planning, and developmental activities.

In the study, a total of 182 stream sediment samples were collected by covering 698 sq km. area. One soil profile from each 5' x 5' quadrant was selected for the collection of Regolith (R) and C-horizon (C) samples, developed over the prominent litho-unit present in that grid. A total of nine sites of R and C were selected for sampling. Nine duplicate samples were also collected from the nine different 5' x 5' quadrants.

Total rare earth elements (TREE) range between 22 ppm and 264 ppm. La constitutes 18 to 66 ppm. The highest value of Cr (440 ppm) was observed in the northern part of toposheet near Maram Khullen village. A high value of Ni (190 ppm) was observed in the western part of the toposheet near Karong village. A high value of Zn (185 ppm) was observed in the eastern part of the toposheet near Oinam Naga village.

Water pH in the area varies from 6.8 to 8.1, which shows that water is alkaline to neutral in nature.

Study Title

Interim Report on Geochemical Mapping of Toposheet 83J/15 and 83 K/13 in Kiphire, Longleng, and Mokokchung Districts of Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Nagaland, 2013

Objective

To create a geochemical database and prepare regional geochemical maps with multi-elemental analysis.

Study Recommendation

- Detailed study of sample numbers 3K13/007/S/13, 83K13/101/S/12, and 83K13/006/S/13 may be taken up for large-scale work.
- National geochemical mapping (NGCM) was aimed at delineating the geochemical patterns of the land surface and to prepare a geochemical baseline. Ideally, geochemical mapping should start at the continental scale and continue to the national and finally local scale in the areas of concern.
- With respect to the environment, the agricultural fields are sufficient of micro- and macro-nutrients.
- During the course of the geochemical mapping programme, the entire study area has been examined very closely and it is observed that there is scope to improve/modify the existing knowledge of the geology of the area.
- There is no major geogenic health hazard reported from the study area.
- Identification of anomalies, background, and baseline levels requires an extensive amount of data processing and application of varied statistical tools. Thus, it is recommended that the data processing should be carried out for much larger datasets that are available for this study, preferably at degree sheet level. For this purpose, certain specialized statistical software can be procured.

Analysis and Outcome

The study will provide help in the fields of mineral exploration, land use, agriculture, forestry, environmental management, various aspects of human, animal health, and site selection for waste disposal. The study area exposes rocks of Disang and Laisong Formations of Palaeocene to Oligocene age. The rocks of the study area have undergone at least two phases of deformation. The area is totally devoid of economic minerals; the sandstones of Laisong and Disang Formations are used as building stone.

It is observed from the geochemical contour maps showing distribution of oxides/elements that oxides like SiO_2 , Al_2O_3 , Fe_2O_3 , MgO , CaO , P_2O_5 , Na_2O and elements like Zn, Pr, Cu, Cr, Ba, La, Sr, Co, Sc, Pb, Ta, Hf, Sn, Er, Ho, Dy, Tb, Pr, and Rb show some definite pattern of their disposition, which are mainly dependent on underlying lithology. Whereas some other oxides like TiO_2 , K_2O and elements like Zr, Na, Y, Ni, Th, V, and Ga show random distribution. Most of the major oxides/elements are exposed in the Lower and Upper Member of Disang Formation. So far as the elements of economic importance are concerned, their distribution correlation is not appreciable in the study area.

The study also shows that stream water samples can be used for domestic purposes.



Study Title

Report on Detailed Geotechnical Investigations and Monitoring of the 5th Mile Landslide on Gangtok-Nathula Road, East District, Sikkim

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Sikkim, 2017

Objective

The primary aims of the present study were to geologically map the landslide area on 1:500 scale and supplement it with a detailed numerical slope stability analysis to assess the current state, activity, and pattern of failures.

Study Recommendation

As a basic principle of slope protection, attempts are made to suggest measures

- To strengthen the shearing strength and reduce the shear stress of the slope-forming material.
- To manage surface drainage for controlling pore water pressures and to restrict/avoid recharging of fragile groundmass.
- To restore and strengthen the newly cut road benches. Accordingly, for containing the 5th Mile landslide, the following remedial measures are suggested based on the detailed field studies and analytical results.

Analysis and Outcome

The area under study lies in a strategically important area on which road has been constructed. The study is of importance for any developmental (construction) activities of the road. During the course of geological mapping, eight slide subzones have been identified and mapped in various parts of the slide zone out of which two are located in stable Palaeoslide debris. The SMR analysis indicates that the rock mass belongs to "fair and good category". It also indicates that planar, block, and wedge failures due to unfavourably oriented joints and topple failure caused by bedding/foliation parallel valley dipping joints are plausible in the top most central part, north-western part, and toe portion in south-eastern part of the slide zone.

Preventive recommendations given in the study can be taken up by the PWD or construction agencies or contractors.

Study Title

Geochemical Mapping of the Toposheet No. 79 M/9 and Part of TS No. 79 M/5 in the Tertiary Fold Belt of Khowai and West Tripura Districts, Tripura

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Tripura, 2018

Objective

To generate a baseline geochemical database which will be helpful in the identification of target areas for mineral exploration, development of natural resources, and applications in environment, soil fertility, animal and human health, agriculture, and forest.

Study Recommendation

- The area situated south-east of Rupachhara may be given more focus to know the causes for enrichment of certain oxides—CaO, MgO, Fe₂O₃, and K₂O—and chalcophile elements—Pb, Zn, and Cu. The aerial extent for this enriched zone is needed to be demarcated.
- Other soil profiles surrounding the area located within Taidu forest (23° 42'17.6" N, 91° 40'58.5" E) also need to be thoroughly studied.

Analysis and Outcome

The study provides a set of baseline geochemical values for geological domain in parts of Khowai and West Tripura districts, Tripura, for the assessment of contamination from urban or industrial land-use changes and mining activities. Stream sediment mapping can provide important new information in the future regarding application across a number of sectors, including agriculture, health, land use, and planning.

The area manifests structurally and lithologically controlled topography with a broad synclinal valley of Khowai river flanked by anticlinal ridges of Baramura in the west and Atharamura in the east. The litho-units of the area expose monotonous unmetamorphosed sedimentary sequence of Tertiary age.

The values of REEs and their strong correlation with each other indicate that the source rock may have granitic signatures. Analytical result of water samples in the mapped area shows that in general a favourable environment exists for aquatic animals to live and flourish.

Further research on the recommendations can be done by the GSI.



Study Title

Specialized Thematic Mapping around Khowai-Natun Bachaibari, Khowai District, Tripura to Study Dupitila Group

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Tripura, 2016

Objective

- Lithofacies analysis for lithostratigraphic classification of Dupitila Group.
- To establish provenance, tectonic set-up, depositional environment, palaeocurrent, and palaeoclimatic conditions of the Dupitila Group of rocks.

Study Recommendation

- Clay deposits within Dupitila sediment occur as lensoidal bodies. In some exposures, two clay deposits are sandwiched by loose, cross-bedded sandstone. Thus, a detailed study may be carried out in the adjoining areas also to determine their extension, reserves, and industrial applications.
- Huge sand bodies/deposits (Quaternary) have been noted along the Khowai river, which are apparently well sorted and silica rich. A detailed study on glass sand deposits may be carried out to understand the economic viability and reserves.

Analysis and Outcome

The study has significant importance for mineral exploration and land use in the region. The specialized thematic mapping was carried out with the objective of lithostratigraphic classification and to establish the provenance, tectonic set-up, depositional environment, palaeocurrent and palaeoclimatic conditions of Dupitila Group, besides exploring for mineral occurrences with special reference to clay and identification of fossiliferous horizon.

This study concludes that the chemical characters of Dupitila are broadly akin to Surma and Tipam rocks. Source rocks from the provenance studies indicate their derivation predominantly from acidic igneous with minor contributions from metamorphic and mafic/ultramafic sources.

The given recommendations may be carried forward by GSI itself.

Study Title

Geochemical Mapping in Tertiary Fold Belt of South Tripura District, Tripura (in Parts of TS Nos. 79M/12, 16 and 79N/9)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Tripura, 2014

Objective

To generate geochemical baseline database for multipurpose uses like managing/developing natural resources and applications in agricultural, environmental, public health, and other societal concern.

Study Recommendation

Detail studies have to be carried out in detecting whether it is Cr (III) or Cr (VI) and their toxicity influence in the area.

Analysis and Outcome

The study will help in understanding the environment, especially mineral resources in the area. The study can be utilized for mineral exploration, development and planning activities, agricultural practices, and water resources management.

The study area exposes a monotonous sequence of unmetamorphosed upper tertiary sediments belonging to Surma, Tipam, and Dupitila Groups and Holocene sediments.

Analytical results of water samples only W(A) in the mapped area show that a favourable environment exists for the aquatic animals to live and flourish. The low values of Ca^{2+} , Mg^{2+} , and HCO_3 indicate that the stream water is soft in nature.

The given recommendation may further be investigated by GSI or specialized laboratories dealing with toxicity of soil and water.



Study Title

Geochemical Mapping in Parts of Kohima and Phek Districts of Nagaland and Senapati District of Manipur in TS No. 83K/2

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2019

Objective

To delineate subsurface geological structures like fold, fault, etc. for identification of the area suitable for mineral exploration and to establish the gravity-magnetic database of degree sheet nos. 83B and 83G under project NGPM.

Study Recommendation

Recommendation has not been outlined in the report.

Analysis and Outcome

The study has important application in land use, planning and development, and environmental issues. Several geochemical tests were performed in this study showing element distribution for all the 50 elements of stream sediments samples. The elemental data received are characterized by high value of SiO_2 , alumina, and low Cr, Ni, Mg, and REE. No anomalous values of oxides/elements are observed from the received analytical data.

The water samples in the area are neutral/weakly alkaline and are good as far as the water quality is concerned and do not show any alarming contents of toxicity of major oxides and elements as the values are all under permissible limit given by BIS and WHO standards. Also as TDS varies from 91 ppm to 349 ppm in the water samples collected, the water is suitable for potable purposes.

