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WILL INDIA ATTAIN ITS FORESTRY NDC TARGET OF ACHIEVING 2.5–3 BILLION TONNES OF CO₂EQUIVALENT THROUGH ADDITIONAL FOREST AND TREE COVER BY 2030?

POLICY BRIEF

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WILL INDIA ATTAIN ITS FORESTRY NDC TARGET OF ACHIEVING 2.5–3 BILLION TONNES OF CO₂ EQUIVALENT THROUGH ADDITIONAL FOREST AND TREE COVER BY 2030?

Background

Climate change essentially refers to the rise in the average surface temperature on Earth. Historical emissions since 1880 have resulted in 0.85°C rise in global temperature (MoEF&CC 2009). Till 2009, the historical carbon space occupied by India was only 3%. The percentage share of India in the global annual emissions as on 2018 is 7%. India, even though not part of the problem, has been an active and constructive participant in the search for solutions. At the 19th COP in Warsaw in 2013, all the countries were required to prepare Nationally Determined Contributions (NDCs) and present them in COP 21 in Paris. The Government of India presented its NDCs as it felt it was balanced and comprehensive. India communicated its NDCs on October 2, 2015 and ratified it on October 2, 2016. By 2030, India has committed to reduce the emissions intensity per GDP by 33–35% from the 2005 level. India's NDC has three quantified targets: first is related to emissions intensity of GDP; second is related to contribution of renewable energy in the overall installed power; and third is about achieving further carbon sink of 2.5–3.0 billion tonne of carbon dioxide equivalent (CO₂e) through additional forest and tree cover by 2030. The present study focuses on the third target specified in quantity. It is felt that developing additional carbon sequestration sink of 2.5–3 billion tonne of CO₂e through the forestry sector will be an exceedingly difficult and ambitious task that will require immediate reforms as well as strong political and financial commitment from the government. In this document we will present a brief analysis of the impending challenges in attaining the desired NDC goals through forestry, and summarize the possible recommendations and a road map for achieving the NDC objectives.

Forests in India are primarily treated as social and environmental resources, and only secondarily as a

commercial resource. Forests are home to 80% of the country's biodiversity (FAO 2010). They provide 40% of energy needs, 30% of fodder supply, and 50% of grazing requirement along with other non-timber forest products (NTFPs). India's mandate of high economic growth, Make in India, House for All, Electricity for All, and 1.5-billion population by 2030 also impact the quality of the forests. In view of this, it is evident that the anthropogenic pressure endured by the nation's forests is enormous. With the rapidly growing population, this pressure is set to rise in future leading to seriously affect the quality of forests and their sequestration potential. These impending challenges in attaining the desired NDC goals can only be possible through the forestry sector, possible recommendations, and a road map for achieving the NDC. The forest sector provides livelihood support to one-fourth of the population living in 173,000 forest-dependent villages.

Forests come under the concurrent list of the Indian Constitution, and the central government is responsible for its policy and planning while the state government's responsibility is to implement them. The country's total forest cover (FC) is 71.22 million hectare, which is 21.67% of the geographical area (FSI 2019). The areas under very dense forest (VDF), moderately dense forest (MDF), and open forests (OF) are 9.92 million hectare (3.02%), 30.84 million hectare (9.38%), and 30.44 million hectare (9.26%), respectively. Natural forests contribute to about 95% of the forest cover in the country. The tree cover (TC) is 9.50 million hectare which is 2.89% of the geographical area of the country. The total forest and tree cover in the country is 80.72 million hectares which amounts to 24.56% of the geographical area. The growing stock of India's forests is 4273.47 million m³ and the growing stock of trees outside the forest (TOF) is 1642.29 million m³ (FSI 2019). While open forests increased, there was a reduction of 0.34

million hectare of moderately dense forests, indicating forest degradation (FSI 2019). Unsustainable harvest of fuelwood and minor forest produce is the major driver of forest degradation. In view of the above, it is evident that the anthropogenic pressure endured by the nation's forest is enormous. With rapidly growing population, this pressure is set to rise in the future. This will seriously affect the quality of forests and their sequestration potential.

In the last one and a half decade, forest and tree cover in India has shown a gradual and steady increasing trend.