Study Title

Geochemical Mapping in Parts of Toposheet Nos. 83B/04, 78O/08, 78O/16 of Ri-Bhoi, South West Khasi Hills, East Khasi Hills Districts of Meghalaya and in Parts of Toposheet No. 83C/12 in Cachar District of Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2019

Objective

To generate a baseline geochemical database that can be utilized as a tool for searching mineral deposits, assessment of soil fertility, applications in environmental, agricultural, public health, and other societal concerns.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

The study has important application in mineral exploration, land use, planning and development, environmental concerns, and agriculture. The study reveals several geological features/structures and formation of the study area. In addition, several geochemical tests were performed to determine the mineral constituents of the area.

The study shows several areas with good mineral prospect for mining. In addition, water samples in the area also tested within the BSI standard.



Study Title

Geochemical Mapping in Parts of Toposheet No. 83G/09 in Karbi Anglong District, Assam and Dimapur District, Nagaland

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

To generate a geochemical database of degree sheet 83G of Assam and Nagaland states using multi-elemental analyses.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

The study is important for planning and developmental activities. Besides, it will also be useful for agricultural purposes and land use. The studies show that the data of all the elements fall within the range of Standard Global Soil Composition (SGSC) and within range or near the threshold value. Therefore, no anomalous zone for any elements is found in the study area for mineralogical prospective.

Heavy mineral study identifies various minerals as allanite, monazite, ilmenite, garnet, zircon, apatite, and sillimanite showing the probable source felsic igneous, metamorphic, and sedimentaries even though only tertiary and quaternary sediments are exposed in the study area.

Study Title

Geochemical Mapping in the Ophiolite Belt in Parts of Manipur and Nagaland in Parts of TS Nos. 83K/6, 7, 10, 11, and 12

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

To generate a regional database for use in locating target area for mineral exploration, agriculture application, environmental purposes, and other societal concerns.

Study Recommendation

Anomalous value of Cr (3231 ppm) in grid nos. 83K/11/058/15 lies over the ultramafics of the Ophiolite terrain. The value is higher than the cut-off limit of 3000 ppm set by the Indian Bureau of Mines and hence further studies may be carried out to ascertain the values of chromium.

Analysis and Outcome

The study has significance for mineral exploration, agriculture application, environmental purposes, and other societal concerns.

Various geological and geochemical mapping was done in the study. The study indicates that there is good scope for mineral prospecting. Water in the areas is good as far as the water quality is concerned and does not show any alarming contents of toxicity of major oxides and elements, except potassium (water sample no. 83K6/05/W/14, K = 40 ppm) and CaCO_3 (values 420 ppm, 300 ppm, 280 ppm, 270 ppm, and

290 ppm have been recorded from the water samples nos. 83K11/158B/W/15, 83K10/30C/W/15, 83K11/145D/W/15, 83K6/01/W/15, and 83K6/02/W/15, respectively), which have values higher than the maximum permissible limit given by BIS and WHO standards.

The given recommendation may be further carried forward by the GSI.



Study Title

Geochemical Mapping in Toposheet No. 83C/15 in Dima Hasao District, Assam and East Jaintia Hills District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

To generate geochemical baseline data for 68 elements on 1:50,000 scale

Study Recommendation

- Unit cell of composite samples having anomalous value may be further analysed for specific element.
- Stream water from Dithur village may not be used for drinking without proper treatment.

Analysis and Outcome

The study can be of effective use for planning and development, mineral exploration, land use, and agricultural practices in the region.

Statistical analysis of the chemical data of the stream sediments collected from different villages in the study area has been given. Mineral composition or distribution in different villages of the study area has been given. Analytical result of C1 quadrant of soil samples reveals that vanadium (V) is present above the toxic limit in the Regolith © as well as in so©(C). Chromium (Cr) is also present above the toxic limit in almost all the samples of soil (R and C).

Heavy mineral study reveals that zircon and tourmaline are the most common minerals.

The pH of stream water value ranges from 6.4 and 7.5. The pH values of all the collected samples are within the permissible limit of 6.5 to 8.5 prescribed for drinking water by BIS (2012). All the water is considered fresh and suitable for drinking and irrigation purposes based on the geochemistry of the water samples, except the water from the Dithur village stream.

Study Title

Geochemical Mapping in Toposheet No. 83c/16 in Dima Hasao and Cachar Districts of Assam and East Jaintia Hill District, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2018

Objective

To generate a geochemical database of degree sheet 83C of Assam state using multi-elemental analyses.

Study Recommendation

- Coal outcrops were observed associated with sulphur staining during the field work, were exposed all along Madura nala, and were traced along the strike around 1 km and were not traced further due to the presence of a dense forest.
- Further investigation may be carried out after characterization of coal sample exposed there.

Analysis and Outcome

This study has application for mineral exploration, planning and developmental activities, environmental management, agricultural practice, and land use in the area.

The rock types exposed in the study area are argillaceous Disang Group, Barail Ranges, and Surma and Tipam Groups. The study area is mainly composed of sandstones and shale.

Overall, water quality is good where all constituents are within the permissible limit as per WHO 2006 standards.

Further exploration on the given recommendations may be carried forward by the GSI.



Study Title

Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in Parts of Toposheet Nos. 78 O/09 and 78 O/10, Ri-Bhoi, East Khasi Hills, and West Khasi Hill Districts, Meghalaya, and Kamrup District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2017

Objective

- To prepare a landslide inventory database using high-resolution remote-sensing data and field inputs.
- To prepare toposheet-wise 1:50,000 scale spatial database for geofactors of landslides for use as input thematic maps.

Study Recommendation

- The susceptibility map is actually meant for regional application because the information is shown on the scale of 1:50,000. Areas falling in high susceptibility zone should be given due attention through large-scale slope stability studies while executing any civil constructions.
- As about 93% of the total landslide incidences reported are induced due to anthropogenic activities along the NH-44E and Mairang-Nongkhaw-Patharkhamma state highway and NH-44E as discussed in section 5.2. Some generic recommendations for the cut-slope failures include removal of loose debris from slope, moderation of slopes by suitable modification of slope geometry, construction of a retaining wall of suitable design preferably founded on the sound bedrock or deeper sub-stratum at the toe portion below the road bench with weep holes, lateral hillside drain along the toe, and a contour drain to contain the surface run-off from the affected area.
- At places where the toe is day lighted due to road cutting slope protection measures like rock bolting and wire mesh shotcrete in the rocky portion and covering of the slope by geo jute/geo-grid in loose/soil mass are recommended.
- The several villages or communities located in and around the study area and at the vicinity of high-hazard areas should be given priority in holding Community Based Disaster Management Programme (CBDMP).

Analysis and Outcome

The current study shows that about 1.13% of the total area comes under highly susceptible area, while moderately susceptible area accounts for 6.49% and low susceptible area accounts for 92.38%. The highly susceptible areas are mostly confined to the NW quadrant of toposheet 78 O/09. The susceptibility map also depicts that the major urban agglomeration like Shohing, Mairang, Patharkhamma, and Nongkhaw comes under the low susceptible area. The susceptibility map is the outcome of both remote sensing and field inputs, and the map shows the qualitative estimate of landslide susceptibility of the study area.

The results provided the qualitative estimate of landslide susceptibility of the study area, which are of important societal value. The landslide susceptibility maps obtained could serve as a scientific basis for regional planning, landslide hazard management, and mitigation purpose.

The concerned PWD and construction contractors should implement the given recommendations.

Study Title

Geophysical Mapping in Parts of Ri-Bhoi and Jaintia Hills Districts, Meghalaya and Karbi Anglong District, Assam, Covering Toposheet 83C/1 and Part of 83C/2

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2015

Objective

- To delineate subsurface structural features if any.
- To generate gravity and magnetic maps.

Study Recommendation

The high gravity anomaly zone also associated with high-intensity magnetic signatures brought out around Bamkamar and Mawkhanu in the southern part needs to be studied in detail employing geological, geophysical, and geochemical investigations to verify the possible extension of Sung Valley ultramafic complex in this part of the study area.

Analysis and Outcome

The study has significant importance in understanding the geology of the region. The study can be utilized for developmental activities, land use, and agricultural activities. The gravity-magnetic survey has delineated a few significant anomalies and lineaments corroborating the geology and structural feature of the area. Gravity high anomaly associated with magnetic high signature was brought out in the southern part of the study area, which is possibly due to the presence of basic intrusive.

The GSI should carry forward the recommendation for further research.



Study Title

Geochemical Mapping in Toposheet No. 78O/1 and Parts of 78 O/5 in Goalpara and Kamrup Districts, Assam, and East Garo Hills and West Khasi Hills Districts, Meghalaya

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2014

Objective

- To generate the baseline elemental geochemical database of the area and creation of geochemical maps.

Study Recommendation

- In toposheet no. 78O/1, most of the sample showing values of Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, and Lu are higher than the Standard Global Soil Composition (SGSC) range. Higher values are seen over younger intrusive (porphyritic granite and non-porphyritic granite), which may be studied in detail.
- Isolated high peaks of uranium and thorium values were observed in south-eastern corner of toposheet 78O1 over younger intrusive (porphyritic granite), which may be studied in detail.
- In the toposheet no 78O/5, the higher values of La, Ce, Pr, Sm, Eu, Tb, Dy, Ho, and Lu were seen in the south-western side of the toposheet, which may be considered for a detailed study.

Analysis and Outcome

The study is important in the fields of mineral exploration, environmental aspects, land use, agriculture, and health hazards. The area under study is occupied by crystalline rocks from Archean to Neo-proterozoic, i.e. older metamorphic groups of Archean age, Assam–Meghalaya Gneissic Complex of Proterozoic age, basic intrusive and acid intrusives of Neo-proterozoic and Quaternary Formations (Chapar, Sorbhog, Hauli, and Barpeta formation) of early Plesitocene to Holocene.

In the toposheet no. 78O/1, the higher values of Co, Cr, Cu, Ni, and Sr are seen as isolated high peaks.

The higher As values are seen in southern and south-western side of the toposheet. Most of the sample showing values of Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, and Lu are higher than Standard Global Soil Composition (SGSC) range. In the toposheet no 78O/5, the higher values of La, Ce, Pr, Sm, Eu, Tb, Dy, Ho, and Lu are seen in the south-western side of the toposheet.

The GSI can carry forward the given recommendations for further study.

Study Title

Final Report on Regional Geochemical Mapping in Toposheet No. 83c/06 in Parts of Jaintia Hills District, Meghalaya and Karbi Anglong District, Assam

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2013

Objective

Creating a geochemical database for 68 elements under NGCM programme geochemical.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

The geochemical database is useful for mineral exploration, soil fertility assessment, human and animal health, establishing valid environmental baseline, and understanding the chemistry of the environment.

The available analysed elements along with data of earlier report (59 elements) have been prepared along with their spatial distribution map and statistical analysis. One of the main goals of the programme is to pick up anomalous zones of mineralization concealed under thick soil cover.

The groups of elements (composited stream sediments) that show strong similarity in the distribution patterns are as follows: (i) Fe_2O_3 and TiO_2 ; (ii) Ba, Nb, Sr, and Zr; (iii) Co, Cu, Ni, Sc, and V; and (iv) Rb, Th, and Y. The following REE elements (composited stream sediments) show strong positive correlation in the cluster field: (i) La, Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ce, and U; (ii) Sn, Mo, Ge, and Be.

The distribution pattern in oxides and trace elements suggests close affinity of certain group of oxides and trace elements controlled by lithology of the terrain. The following groups of major oxides occur in clusters as they show strong similarity in the distribution patterns: (i) Na, NO_3 , and SO_4 ; (ii) NO_3 and P_2O_5 ; and (iii) EC and HCO.

Any further research can be carried forward by the GSI.



Study Title

Culture-Dependent and Culture-Independent Evaluation of Microbial Community Population Dynamics in the Indigenous Fermentation of Soibum for Selecting Potential Starter

Implementing Institution

Institute of Bioresources and Sustainable Development (IBSD)

Project Location/Completion Year

More than one state, 2011

Objective

To study the indigenous fermentation process of bamboo shoot (*soibum*), the microbial content, and the nutritional content of fermented bamboo shoot.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

The study investigates the production technologies (methods) of fermented bamboo shoot in the North East India. The study focused on the development of production technology for quality *soibum* by selecting appropriate microbial starter culture and value addition by labelling its nutritional and functional properties. Establishment of small-scale fermented bamboo shoot industry in the north-eastern states of India (region with rich bamboo resources) for the production of high pharmacologically valuable fermented bamboo shoot products will improve the socio-economic status of the region.

The study shows immense potential of bamboo in terms of food and nutrition as North East India harbours a large amount of bamboo forest coverage.

Regional agricultural institutes along with local entrepreneurs and farmers can produce fermented bamboo shoots in the commercial scale. Such undertakings can uplift the economic status of the people.

Study Title

Development of Enzyme Based Extraction Process for Improving Quality and Recovery of Starch from Different Varieties of *Colocasia esculenta* (Arbi) of Assam for Food Use

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2015

Objective

- To examine the physicochemical characteristics of starch from different varieties of *Colocasia esculenta* available in Assam.
- To identify the varieties suitable for starch extraction for food used based on the physicochemical characteristics.
- To study the application of these starch in the preparation of different food products.
- To optimize the enzymatic starch extraction process using pure enzymes as well as crude enzymes extracted from microorganisms.

Study Recommendation

- Other enzymes may be used for the extraction of starch.
- Enzymatic treatments might be combined with other treatments like microwave, ultrasound, etc. to further increase the efficiency.
- The effect of incorporation of starch extracted by different methods might be examined on the quality parameters of tomato ketchup.

Analysis and Outcome

This study shows the importance of starch derived from *Colocasia esculenta* also called Taro starch. Taro starch is an alternative and superior to other conventional starch derived from potato, sweet potato, cassava, wheat, maize and so on [346, 347]. In the study tubers of seven cultivars of taro were used in the present investigation. The cultivars collected were: Kani, Ahino, Muktakasha, Panchamukhi, Garu, JCC37 and JCC57. Starches from potato variety Chandramukhi (*Solanum tuberosum*) and rice variety Mahsuri (*Oryza sativa*), were used for comparison. Maize starch was purchased from HiMedia Laboratory, India and also used for comparison.

The study revealed that the physicochemical, functional, textural and colour properties of starches of various taro cultivars of Assam from North-East India are different from taro varieties available in other regions of the world. The properties of taro starch were found to be closer to rice and maize starch in many respects, evincing its potential as an ingredient in food processing and other industries. The high gelatinization and pasting temperature coupled with low viscosity make them suitable for applications in food products which are subjected to heating at high temperature, wherein change in viscosity is not desirable during heating and cooling. The study also revealed that higher yield of starch from taro tubers could be achieved using cellulose and xylanase.

The study has potential for food and non-food applications. Action or followed up can taken up in collaboration with food industries such as Nestle, and other local food industries.



Study Title

Studies on Functional Properties of Dominant Microflora Found in Rice Beer of Assam

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2015

Objective

- Isolation of functional microbes from rice beer produced in Assam and to identify them.
- Study of the functional properties of the isolated microbes.
- To develop better-quality rice beer.

Study Recommendation

Methodology developed for the production of rice beer using microbes with good functional properties can be used for obtaining better-quality rice beer.

Analysis and Outcome

Rice beer is known to may have health benefits due to the presence of potent prebiotics, probiotics and nutraceuticals [350]. The study was undertaken to identify various microbes found in rice beer, and indigenous beverage consumed in the Northeast India. In the study lactic acid bacteria (LAB) were isolated from rice beer and their characterization was done. Good antibiosis and antioxidant activities were exhibited by some of the isolates and they were identified as *Lactobacillus pentosus*, *Pediococcus pentosaceus*, *Lactobacillus casei* and *Lactobacillus plantarum*. *Saccharomyces cerevisiae* and *Saccharomyces bayanus* were found to possess high ethanol tolerance.

From the study microbial strains with promising functional properties involved in the production of rice beer in Assam have been identified. It has also standardized methodology for preparing rice beer has been developed. Further, fuzzy methodology for the sensory evaluation of rice beer has been developed.

An improvised technology for preparing beer using identified microbial stains and *Albizia* extracts has been developed and submitted for patent. The effects of consumption of traditionally prepared rice beer on human gut microbiota and fecal metabolites have been observed [351]. Potential application of rice beer has also been studied. Practical application in the formulation of mixed-microbial cultures for biofuel production from plant-based feedstocks [352] is observed.

As on October 2021, the recommendation given above is not known to have been implemented.

Study Title

Quantifying the Microbial Risk in Protein-Rich Fermented Foods of Manipur to Identify the Critical Control Points and Development of LAMP-Based Rapid Diagnosis Kit for Major Food-Borne Pathogens

Implementing Institution

Institute of Bioresources and Sustainable Development (IBSD)

Project Location/Completion Year

Manipur, 2020

Objective

- To quantitatively assess the microbial risk in the production of protein-rich fermented foods of Manipur for identifying the critical control points.
- To develop a LAMP (loop-mediated isothermal amplification) based diagnosis kit.

Study Recommendation

The results suggest a potential risk associated with the consumption of Hawaijar (fermented soya bean) and Sa-ung (fermented pork).

Analysis and Outcome

The study gives insight to various issues of food habit, food safety, pathogens in food, etc, in the N-E India. In the study, five different kinds of fermented foods of Manipur were intervened under this project are *Ngari* (fermented dry fish), *Hentak* (fermented fish paste), *Sanggom afamba* (fermented milk), *Hawaijar* (fermented soybean) and *Kapham/ Sa-ung* (fermented pork).

The study revealed the dominant presence of potential food borne pathogens namely *Proteus mirabilis*, *Bacillus cereus*, *Staphylococcus aureus*, *Clostridium* spp., and *Enterococcus faecalis* in the marketed protein-rich (soybean, meat, milk and fish) fermented foods of Manipur. Whole-genome sequencing of three predominant pathogens (*Bacillus cereus*, *Proteus mirabilis*, and *Clostridium tepidum*) showed a high presence of antibiotic resistance genes. Further toxicity analysis supported the risk associated with these foodborne pathogens. In this study, Loop-mediated isothermal amplification (LAMP) based low cost and rapid diagnosis kit for simple screening at the field level was aimed. The study has optimised the LAMP reactions for 10 WHO prioritised foodborne pathogens commonly present in the fermented foods of Manipur. A simplified version of LAMP reaction-based diagnostic kit in 96 well microtiter plates was achieved during this study. A complete package of LAMP-based diagnosis kit for field-level detection of foodborne pathogens is planned further for commercialization of the LAMP-based diagnostic kit developed during this study.

The study also highlights the indigenous knowledge using unseen microorganisms to obtain the organoleptically desirable and culturally acceptable fermented foods. Besides, it also shows beneficial importance of abundant microbiota and health-promoting benefits of fermented foods^[357].



Study Title

Molecular Analysis of Gut Microbiome Composition Changes Due to Regular Consumption of Traditional Fermented Foods

Implementing Institution

Institute of Bioresources and Sustainable Development (IBSD)

Project Location/Completion Year

Manipur, 2011

Objective

To understand the impact of the long-term dietary habit of fermented foods on intestinal microbiota in an isolated homogenous human population.

Study Recommendation

- The fermented food consumption affects the seasonal stability and Bacteroidetes structure by impacting the gut microbiota interaction network.
- The findings undermine the resilient nature of gut microbiota and showed enterotype shift within six months.
- A model for enterotype trafficking driven by a negative interaction network between Clostridium cluster-XIVa and Bacteroidetes is proposed here.
- The work indicates possible regulation of microbial interaction network through dietary intervention to achieve a stable healthy gut microbiota.

Analysis and Outcome

This study researched on how long-term consumption fermented food, called *Hawajar* and *Dahi* impact human intestinal microbiota structure and stability. Even though no jump in the composition of food fermenting bacteria was evidenced, the reduced abundance of *Bacteroidetes* and pathogens, and favouring enterogradient trafficking towards *Ruminococcus* state with higher butyrate production supported the health claims of fermented foods consumption. Even though the healthy gut microbiota structure is not yet defined by targeting the negative interaction network described in this study through dietary intervention it is possible to modulate the disturbed gut microbiota and improve the related disease status or sustain the healthy gut microbiota. Research on the impact of different foods on gut microbiota interaction networks and modulating the interactions to get a healthy structure has potential future for development of novel functional foods.