- National Environment Policy, 2006
- Compensatory Afforestation Fund Act, 2016

The following are the policies indirectly related to the forestry sector contributing in creation of carbon sinks:

- National Rural Employment Guarantee Scheme, 2005
- Pradhan Mantri Ujjwala Yojana
- Pradhan Mantri Krishi Sinchayee Yojana
- National Agricultural Policy, 2000
- National Mission for Sustainable Agriculture

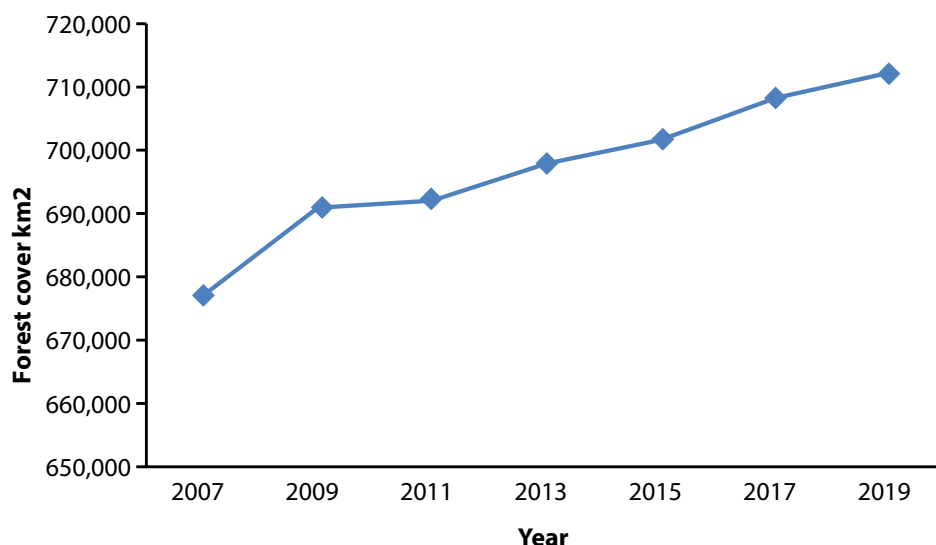


Figure 1. Trend in forest cover from 2007 to 2019

To analyze the current status of India in terms of achieving its NDC target, it is important to consider the policies and legal measures adopted by the government. A few policies directly related to the forestry sector are as follows:

- Indian Forestry Act, 1927
- Wildlife Protection Act, 1972
- National Forest Policy, 1988
- Forest Conservation Act, 1980
- Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA)
- National Biodiversity Action Plan
- Payment for Ecosystem Services
- Green Highway Policy, 2015
- Financial allocation by the Finance Commission
- National Agroforestry Policy, 2014
- Green India Mission
- Van Bandhu Kalyan Yojana
- Integrated Watershed Management Programme
- Rashtriya Krishi Vikas Yojana
- Other schemes by the Ministry of Environment, Forest and Climate Change, Ministry of Rural Development, Ministry of Panchayati Raj, Ministry of Agriculture and Farmers welfare, Ministry of Tribal affairs, etc.

These instruments provide conditions for facilitating sustainable growth of forest and tree covers. The policies directly related to the forestry sector as mentioned above have objectives such as conservation of forests, its maintenance by preserving natural history and biodiversity, prohibiting illegal deforestation and poaching, supporting tribal and other communities who are dependent on forests for their livelihood. The policies which are indirectly related to the forestry sector contribute in providing proper pricing structures, compensation and financial aid to farmers, better

irrigation and water management plans, and reducing pressure on forests. For example, the scheme of providing LPG cylinders at a subsidized rate helps in reducing the consumption of fuelwood.

India is among the few countries in the world who are gaining forest cover. This increase is even more creditable for India, as a large number of tribal people and other villagers living in forest fringe areas depend on forests for their day-to-day needs of fuelwood, fodder, small timber, and NTFPs. The increase in the forest cover became possible only with the high priority accorded to conservation by the national and state governments, which is reflected in a strong framework of policies, acts, rules, and programmes that ensure conservation of forests and biodiversity, enhance green cover and participation of people in conservation activities while protecting the rights of the forest-dependent communities.

This paper follows a mixed approach, which was adopted to compile and collate relevant information, involving secondary research and stakeholder consultations.

The study is based on the secondary sources of data obtained from India State of Forest Report (FSI 2019). The biomass gain and loss method was adopted to estimate greenhouse gas (GHG) emissions and their removals, and to assess the trends of growing stock and carbon stock as reported in the ISFR. The following table provides the data of carbon stock in forest and tree covers of four years – 2004, 2011, 2013, and 2015 – as mentioned in the ISFR report:

Our main aim is to achieve the additional carbon sink of 2.5–3.0 billion tonne CO₂e from the level of baseline year, in BAU and meeting only the shortfall by additional forest and tree cover. Over the years, several technological and methodological advances have taken place in mapping forest cover leading to better satellite data, higher scale maps, and improved mode of interpretation. Therefore, it is suggested that 2015 be taken as the baseline year instead of 2005. The following advancements in the satellite data have been recorded over the years:

Table 1: Carbon in forest and tree covers of India

Year	Forest cover (in km ²)	Carbon in forest cover (million tonne)	Tree cover (km ²)	Carbon in tree cover (million tonne)	Carbon in forest and tree cover (million tonne)	Carbon in forest and tree cover CO ₂ e (billion tonne)
2004	677,088	6663	91,663	958	7621	27.97
2011	697,898	6941	91,266	953	7894	28.97
2013	701,495	7044	92,572	967	8011	29.40
2015	708,273	7083	93,815	980	8063	29.59

Source: FSI Technical Information series 2019

Table 2: Advancements in satellite data over the years

Year	Sensor	Spatial resolution	Scale	Mode of interpretation
1999	IRS-1C/1D LISS III	23.5 m	1:250,000	Visual and digital
2005	IRS-1D LISS III	23.5 m	1:50,000	Digital
2009	IRS P6-LISS III	23.5 m	1:50,000	Digital
2015	IRS P6-LISS III	23.5 m	1:50,000	Digital
	IRS-Resourcesat-2			
	LISS III			

Source: FSI 2019

Presuming 2015 as the baseline year, the NDC target in respect of additional carbon sink through additional forest and tree cover would be as follows:

It was suggested that 2015 be selected as the baseline year rather than 2005, as many technological and methodological upgradations have taken place over the years in various spheres. With the new baseline year, the target would be 32.12 billion tonne of CO₂e at the additional 2.5 billion tonne level and the target at the additional 3 billion tonne level would be 32.62 CO₂e billion tonne.

Therefore, according to the above interpretation, the target would be between 32.12 and 32.62 billion tonne of CO₂e. It is important to have clarity on the baseline year and correct interpretation of the NDC target. Figure 2 shows the projections of carbon sink till 2030.

Factors affecting achievement of NDC target

Many factors limit the increase of tree cover. These factors can be natural as well as humanmade. Increasing population leads to increase in their livelihood needs which results in high pressure on forest reserves.

Table 3: NDC target taking 2015 as baseline year

Baseline year	Carbon in forest And tree covers (billion tonne of CO ₂ e)	Plus 2.5 billion tonne	Plus 3 billion tonne
2015	29.62	32.12	32.62

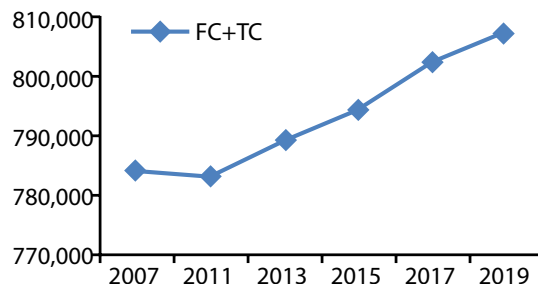
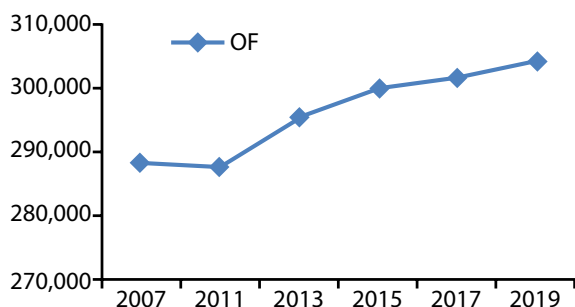
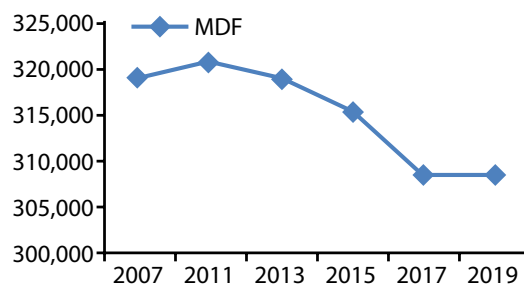
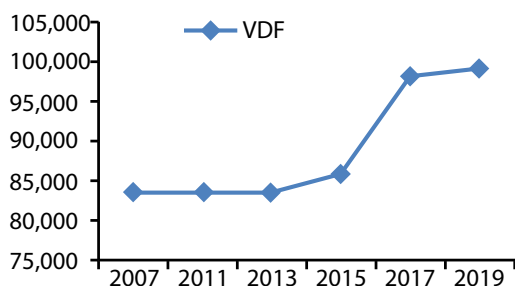