Several studies show that there is positive correlation between consumption of fermented food and human health ^[358, 359, 360].

Study Title

Bioprospecting of Lactic Cultures from North Eastern Region to Develop Functional Fermented Soy Foods with Potential Health Benefits

Implementing Institution

North Eastern Hill University

Project Location/Completion Year

More than one state, 2018

Objective

- Isolation of lactic acid bacteria from fermented foods of North Eastern Region and their molecular diversity.
- Screening of bacterial isolates for their potential techno-functional and therapeutic attributes.
- Application of promising isolates for the development of value-added functional fermented soy or cereals containing products.
- Shelf life study and bio-functional properties of the functional fermented soy products under different storage conditions.

Study Recommendation

Clinical investigations are required to validate the health claims or bio-functional properties shown by the potent *Lactobacillus* cultures.

Analysis and Outcome

The cultures employed in the study can be presumed to enhance health promoting benefits and bio-enrichment of nutritional values which will help in uplifting the socio-economy status of the ethnic tribal people residing in Meghalaya as well as in popularizing their traditional ethnic foods at a commercial scale to other parts of the country.

Another study [361] also reveals that bioactive peptide production by lactic acid bacteria display a pattern of biofunctions such as anti-hypertensive, antioxidant, immuno-modulatory, and anti-microbial activities.



Study Title

Development and Application of DNA Chip Based Analysis Platform for Assessment of Microbial Risk Associated with Traditional Fermented Foods of North East India

Implementing Institution

Institute of Bioresources and Sustainable Development (IBSD)

Project Location/Completion Year

More than one state, 2018

Objective

- To develop a DNA Chip with array of oligo probes specific to species, strain, toxin, and virulence of the common food-borne pathogens detected in the traditional fermented foods of North East India.
- To apply the DNA Chip Based Analysis Platform.

Study Recommendation

- Unlike other naturally fermented foods reported worldwide, *Clostridium* spp. (particularly a phylotype related to *Clostridium botulinum*) and *Proteus* spp. (particularly *Proteus mirabilis*) were predominantly present in the fermented foods of North East India.
- Two versions of diagnostic kits called the IBSD FoodPatho Chip were developed to probe both food-fermenting bacteria and food-borne pathogens and to assess the overall community structure as a key factor of microbial risk assessment.
- The IBSD FoodPathoChip developed can differentiate both viable (RNA-level analysis) and total (DNA-level analysis) load of food-borne pathogens present in the 36 fermented foods. For this purpose, the probes designed and printed in such way to hybridize both Cy-labelled RNA transcript of the food DNA (PCR product/fragmented DNA) and the Cy-labelled cDNA synthesized from food RNA in a single analysis platform.

Analysis and Outcome

The study has significant application in the area of food and nutrition, food technology, and pathology and diseases through food. Out of the study, two versions of IBSD FoodPatho Chip for assessing the microbial risk in naturally fermented foods have been developed.

The study identified that the overall bacterial community structure of the naturally fermented food is a key factor in deciding the safety of naturally fermented foods. It also showed a drastic difference in the structure of the bacterial community of outbreak samples of fermented foods in comparison to non-outbreak samples (though several food-borne pathogens along with virulence factors were detected in both the cases).

The technology developed can be effectively used in the food safety analysis laboratories for assessing the risk in the naturally fermented foods marketed in India and in the diagnostic laboratories for a fast and reliable diagnosis during fermented food-borne outbreaks.

Study Title

Embankment Survey and Monitoring Using Unmanned Aerial Vehicle (UAV)

Implementing Institution

North Eastern Space Applications Centre

Project Location/Completion Year

Assam, 2018

Objective

To capture high-resolution images of Ranganadi (18.5 km) and Puthimari (12 km) river systems using UAV for monitoring of embankment health.

Study Recommendation

UAV can be effectively used to understand the embankment cross section and profile to identify potential breach points.

Analysis and Outcome

The study is important for understanding the environment and river of the region. It may also be used for developmental and agricultural purposes. An unmanned aerial vehicle (UAV) was utilized effectively to capture high-resolution images of Ranganadi (18.5 km) and Puthimari (12 km) river systems for the monitoring of embankment health. The horizontal resolution of the image captured is 5 cm and generated a digital elevation model of 20 cm vertical resolution. The longitudinal and cross-sectional profiles reflect structural deformations of the embankments. The longitudinal profile prepared from the digital elevation model created from UAV image shows that the gradient of Ranganadi river embankment is not uniform. There are depressions in some places, which is also revealed by the cross-sectional profiles prepared in 24 locations of both of the embankments. The cross-sectional profiles further show that top width, bottom width, and height of Ranganadi embankment are not uniform.

The study will be helpful for government officials of the concerned department for planning and management.



Study Title

Digitization, Scrutiny, Modification, and Uploading of 1:50k Maps; Validation and Standardization of Uploaded Maps in Portal

Implementing Institution

Geological Survey of India

Project Location/Completion Year

More than one state, 2014

Objective

- Sheet-wise compilation, digitization, and integration with NER mosaic and uploading of all layers to the GSI portal.
- Standardization of already uploaded digital data to make them seamless across the region (up to litho-unit level).
- Identification of gap/mismatched areas.

Study Recommendation

- Identification of gap/mismatch areas and intimation to the respective state units for further course of action.
- Uploading of standardized data to the portal.
- Digitization and uploading of remaining unmapped sheets as and when they are made available.

Analysis and Outcome

The study is a technical report, and it would be of interest to a few technical scientists or researchers in the field of geoinformatics. The study involves standardizing of geoinformatics information, including mapping, drilling, mining, geochemical exploration, coal, geophysical exploration, PGRS, environmental geology, natural hazards and rock sample analyses, which have to be uploaded to the database.

In the study, unique values of age, super group, group, and formation were prepared as separate lists from the digital mosaic map of lithology layer and all duplicate/miss-spelled values were removed/corrected, the attributes of the lithology layer were standardized up to litho-unit level. An additional 11 sheets were digitized, standardized, and integrated with the lithology mosaic map.

The recommendations of the study, such as unmapped and mismatched areas, were identified and communicated to the respective state units for taking up priority items to resolve the issues.

Study Title

Magnetic Survey for Chromite-Bearing Ultramafics Bodies in Mantum Ching, Chandel District, Manipur (G4)

Implementing Institution

Geological Survey of India

Project Location/Completion Year

Manipur, 2014

Objective

The detailed magnetic survey was carried out in Mantum Ching block, Chandel district, Manipur covering an area of 6.10 sq km in part of toposheet No. 83 L/7 to delineate zones of chromite-bearing ultramafic bodies in Ophiolite suit of rocks.

Study Recommendation

The significant magnetic anomalies in Table 2 may be tested with shallow drilling to verify the source rock.

Analysis and Outcome

The study has application in mineral exploration in the area. The area is occupied by two main litho-units: Disang Formation and Ophiolite suit of rocks. The Disang Formation comprises sandstone, shale, siltstone, slate, quartzite, and phyllites. The Ophiolite Suite of Rock (OSR) is represented by ultramafics, mafics, plagiogranite, and volcanic enveloped within the Oceanic Pelagic Sediments (OPS).

The magnetic (T.F) map has clearly demarcated the contact between OPS and ultramafics in the south at traverse S1800 with different magnetic variations and change in magnetic contour pattern. The processed magnetic maps were helpful in identifying different formations and major structural features affecting the deposition of Ophiolite sequence besides demarcating its continuation. The study observes that the estimated depths of magnetic bodies producing these magnetic anomalies vary from 4 to 10 m. The nature of magnetic anomalies in the study area suggested small-sized discontinuous chromite bodies.

The GSI can take up the given recommendation for further research.



Study Title

Polymer Supported Green Nanoparticles: Using Plants of North East India; Studies on Toxicity and Anticancer Property

Implementing Institution

Tezpur University

Project Location/Completion Year

More than one state, 2017

Objective

- Synthesis of green silver nanoparticles using extracts of plants from North East India.
- Physical characterization of the synthesized nanoparticles.
- In vitro and in vivo toxicity study using animal model of different taxonomic position.

Study Recommendation

The following new leads have been borne from the study:

- Spherical silver nanoparticles are synthesized by aqueous extracts from different leaves.
- These silver nanoparticles showed very efficient anti-cancerous properties.
- These nanoparticles are relatively nontoxic to healthy cells.

Analysis and Outcome

The study explores the application of *green* silver in medicine. In the study, silver nanoparticles (AgNPs) were synthesized, characterized, and used for biomedical applications such as anti-cancerous material. Different leaves such as *Thuja occidentalis*, *Aloe vera*, *Mentha arvensis* (Linn.), etc. were used. Leaves-extract-mediated AgNPs prepared under ambient conditions showed a narrow size distribution with average particle size less than 10 nm. These nanoparticles are characterized by various instrumental techniques. Interestingly, these nanoparticles exhibited anticancer activity against human breast (MCF 7, MDA MB 231) and cervical cancer (HeLa) as well as mouth epidermoid carcinoma (KB) cell lines at the concentration range of 6.25–50 µg/mL. On the contrary, they are quite compatible with normal mammalian cells (human peripheral blood mononuclear cells and rat hepatocytes) in vitro. Moreover, the nanoparticles exhibited good compatibility to soil health. Thus, the prepared nanoparticles are highly biocompatible and have strong potential in the development of anticancer chemotherapeutics.

Medical research institutes such as ICMR, biotech companies, and medical and research institutes can collaborate on further research of the recommendations.