Figure 2. Projections of carbon sink till 2030

Overgrazing, clearing of forest lands for urbanization, extensive consumption of timber and fuelwood, among others result in degraded quality of forests. At the same time, forests are deteriorated due to natural factors such as invasion of foreign species, forest fires, climate extremities, soil degradation, etc. Apart from these factors, poor infrastructural and institutional framework hinders the achievement of the targets. Therefore, a suitable financial mechanism is needed to fulfil the NDC commitments.

Fuelwood consumption

It is alarming to see that from 2009 to 2011, 216.42 million tonne of fuelwood was used for energy requirement, out of which 58.75 million tonne came from natural forests (FSI 2011). In 2019, 274.36 million tonne of fuelwood

Fuelwood consumption in 2019 (ISFR 2019):

- Total: 274.36 million tonne
- Source from natural forest: 85.29 million tonne

Reasons for increase in fuelwood demand: Population growth, demand of energy in rural areas, urbanization, etc.

Estimated CO₂ emissions from fuelwood consumption:

- 2020: 503.45 million tonne of CO₂e
- 2030: 579.01 million tonne of CO₂e

was used to meet the annual energy requirement out of which 85.29 million tonne of fuelwood was collected from natural forests (FSI 2019). The use of fuelwood in future will keep on increasing considering the population growth, demand of rural energy, and energy requirement of brick kilns due to more urbanization. The emissions from fuelwood were calculated using parameters such as fuelwood consumption for energy requirement and

GHG Emission

India :3,202 MtCO₂e*

Total GHG emissions (6.55% of world total)

World: 48,892.37 MtCO₂e

Sources: World Resources Institute Climate Analysis Indicators Tool (WRI CAIT) 4.0, 2017, FAOSTAT, 2018

population dependent on fuelwood. The total CO₂ emissions from the fuelwood consumption in 2020 were estimated as 503.45 million tonne of CO₂e, based on which a projection on the values for 2030 was made. This includes the emissions in 2030 will increase to 579.01 million tonne of CO₂e.

The total estimated CO₂ emissions from the forestry sector (fuelwood, pulp and paper, and forest fire) in 2020 is 539.14 million tonne of CO₂e. Thus, the CO₂ emissions will increase up to 626.91 million tonne of CO₂e in 2030 (Source: TERI 2020).

However, the total greenhouse gas emissions in India was 3202 MtCO₂e annually which is dominated by emissions from land use change and forestry (122.5 MtCO₂e), agriculture (626.86 MtCO₂e), waste (61.05MtCO₂e), industrial process (193.19 MtCO₂e), and energy (2198.71MtCO₂e) (World Resources Institute Climate Analysis Indicators Tool (WRI CAIT) 4.0, 2017).

Fodder extraction

India has only 2.3% of the world's land resources whereas it is home to 17% of the world's human population and ~11% of the world's livestock resources. Livestock contributes to 32% of farmers' income—growing at 4%

India has a large livestock population whose feed requirements are met from crop residues and by-products and grazing on common lands and harvested fields. The land resources supporting the livestock is highly inadequate which gives rise to the importance of sustainable harvesting methods – for instance, agroforestry, community farming, etc. These practices can restrict degradation of land and also provide financial and institutional support to farmers.

per annum. With nearly 5 per cent contribution in GDP, livestock plays an important role in the Indian rural economy. The 2019 Livestock Census estimated India's total fodder-consuming livestock population at 536.76 million (Figure 3) (DAHD 2019). India has one of the largest livestock populations in the world. Besides providing livelihood security to forest fringe villages, forests are used as a source of fodder and grazing for livestock.

India possesses a great wealth of livestock comprising cattle, buffalo, yaks, mithuns, sheep, goats, pigs, horses

and ponies, mules, donkeys, camel, etc., as shown in Figure 3. India has a total of 226.41 million livestock in forest fringe villages which is around 42% of the total livestock in India (FSI 2020).

The land resource to support the livestock numbers is highly inadequate in India. Here, 20 percent of the world's livestock population lives on only 2 percent of the world's geographical area. The major land sources of fodder in

Species	1951	1956	1961	1966	1972	1977	1982	1987	1992	1997	2003	2007	2012	2019
Cattle	155.3	158.7	175.6	176.2	178.3	180.0	192.5	199.7	204.6	198.9	185.2	199.1	190.9	192.5
Adult Female Cattle	54.4	47.3	51.0	51.8	53.4	54.6	59.2	62.1	64.4	64.4	64.5	73.0	76.7	81.4
Buffalo	43.4	44.9	51.2	53.0	57.4	62.0	69.8	76.0	84.2	89.9	97.9	105.3	108.7	109.9
Adult Female Buffalo	21.0	21.7	24.3	25.4	28.6	31.3	32.5	39.1	43.8	46.8	51.0	54.5	56.6	55.0
Total Bovines	198.7	203.6	226.8	229.2	235.7	242.0	262.2	275.7	288.8	288.8	283.1	304.4	299.6	302.3
Sheep	39.1	39.3	40.2	42.4	40.0	41.0	48.8	45.7	50.8	57.5	61.5	71.6	65.1	74.3
Goat	47.2	55.4	60.9	64.6	67.5	75.6	95.3	110.2	115.3	122.7	124.4	140.5	135.2	148.9
Horses and Ponies	1.5	1.5	1.3	1.1	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.6	0.6	0.3
Camels	0.6	0.8	0.9	1.0	1.1	1.1	1.1	1.0	1.0	0.9	0.6	0.5	0.4	0.3
Pigs	4.4	4.9	5.2	5.0	6.9	7.6	10.1	10.6	12.8	13.3	13.5	11.1	10.3	9.1
Mules	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.1
Donkeys	1.3	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	0.9	0.7	0.4	0.3	0.1
Yak	NC	NC	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Mithun	NA	NA	NA	NA	NA	NA	NA	NA	0.2	0.2	0.3	0.3	0.3	0.4
Total Livestock	292.9	306.6	336.5	344.5	353.2	369.4	419.6	445.2	470.9	485.4	485.0	529.7	512.1	535.8
Poultry	73.5	94.8	114.2	115.4	138.5	159.2	207.7	275.3	307.1	347.6	489.0	648.8	729.2	851.8