Study Title

Identification of Competent Alkali-Surfactant-Polymer Formulations for Enhanced Oil Recovery of Assam Crude Oil

Implementing Institution

Dibrugarh University

Project Location/Completion Year

Assam, 2016

Objective

To enhance the capability of EOR to maximize the possible recovery of OOIP from the depleted reservoir of Upper Assam Basin by identifying the optimal parameters of ASP flooding for Assam crude oil.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

This study offers an effective method of crude oil extraction using Alkali-Surfactant-Polymer. Similar study using Surfactant-Polymer/Alkaline-Surfactant-Polymer Formulation for Enhanced Oil Recovery (EOR) processes has also been demonstrated [345]. An integrated model of ASPEOR based on performance, applicability and understanding of the operating mechanisms using the data from the flooding experiments were done. In the study identification of alkali was done based on wettability, it's assistance as a co-surfactant and reduces adsorption onto the porous media. The identified alkali was found to be Sodium Carbonate (Na_2CO_3). The synthetic surfactant synthetic identified was Sodium Dodecyl Sulphate (SDS) and natural surfactants identified were Black Liquor (BL). Both these surfactants were anionic surfactants which were earlier proved to be compatible to the anionic reservoir condition.

Further, identification of the polymer was done based on the mobility ratio of the displacing to the displaced fluids and thereby improving the macroscopic sweep efficiency of the reservoir. The identified polymer was found to be Polyacrylamide (PAM). Based on the above selection of alkali, surfactants (both SDS and BL) and polymer, the ASP slugs were formulated as natural ASPEOR slug when BL was taken and synthetic ASPEOR slug when Na_2CO_3 was taken. The core flood experiments were conducted both in Berea sandstone core plugs from Michigan, USA and in conventional core plugs. After secondary water or brine flooding, individual cores were subjected to alkali, surfactant, polymer, alkali-surfactant, surfactant polymer, polymer-alkali and finally alkaline-surfactant-polymer (ASP) flooding experiments. It was found that maximum recovery was during ASP flooding.



Study Title

GIS Modelling Based Impact Assessment of Ground Water Arsenic Contamination in Brahmaputra Basin and Development of a Remediation Strategy using Endemic Lignocellulosic Agrowaste Based Nanobiosorbants

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2016

Objective

GIS modelling based impact assessment of groundwater arsenic contamination in the Brahmaputra basin and the development of a remediation strategy using endemic Lignocellulosic agrowaste based nanobiosorbants.

Study Recommendation

Recommendation has not been outlined in the report

Analysis and Outcome

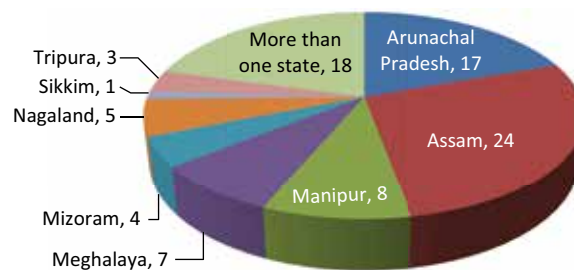
The study gives an understanding of the contamination of groundwater by arsenic. This study is important for the healthcare and diseases caused through water contamination. It is also useful for water usage and management for different agricultural purposes and other developmental purposes in the area.

In the study, a total of 200 groundwater samples were collected from 14 different districts in Assam and analysed for the presence of arsenic. Out of the 200 samples, 126 groundwater samples showed arsenic in the range of >10 ppb, which is well beyond the WHO permissible limit, and 110 groundwater samples showed arsenic in the range of >50 ppb, which is well beyond the acceptable limit in India (in the absence of an alternative source of potable water). During the study, seven different biosorbents with a total of 23 different sub-types were developed and analysed for structural and functional attributes using various techniques, including transmission electron microscopy (TEM), scanning electron microscopy (SEM), atomic force microscopy (AFM), X-ray diffraction (XRD), spectroscopy, Fourier transform infrared (FTIR) spectroscopy, photon correlation spectroscopy, thermogravimetry (TGA), and differential thermogravimetry (DTG).

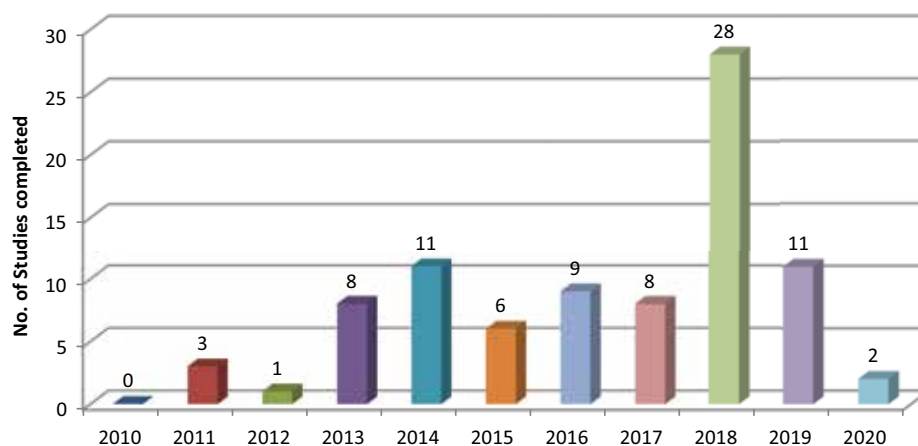
State-wise Summary

In the present study, over 87 study reports related to Science and Technology have been collected and analysed. These research studies have been carried out in the North Eastern Region (NER) of India by various academic and research institutions during 2010 to 2020. Keeping the collected study reports on Science and Technology sector in view, it has been observed that Assam received the maximum number of studies (24), followed by Arunachal Pradesh (17), Manipur (8), Meghalaya (7), Nagaland (5), Mizoram (4), Tripura (3), Sikkim (1), and there are 18 study reports, which focus on more than one state.

Based on the collected study reports in the present study, it has been observed that a number of studies on Science and Technology have been completed during 2018.



Studies completed in Science & Technology Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Science & Technology Sector in NER during 2010 to 2020 (Year-wise)

Arunachal Pradesh

Arunachal Pradesh, the largest north-eastern state having total geographical area of 83, 743 sq. km is endowed with vast natural resources—mainly forest, minerals and hydropower potential. For the development in the region without any disturbance to the resources, science and technological applications need to be utilized. Thus, science and technology can play a vital role towards utilization and management of the vast natural resources and addressing the problems for all-round development of the State.

In the present study, seventeen (17) study reports have been collected and analysed. Out of 17 study reports, sixteen (16) study reports are related to geochemical mapping of different districts in Arunachal Pradesh. These studies have been carried out by the Geological Survey of India (GIS) during 2017 and 2018. These studies are significant to understand the geochemical composition of the area with respect to mineral prospect. The geochemical maps will be used for searching of hidden mineral deposits, soil fertility assessment, human and animal health, establishing valid environmental baseline, and understanding the chemistry of the surface environment. Another study report is related to ethno-botanical knowledge. The study was conducted in most of the districts of Arunachal Pradesh, including the different geographical



zones and indigenous groups. Ethno-botanical knowledge of utilization, practices on wild edible plants associated with different tribes have been recorded and documented.

Assam

Twenty four (24) study reports focusing on science and technology sectors in Assam have been collected and analysed to understand the technological development in the region. There are fifteen studies (15), which have been carried out by the GIS. These studies are basically exploratory in nature. In these studies, geochemical mapping in 15 different districts in Assam have been carried out by the GIS. These studies are important for understanding environment and geology of the region. Geochemical mapping was carried out in almost all the districts of Assam with the objective of generating baseline geochemical data that has wide-ranging utilities in the fields of resource development, agriculture, medical geology, and environment. There are nine (9) other studies carried out by some academics and institutions, viz., Tezpur University, Dibrugarh University, North Eastern Space Applications Centre, and South Asian Forum for Environment. One of the studies was carried out in 2017 by the South Asian Forum for Environment and funded by the National Bank for Agriculture and Rural Development (NABARD) wherein flood resilient agriculture method was developed by using floating raft in agriculture in Majuli.

Four (4) other studies carried out by Tezpur University are based on the technological interventions such as: i) Development of nanocomposite materials from waste plastics and non-conventional plant materials, ii) GIS modelling-based impact assessment of groundwater arsenic contamination in Brahmaputra basin, iii) Preparation and characterization of peroxy-metal compounds and studies on their biological significance in cellular signaling, iv) Development of green nanocomposites based on natural resources, v) Studies on functional properties of dominant microflora found in rice beer of Assam, and vi) Development of enzyme based extraction process for improving quality and recovery of starch from different varieties of *Colocasia esculenta* (Arbi) of Assam for food use.

Manipur

Eight (8) study reports focusing on science and technology sectors in Manipur have been collected and analysed to understand the technological development in the region. There are five (5) studies, which have been carried out by the GSI. These studies are mainly focusing on geological mapping, remote sensing, and magnetic survey at different locations of Manipur. Two (2) other studies have been carried out by the Institute of Bioresources and Sustainable Development (IBSD). One of the study conducted by IBSD has demonstrated how long-term consumption fermented food, called *hawajar* and *dahi* impact human intestinal microbiota structure and stability and the other study gives insight to various issues of food habit, food safety, pathogens in food, etc., in North-East India. There is another study report which has been carried out by Ernst & Young on "New technology centre at Imphal". Imphal and its surrounding areas have a conducive climate for the growth of medicinal and aromatic plants, which serve as raw materials for the development of essential oils and medicinal plant extracts. Keeping this in view, a study has been done to develop a technology centre that will contribute towards skilling youth to make them employable in industry by designing courses relevant to them.

Meghalaya

In the present study, seven (7) study reports related to science and technology sectors focusing on Meghalaya have been collected and analysed. These seven studies have been carried out by the GSI during 2013 to 2020. There is a significant importance in mineral exploration in the NER. There are two studies on Geochemical Mapping conducted at two different locations. These studies have aimed towards generating a geochemical elemental baseline database in the area as part of the National Geochemical Mapping Programme for use in developing and managing natural resources and various other social concerns. Such studies are useful in developing and managing natural resources, especially mineral resources, and various other social concerns.

One of the studies is based on landslide susceptibility mapping in Tongseng-Sonapur-Kuliang Road sector of NH-6 (erstwhile NH-44), East Jaintia Hills, Meghalaya. This study has effective application for planning and development; it can also be used for natural disaster mitigation plans. The recommendations are facet specific and may be addressed by the concerned administration, PWD, and civil engineers.