Source : Livestock Census, DAHD&F, GoI

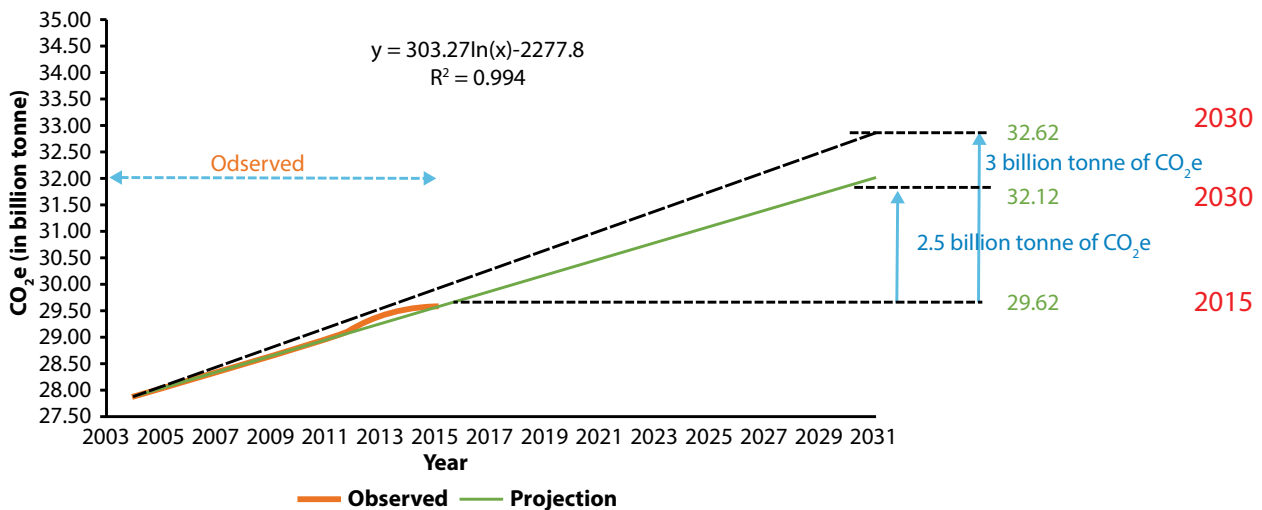


Figure 3. Species-wise livestock population in India

Source: Details available at <http://dahd.nic.in/>

rural India comprise forests, permanent pastures and other grazing areas, culturable wastelands, agricultural lands (net sown area), etc.

Fodder is harvested for around 9 months in a year. The harvested grass and tree fodder is used to feed livestock. The total quantity of fodder extracted annually from forests is 1.05 billion tonne. Madhya Pradesh extracts the highest amount of fodder followed by Maharashtra and Gujarat. In terms of the average removal of fodder per capita in a year, the highest dependence is observed in Mizoram followed by Jharkhand and Arunachal Pradesh. The sustainable limit of harvest is estimated to be around 0.6 billion tonne and the unsustainable harvest was calculated as 0.45 billion tonne. Through sustainable harvesting practices, we can minimize reduction in carbon stocks in forests and plantations.

Deployment of LPG connections to forest-dependent communities

India is home to more than 24 crore households, out of which about 10 crore households are still deprived of LPG as a cooking fuel and have to rely on firewood, coal, dung cakes, etc., as a primary source of cooking (Mall 2019).

Policy intervention is necessary in order to reduce pressure on fuelwood and unclean cooking fuel options. PMUY is such a step in this direction. It aims to replace conventional unclean cooking fuels with LPG in rural areas and BPL households. Refilling of LPG cylinders still remains a challenge and a loophole in the complete success of the scheme. The financial gains from the scheme can be utilized for achieving the NDC targets.

The Pradhan Mantri Ujjwala Yojana (PMUY) is an ambitious social welfare scheme that focuses on replacing unclean cooking fuels mostly used in rural India with LPG (Liquefied Petroleum Gas) which is clean and more efficient, and focusing mostly on BPL households.

The following are the impacts that the PMUY scheme has created in conserving forest in a sustainable manner by providing LPG connections:

- Reduction in fuelwood demand
- Improved carbon sequestration potential
- Community can get carbon price as motivational income

It is estimated that if the 10 crore households adopt LPG for cooking, it will lead to saving of trees and fuelwood demand to a large extent accounting to 1377 million tonne of fuelwood through which 1734 MtCO₂e per year could be sequestered. In addition to it, carbon finance can be obtained of approximately worth ₹ 65,025 crore per annum against the sequestered CO₂. For achieving the aforementioned mode of financial mechanism, the government needs to spend ₹16000 crore per year to provide 50% subsidy per cylinder to 10 crore households as described further.

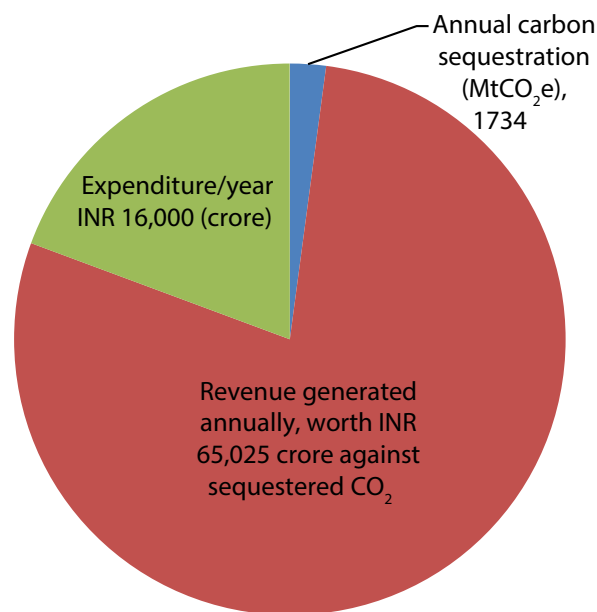


Figure 4. Reduction of fuelwood consumption by providing subsidised LPG connection under the PMUY scheme

With the annual expenditure of ₹ 16,000 crore, India has the potential to optimize the financial gain for achieving the NDC targets. The gained capital can be further utilized in implementing and supporting other financial mechanisms for successful achievements.

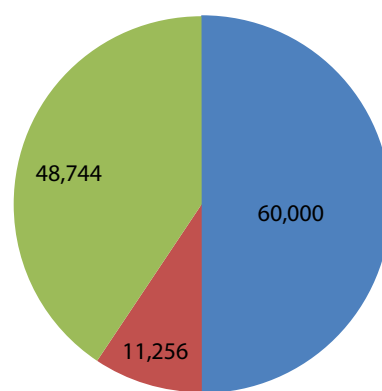
Challenge - PMUY: Refilling of LPG cylinders by the households still remains a challenge. As per a survey done by CRISIL in 2015, 86% of the population who received LPG cylinders as part of the Ujjwala scheme said they had not shifted from biomass to LPG because the price of refilling the cylinder was too high (CRISIL 2015). While official figures state that 80% of the PMUY beneficiaries opt for at least one refill, field-based media reports suggest that the number of refills is far from sufficient to meet the cooking needs of the households. According to a June 2017 study undertaken by the Centre for Science and Environment in Uttar Pradesh, many of the families have not opted for the LPG connection despite being eligible, since refilling was not affordable. While it is argued that PMUY is an access-centric scheme thana refill centric, the effectiveness of the scheme is dependent on whether people refill their cylinders or revert to previous fuels, including fuelwood.

Innovative financial mechanism to obtain forest carbon finance through formulating carbon neutrality policy at national level

Estimates suggest that about ₹ 60,000 crore per annum is needed till 2030 for forest development, livelihood activities, implementing minimum support price (MSP) schemes for agroforestry, and providing LPG to forest-dependent communities. The expenditure for 2012–17 was of the value of around ₹ 56,279 crore (roughly ₹ 11,256 crore per annum) under the state and centrally sponsored schemes relating to forest conservation. Innovative financial mechanisms to obtain forest-based carbon finance such as a national carbon neutrality policy will boost the efforts towards achieving the NDC target. Consequently, we have used both the secondary data and information obtained through stakeholder consultations in order to study the financial mechanism. The roadmap to achieve the NDC target through existing sources of funding such as CAMPA, MGNREGA, GIM, Finance Commission, and other government schemes as well as innovative funding mechanisms and streamlining of funds can help achieve the target. There is a financial gap of ₹ 48,744 crore – calculated by deducting the

annual money spent (₹ 11,256 crore) under various state and centrally sponsored schemes from the total money required, i.e., ₹ 60,000 crore – to achieve 2.5–3.0 billion tonne of CO₂e through additional forest and tree cover. Therefore, the most important is to have a strengthened political commitment to achieve the target. There is a gap in the means of implementation for achieving the NDC target which could be bridged through the payment of ecosystem (PES) scheme and carbon neutrality policy at the national level. It is worth mentioning that external finance to fill this gap can be of importance. In the 14th Finance Commission (2015–2020), there were no funds transferred to the states. However, the 15th Finance Commission (2020–2025) recommended for allocation of funds to the forestry sector (7.5% for forest cover and 10% for forest and ecology). States need to be proactive in earmarking grants for the purpose of forest development.

A total of ₹ 60,000 crore/annum are estimated for funding forest development, livelihood activities, MSP schemes for agroforestry, etc., till 2030. To achieve the NDC targets, a strong political commitment along with funding schemes under CAMPA, MNREGA, allocation by Finance Commission, etc., is needed to streamline carbon finance and adopt a carbon neutrality policy. The 15th Finance Commission recommended allocation of 7.5% of funds for forest cover and 10% for forest and ecology in the forestry sector.