Another study is based on compilation of existing baseline information for first-level seismic hazard assessment of Shillong Urban Agglomeration Area, East Khasi Hills District, Meghalaya. This study implies

the importance of understanding the seismic hazard of the region. The collected information will be used for taking up the second level of seismic hazard assessment study using suitable attenuation relations to arrive at a comprehensive seismic hazard assessment of the area for disaster mitigation and urban planning. The given recommendations in the study have to be further studied by the GSI.

Mizoram

In the present study, four (4) study reports related to science and technology sectors focusing on Meghalaya have been collected and analysed. These four studies have been carried out by the GSI during 2013 to 2016.

Two studies are based on landslide susceptibility mapping in the region of Lunglei, Saiha, Aizawl, Serchip, and Mamit Districts of Mizoram. The study has important applications in planning and development and disaster management. In one of the study, a total of 146 landslides were studied in the field with 42-point-geo-parametric data including 75 debris slides, 40 rock slides, 16 rock falls, and 15 soil slides. This study provides the qualitative estimate of landslide susceptibility of the study area. The results are of important societal value and can provide inputs for regional land-use planning and planning of risk reduction strategies. The given recommendation can be implemented by municipality and district administration under the guidance of the GSI.

Specialized thematic mapping in Aizawl District, Mizoram have been carried out in one of the studies. The study has important applications for planning and development and land use in the area. Whereas, in another study, photogeological mapping has been carried out in parts of Mizoram. This Study provides an overview of the terrain in photo interpretation and to gather information about the nature and distribution of materials and features occupying the terrain.

Nagaland

In the present study, five (5) study reports related to science and technology sectors focusing on Meghalaya have been collected and analysed. These five studies have been carried out by the GSI during 2013 and 2019. The GSI has launched National Geochemical Mapping with a view to generate baseline data, which will be useful in locating/developing natural resources and in wide application in environmental studies, agriculture, public health, and other social concerns.

All the five studies are based on geochemical mapping in the region of Lunglei, Saiha, Aizawl, Serchip, and Mamit Districts of Mizoram. The geochemical database can be utilized for targeting mineral exploration, land use, agriculture, forestry, management of environment, animal, and human health, etc.

Sikkim

In the present study, one (1) study report focusing on geotechnical investigations and monitoring of the 5th Mile Landslide on Gangtok-Nathula Road, East District, Sikkim has been collected and analysed. This study was carried out by the GSI in 2017. The study area lies in a strategically important area on which road has been constructed. The Study is of importance for any developmental (construction) activities of the road. During the course of geological mapping, eight slide subzones have been identified and mapped in various parts of the slide zone out of which two are located in stable Palaeoslide debris.

The data collected during the Study is useful for the government and other organizations for better planning of their infrastructures, developmental activities, and disaster preparedness. The preventive recommendations given in the study can be taken up by the PWD or construction agencies or contractors.

Tripura

In the present study, three (3) study reports related to science and technology sectors focusing on Tripura have been collected and analysed. These three studies have been carried out by the GSI during 2014, 2016, and 2018, respectively. Study on geochemical mapping of tertiary fold belt of three districts, viz., Khowai, South and West Tripura have been conducted to generate geochemical baseline database for multipurpose uses like managing/developing natural resources and applications in agricultural, environmental, public



health, and other societal concern. The study will help in understanding the environment, especially mineral resources in the area. The study can be utilized for mineral exploration, development and planning activities, agricultural practices, and water resources management. The given recommendation may further be investigated by the GSI or specialized laboratories dealing with toxicity of soil and water.

Overall Scenario

Eighteen (18) study reports focusing on science and technology have been collected and analysed. These studies have been conducted in more than one state in the NER for the development of this region. Out of 18 study reports, 11 study reports have been conducted by the GSI under the National Geochemical Programme. Under these studies, geochemical mapping was conducted in different districts of North-Eastern states. Statistical analysis of the chemical data of the stream sediments collected from different villages in the study area has been carried out. These studies are important in the fields of mineral exploration, environmental aspects, land use, agriculture, and health hazards. One of the studies conducted in Dima Hasao District, Assam and East Jaintia Hills District, Meghalaya has recommended that all the water in the study area is considered fresh and suitable for drinking and irrigation purposes based on the geochemistry of the water samples, except the water from the Dithur village stream. Another study on geochemical mapping was carried out in Ophiolite Belt in Parts of Manipur and Nagaland in 2018 by the GSI wherein statistical analysis of the chemical data of the stream sediments was collected from different villages. The study revealed that there is good scope for mineral prospecting in the study area. Water in the areas is good as far as the water quality is concerned and does not show any alarming contents of toxicity of major oxides and elements, except potassium.

Khasi Mandarin is a commercially grown variety of mandarin orange in North-Eastern states. It is well known for its quality fruits among the consumers of the region. A study has been conducted by the Department of Bioengineering and Technology, Gauhati University in 2016 on Rough lemon and Khasi mandarin. This study has been carried out to identify the low-cost molecular markers for detection of nuclear embryos and zygotic embryos in rough lemon and Khasi mandarin from North-East India. This study is a useful source of information for environmentalists, horticulturists, PGR workers, seed biologists, policymakers, faculty and students who wish to refer it for their research work.

One of the study was jointly conducted by the Indian Agricultural Research Institute, Central Agricultural University Meghalaya, and Nagaland University in 2015 on plant (rice) disease. Rice constitutes a major staple food in the NER. The study is very important to understand blight in rice that causes substantial loss in harvest. The study demonstrated the presence of 21 Xop-T3Es in the most virulent race 4 and determined the T3SS-dependent translocation of these effectors. Further research of the given recommendations can be carried forward by agricultural research institutes such as IARI, Central Rice Research Institute, and other state agricultural institutes or departments.

The NER of India is home for great varieties of indigenous bamboo shoot products, which are unique to the ethnic communities in their taste, organoleptic characters, and preparation methods. Studies on food processing technologies have been focused in some of the studies conducted by various research and academic organizations.

“Applications of Remote Sensing and GIS in Sericulture Development (Phase II) for North Eastern Region” is another study conducted by North Eastern Space Applications Centre in 2018. This study has tremendous applications for the development of sericulture in the NER. This study is a continuation of the previous work carried out for 108 districts representing 24 states of India. In this study, potential sites for mulberry, eri muga, and tasar were explored in 20 selected districts of the NER using multicriteria GIS analysis. The study revealed that among the states, Assam is found to have maximum suitable areas (149,442 ha covering seven districts) that can be brought under mulberry sericulture.

Geologically, the NER also lies in a sensitive zone where the tectonics is still active. In view of this, there is a greater need to research especially, in human settlement and development processes to avert toll on human lives. However, NER lacks investments in academic and R&D infrastructures. This is one principal barrier to implement S&T based R&D activities.

For the development of agriculture in NER, access to the information on agriculture to the farmers is very essential. There is a need to develop information kiosk which should be a ‘single window’ access to knowledge base in the field of agriculture sector to facilitate the agricultural reform processes in each districts of NER.



6.13 TOURISM

Study Title

Hotels in Tezpur: profiling the guests

Implementing Institution

Tezpur University

Project Location/Completion Year

Assam, 2010

Objective

- To create directory of hotels and other lodging facilities in and around Tezpur.
- To estimate the room capacity of existing hotels in Tezpur.
- Comparison of existing star category hotels in terms of existing infrastructure, facilities available, services provided, room categories, etc.
- To find out drivers of demand, i.e., the customers' profile, target market, market segmentation, enabling environment, etc., of hotels in Tezpur.
- To determine the key issues/areas of making hotel project success/ failure in and around Tezpur.

Study Recommendation

The report finds that the region is not ready to host more accommodation targeted towards business travellers. It recommends for catering to extra luxury segment.

Analysis and Outcome

It has been observed that over the period of time there are more hotels and homestays that have emerged to fill in the need of tourism sector in Tezpur. Assam government is taking good steps to help in the flourishing of tourism sector in the region. The outcome of this study may help the entire hotel industry in the region to enhance their services and offerings, which will attract the tourists.

None of the hotels are officially certified with any star by the Ministry of Tourism, Government of India. Most of the hotels are catering to the business travellers, which ultimately confine themselves to business class facilities rather than leisure tourist-oriented products. Promotion and branding of cultural and craft works would be more beneficial to give boost to tourism activities in the area.

The recommendation of this study is very generic and also implementable. More emphasis can be laid on providing better facilities and leisure tourist-oriented products by the existing hotels and resorts.

Agencies responsible for implementation:

- Assam Tourism Development Corporation, Government of Assam
- Directorate of Tourism, Government of Assam

Study Title

Tourism development plan for Meghalaya

Implementing Institution

Indian National Trust for Art and Cultural Heritage (INTACH)

Project Location/Completion Year

Meghalaya, 2010

Objective

- To develop international and domestic tourism so as to promote development of the State and understand the unique culture of Meghalaya and its biodiversity.
- To promote conservation and enhancement of natural resources as regards flora and fauna, sacred groves and unique features of the mountain environment through controlled development.
- To facilitate planned tourism in the State for bringing about great employment opportunities for the local community.
- To meet the required demand for trained manpower emerging from the tourism industry.
- To distribute the benefits of tourism as widely as possible across Meghalaya.
- To formulate a tourism plan in consonance with local area capabilities so as to socially absorb tourism, subject to infrastructure and manpower constraints.
- To create infrastructure, communication network and to develop collateral for promotion, publicity, advertisement and celebration of fares and festivals.

Study Recommendation

- The development of tourism to be linked with the local community through their mobilization and organization.
- The focus should be given to local community mobilization for the development of tourism awareness, brand development through tourism promotion, setting up tourist city centre, wayside amenities, accommodation, city tours and tour packages.
- INTACH proposed product portfolio for the plan – Cultural, Nature/Eco, Rural, Adventure, Wildlife and Forest, and Leisure and Wellness Tourism for the State.
- Tourism in Meghalaya needs to be promoted by an aggressive and well-coordinated marketing strategy and to be successful as a Brand in the market place.

Analysis and Outcome

Outcome of this study will benefit the overall development of tourism in Meghalaya. The proposed plans are very conducive to promote tourism by holding such potential areas such as cultural, natural, rural adventure, wildlife, forest tourism together. Tourism Department, Government of Meghalaya has initiated work towards the strategies, which will strengthen the quality and attractiveness of the tourism experience in Meghalaya. Tourism Department, Government of India has also taken initiatives to promote tourism in Meghalaya. A vibrant tourism website has been developed for its outreach. The recommendations outlined in the study are being implemented in a phased manner. In 2011, the Ministry of Tourism came out with Meghalaya Tourism Policy 2011^[362].

To implement the recommendation on the ground, coordination among the local tourism NGOs and SHGs with the Directorate of Tourism play a vital role for the development of tourist locations. It has been observed through a report that state government has taken some initiatives such as setting up of garbage bins, public facilities for the convenience of tourists^[363].

Agencies responsible for implementation:

- The Tourism Department, Govt. of Meghalaya



Study Title

Tourism Survey for the State of Meghalaya

Implementing Institution

Market Research Division, Ministry of Tourism, Government of India

Project Location/Completion Year

Meghalaya, 2015

Objective

To obtain the following month-wise information for each district:

- Estimated number of visits
- Profiling the tourists/visitors at district and State level in respect of age, sex, occupation, purpose of visit, State/UT of residence or country of nationality, duration of stay, mode of journey, use of package tour, etc.

Study Recommendation

No recommendations have been outlined in the report

Analysis and Outcome

This report is based on the study conducted by Datamation Consultants Pvt. Limited with support from Market Research Division, Ministry of Tourism, Government of India. The study has come out with a comprehensive data on the areas, viz., demographic, social and geographic; profile of travellers who visit Meghalaya; travel behaviour and modes of travel to Meghalaya; sources of information about Meghalaya as a tourist destination; and opinions and experiences of visitors about their place of stay in Meghalaya, including services and facilities.

The study report has not outlined any recommendations, however, the findings of the study are very useful in policy development and implementing new innovative ideas for the development of tourism industry in the state.

Agencies responsible for implementation:

- Ministry of Tourism, Government of India
- Directorate of Tourism, Government of Meghalaya

Study Title

Tourism survey for the state of Nagaland

Implementing Institution

Mott MacDonald Private Limited

Project Location/Completion Year

Nagaland, 2015

Objective

The field survey in Nagaland was conducted for a period of 12 months in the districts of the State. The survey was done to obtain the following month-wise information for each district.

- Visits by overnight visitors
- Staying at accommodation units
- Staying with friends and relatives
- Others, such as those staying in tented accommodations provided by State Government or by any other charitable organizations
- Visits by same-day visitors
- Profile of visitors, their expenditure pattern, purpose of visits, etc.
- Occupancy rates and direct employment in accommodation units

Study Recommendation

No recommendations have been outlined in the report

Analysis and Outcome

The study has not outlined any recommendations in its report, but it has been observed that a comprehensive study has been conducted on different categories of tourists, their profile, expenditure, and their period of stay in Nagaland.

The study is useful for the entrepreneurs who explore their business in tourism sector. The study has revealed that in December the maximum number of domestic visitors visit Nagaland, which is primarily due to the Hornbill Festival that takes place during that time. The study should have come out with some innovative ways, which might help in the growth of the tourism industry in the North East region.

Agencies responsible for development in tourism sector in Nagaland:

- Directorate of Nagaland, Govt. of Nagaland
- Ministry of Tourism, Govt. of India



Study Title

Tourism survey report for the State of Sikkim

Implementing Institution

Datamation Consultants Pvt. Ltd. New
Delhi-110092

Project Location/Completion Year

Sikkim, 2012

Objective

- To conduct field survey in all districts of the state for a period of 12 months.
- To prepare a frame/ list of all important tourist places in the State and prepare month-wise and annual estimates of occupancy rate of accommodation units at district and State levels.
- To conduct one-day workshop for the officers of the State to be surveyed and a few other States and organizations.
- To prepare a frame/ list of tourist place-wise all accommodation units, such as hotels, dharamshalas, guest houses, etc., for conducting State- level survey on tourism

Study Recommendation

No recommendations have been outlined in the study

Analysis and Outcome

The study has not outlined any recommendations in its report, but it has been observed that a comprehensive study has been conducted on different categories of tourists, their profile, expenditure and their period of stay in Sikkim, which will help in planning and infrastructural development.

Sikkim has a huge scope for different kinds of tourism such as cultural, nature/eco, rural, adventure, etc. Hence, such kinds of studies will be useful to understand the profile of the tourists and best season for tourism. It has been observed from this study that peak months for overnight and same day tourist visits (domestic tourists) is May whereas the lowest arrivals of domestic tourists is measured during the months of August and February. In the case of foreign tourists, a peak month for overnight tourist visits for Sikkim was April.

Agencies responsible for development of tourism sector in Sikkim:

- Tourism and Civil Aviation Department, Govt. of Sikkim
- Ministry of Tourism, Govt. of India

Study Title

Contribution of tourism (Hospitality) sector to the State GDP of Assam, Arunachal Pradesh, Meghalaya and Sikkim

Implementing Institution

I-Win Advisory Services Ltd

Project Location/Completion Year

More than one state, 2016

Objective

- To assess contribution of tourism in the economy of four States under study
- To examine health of tourism sector in terms of income and employment generation
- To suggest respective measures for development of tourism in these States

Study Recommendation

For promoting steady development of the tourism sector, the following issues need to be resolved on priority basis:

Infrastructure and Policy Development-

- Upcoming Pakyong airport near Gangtok, railway line upto Rongpo extended to Gangtok, new National Highway, Ropeway service between Gangtok and Namchi, Bhaley Dunga Sky-walk
- Setting up of Tourism Regulatory Authority (TRA) to enforce fair competition accountability, sustainability measures, communications and coordination among departments and schemes, monitoring and evaluation of tourism for providing global standard tourism services
- Tourism-specific environment risk management like seismic and landslide resistant planning and implementation, optimum intake potential and destination limitation and rational capacity utilization assessment for encouraging intensive development
- Awareness and specific training programmes for managing and maintaining the tourism statistical-accounts and its benefit at government, non-governmental, and community level
- The State Government needs to pursue for more flights to Umroi Airport at Shillong and bring the Baljek Airport under its operating network.

Marketing and Promotion-

- Social media is playing a key role to provide information about destination, can be explored for promotion of tourism in the State.
- Eco, rural and adventure promotion for generating alternative employment and checking urban migration.
- Creating more tourist activities through rejuvenating adventure activities such as trekking, hiking, rock climbing, gliding, angling, river canyoning, zip lining, snow cruise, yak riding, etc.

Skill Development-

- Quality and standard improvement of hospitality sector and competitive pay package for minimizing trained human resource drain from IHM, IHCAE.
- Training of drivers of hired cars as tourist guides and introduction of trained porters, trekking cooks, guides, etc.



Analysis and Outcome

This study has explored tourism potential in four north eastern states in India—Assam, Arunachal Pradesh, Meghalaya, and Sikkim. The findings of the study are useful for the development of tourism in the region. All the recommendations mentioned in the study are implementable. The Ministry of Tourism has taken many initiatives to implement the new innovative ideas for the sustainable development of tourism in the North Eastern Region (NER) of the country. Though the Government of India is providing some special care for the NER, it is still the backward part of India because of many constraints. Further, although the Government has provided funds and programmes for the promotion of Northeast Tourism, the part is still least visited.

It has been observed that many of the recommendations mentioned in the study have already been implemented, viz., Pakyong Airport near Gangtok was inaugurated by the Prime Minister of India in 2018[364], awareness activities have been initiated, skill development programmes have been conducted for the youth who are engaged in hotel industry, travel, etc. However, some recommendations still need to be implemented, viz., enforcement of Tourism Regulatory Authority (TRA).

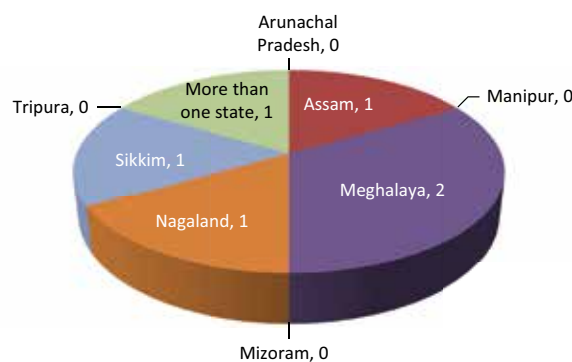
Agencies responsible for implementation:

- Ministry of Tourism, Government of India

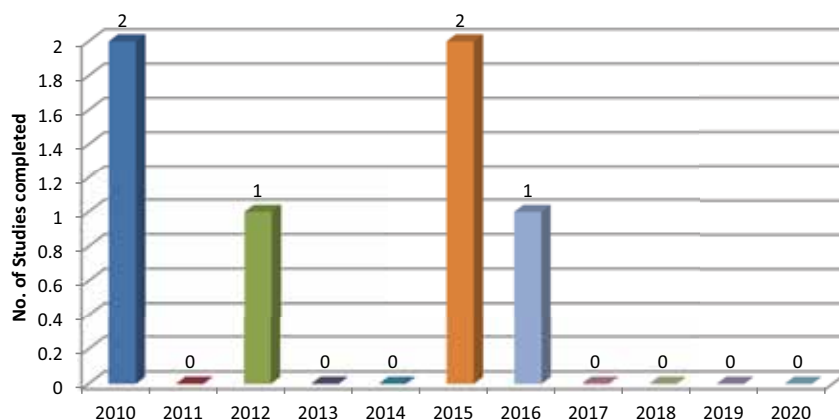
State-wise Summary

North-East India is one of the richest biogeographic areas in the world. The region holds huge potential for tourism even as it is endowed with unique and varied cultural and ethnic heritage. Tourism sectors— both rural and urban—guarantee income generation employment opportunities. The rich biodiversity, exotic wildlife sanctuaries, tea, golf, food have been attracting tourists from all over the world. Recently, the region has witnessed growth in rural tourism that is characterized by showcase of rural lifestyles encompassing aspects of sustainable livelihood, social and cultural landscapes etc. The study has collated few studies that outline state-level survey, roadmap for tourism development, initiative and policies at central and state level for tourism development. Some of the major constraints of Northeast tourism development are connectivity, tourism infrastructure, insurgencies, rugged terrain, etc.

On Tourism Sector, the present study was collated from Assam – 1 (2010), Meghalaya – 2 (2010 and 2015), Nagaland – 1 (2015), Sikkim- 1 (2012), Multiple states – 1 (2016).



Studies completed in Tourism Sector in NER during 2010 to 2020 (Location-wise)



Studies completed in Tourism Sector in NER during 2010 to 2020 (Year-wise)

Assam

A study titled “Hotels in Tezpur: profiling the guest” was implemented in 2010. The study observed that the region is not ready to host more accommodation targeted towards business travellers. It recommends for catering to extra luxury segment. It has been observed that over the period of time there are more hotels and homestays that have emerged to fill in the need of tourism sector in Tezpur. Broadly, the state government is taking positive steps towards tourism sector development in the state. The outcome of this study may help the entire hotel industry in the region to enhance their hospitality services and offerings, which will attract the tourists. None of the hotels are officially certified with any ratings by the Ministry of Tourism, Government of India. Most of the hotels are catering to the business travellers, which ultimately confine themselves to business class facilities rather than leisure tourist-oriented products. Promotion and branding of cultural and craft works would be more beneficial to give boost to tourism activities in the area. More emphasis can be laid on providing better facilities and leisure tourist-oriented products by the existing hotels and resorts.



Meghalaya

“Tourism development plan for Meghalaya” study was commissioned in 2010 with the key objective of developing both international and domestic tourism in the state and to understand the unique culture of Meghalaya and its biodiversity. The study identified and laid out strategic plan that encompasses potential areas of tourism such as local culture, eco-tourism, rural and village adventure. The State Tourism Department with support from the Central Government of India has taken several initiatives towards these strategies that will strengthen and enhance the quality and attractiveness of the tourism experience in the state. As part of the initiative, a vibrant tourism website has been developed for maximum outreach. The recommendations outlined in the study are being implemented in a phased manner. The study also noted that coordination among various stakeholders involving the local tourism NGOs, Self Help Groups, villagers with the Directorate of Tourism would be pivotal for the overall development of the sector. Based on this study, the Ministry of Tourism came out with the Meghalaya Tourism Policy, 2011.

The study “Tourism Survey for the State of Meghalaya” was carried out in 2020. This survey brought out comprehensive data on the areas, viz., demographic, social and geographic; profile of travellers who visit Meghalaya; travel behaviour and modes of travel to Meghalaya; sources of information about Meghalaya as a tourist destination; and opinions and experiences of visitors about their place of stay in Meghalaya, including services and facilities. The study report has not outlined any recommendations; however, the findings of the study will be highly useful in policy development and implementing new innovative ideas for the development of tourism industry in the state.

Nagaland

Tourism survey for the state of Nagaland was carried out in the year 2015. The study involved a comprehensive study on different categories of tourists, their profile, expenditure, and their period of stay in Nagaland. The study will aid as a tool for entrepreneurs venturing into tourism business. The study noted that maximum number of domestic and international tourists visit the state during December every year primarily to attend the Hornbill Festival that takes place during that time.

Sikkim

The study Tourism survey report for the State of Sikkim was carried out in 2012. Sikkim has a huge scope for different kinds of tourism such as cultural, nature/eco, rural, adventure, etc. Hence, such kinds of studies will be useful to understand the profile of the tourists and best season for tourism. It has been observed from this study that peak months for overnight and same day tourist visits (domestic tourists) is May, whereas the lowest arrivals of domestic tourists is measured during the months of August and February. In the case of foreign tourists, a peak month for overnight tourist visits for Sikkim was April.

Overall Scenario

The study “Contribution of tourism (Hospitality) sector to the State GDP of Assam, Arunachal Pradesh, Meghalaya and Sikkim” was carried out in 2016. The study explored tourism potential in the four North Eastern states of India, viz., Assam, Arunachal Pradesh, Meghalaya, and Sikkim. Its findings will be useful to chart out tourism roadmap in the region. The Ministry of Tourism has taken several initiatives by adopting innovative ideas for the sustainable tourism development in the North Eastern Region (NER) of the country. Though the Government of India is extending special attention for the NER tourism sector, it is marred by or lags behind due to several constraints. It has been observed that many of the recommendations mentioned in the study have already been implemented, viz., Pakyong Airport near Gangtok was inaugurated by the Prime Minister of India in 2018, awareness activities have been initiated, and skill development programmes have been conducted for the youth who are engaged in hospitality and travel industry.

NER is known for its tourist destination in India, this requires substantial investment in studies for expansion of the activities and infrastructure development in tourism sector. As per the data collected in this study, only 6 studies have been conducted in the past 10 years in the tourism sector. More studies needs to be carried out in this sector in NER. The sustainability of the tourism infrastructure development projects purely depends on the interest of the State level Tourism Development Corporation or the Department of Tourism. Local involvement need to be strengthened.

7. Annexure

Annexure-1

Study of Studies: Survey Form

Sponsored by MDoNER

* Required

Section A: Project Details

1. Name of the respondent *

.....

2. Email of the respondent *

.....

3. Contact details of the respondent *

.....

4. Role of the respondent in the study? *

Mark only one oval.

- Principal investigator (PI)
- Co-PI
- Team-member
- Higher Authority in the institute
- Sponsor representative
- Government official
- Other: _____



5. Name of the study? *

.....

.....

.....

6. Study location? *

.....

7 Name of the PI?

.....

8. Gender of the PI?

Mark only one oval.

Male

Female

Other

9. Year of start of the study (start date)?

.....

10. Year of completion of the study (end date)?

.....

11. Project value (Rs. in lakhs)?

.....

12. Does the study have cross-cutting sectors? *

Mark only one oval.

Yes

No

13. Sectors covered in the study? *

Check all that apply.

- Agriculture & Allied
- Banking and Finance
- Commerce and Industry
- Energy
- Environment
- Health & Nutrition
- Human Resource Development
- Infrastructure
- Law & Governance
- Rural Development
- Science & Technology
- Tourism
- Other: _____

14. Target Group? *

.....

15. Brief objective of the study? *

.....
.....
.....

16. Major recommendations in brief? *

.....
.....
.....



17. Is the project gender specific? *

Mark only one oval.

- Fully
- Partially
- No

18. If answer to above question is "Fully" or "Partially", please specify recommendation briefly?

Section B: Implementation Details

19. What is the current status of the recommendations? *

Mark only one oval.

- Fully Implemented
- Partially Implemented
- Not Implemented

20. If fully implemented, is there any visible impact?

Mark only one oval.

- Significant Positive Impact
- Not Significant Impact
- Negative Impact
- No Impact
- Not Known
- Not sufficient time to measure the impact

21. If Partially Implemented (PI), what is the level of ‘partial’ implementation?

Mark only one oval.

- Part of one recommendation implemented
- Only one recommendation implemented
- Part of few recommendations implemented
- Part of few recommendations and few recommendations fully implemented
- Most of the recommendations implemented

22. If Partially Implemented (PI) or Not Implemented (NI), what are the reasons responsible for not full implementation? (more than one choice is available)

Check all that apply.

- Financial
- Regulatory
- Administrative
- Judiciary
- Other: _____

23. Impact of the recommendation? *

Mark only one oval per row.

	High	Medium	Marginal	No Impact	Don't Know
Employment generation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Women empowerment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Income opportunity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Infrastructure development (e.g. road/communication)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access to Market/Finance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access to resources (e.g., water/energy/sanitation)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Livelihood improvement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increase in productivity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skill development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



23. Please provide evidence/outcome to validate your observation related to the project impact? *

Check all that apply.

- Report
- Policy formulation
- News items
- Research Paper
- Social media communication
- Other: _____

24. Does the implementation have impact on cross-cutting issues? *

Mark only one oval.

- Yes
- No
- No cross-cutting sector
- Not Known

25. How do you expect the impact to be changed over time? *

Mark only one oval.

- Increase
- Decrease
- No idea

26. What can you suggest for better implementation of the research? *

Check all that apply.

- Better coordination among various government departments
- Effective coordination among all stakeholders
- Public-private partnership
- Pro-active local government
- Enthusiasm from target group (like association)
- More engagement of social institutions (like NGO, SHGs)
- Other: _____

28. Do you think that the recommendations can be generalized for other regions/target groups? *

Mark only one oval.

To a great extent

To some extent

Not relevant

29. Given the current COVID-19 situation, do you feel recommendations need modification? *



Annexure-2

Focus Group Discussion with Subject Experts

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1	Mr. Jigmey Namgyal Addl. CE South and Nodal Officer (IT) Govt of Sikkim	jigmeyla@gmail.com
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4	Dr. Samrat Paul Designation: Assistant Professor Energy Engineering Department North Eastern Hill University, Shillong 9485043421	samrat@nehu.ac.in; paulsamrat17@gmail.com
5	Dr. SUBIR DATTA Assistant Professor Department of Electrical Engineering School of Engineering and Technology Mizoram University Aizawl-796004, India	mzut168@mzu.edu.in; subirnerist@ gmail.com
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Sl.no	Name/ Affiliation	Email
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15	Prof R Varatharajan Professor & Co-ordinator ENTOMOLOGY (Insect Ecology & Systematics) Department of Zoology, Manipur University (MU) Canchipur, Imphal, Manipur State, India - 795 003 Contact: +91-9629940135	rvrajanramya@gmail.com
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Annexure-3

Questionnaires for interviewing the key stakeholders and FGDs

1. What is the current status of the implementation of recommendations?
2. Is there any visible impact(s) of recommendations?
3. What are the possible factors responsible for such impact? (good/ bad/ significant/ negligible)
4. How do you expect the impact to be change over time?
5. Is there any gender aspect in recommendations and/or impact of recommendations?
6. If recommendations were not fully implemented, what are the possible reasons?
7. What can you suggest for better implementation of the recommendations?
8. Can you identify some relevant stakeholders for better implementation?
9. Do you think that the recommendations can be generalized for other regions/target groups?
10. What are the impacts of COVID on recommendations/implementation plan/impact? Do you think that recommendations/implementation plan/impact can change due to COVID pandemic?



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