- Annual financial requirement for achieving additional 2.5–3 billion tonne of CO₂e sequestration from forestry sector (crore)
- Annual expenditure (crore)
- Net financial gap per annum (crore)

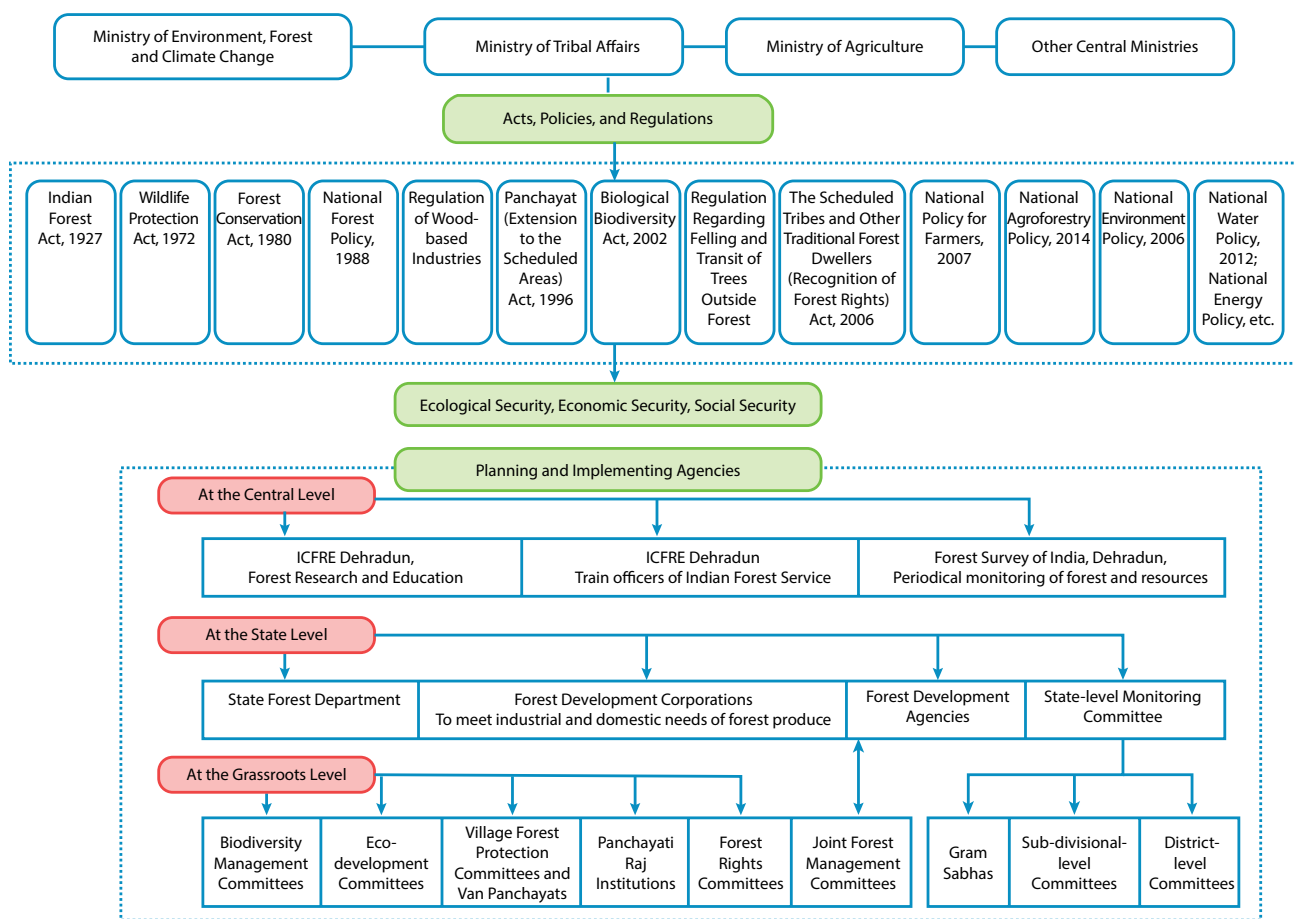
Figure 5. Annual financial requirement for achieving additional 2.5–3.0 billion tonne of CO₂e sequestration from the forestry sector

Analysing the Institutional Framework

The community forest-based governance is mandated under the National Forest Policy of 1988. Convergence of Gram Sabha is required to address the issue of unsustainable harvest of the forest resources due to the growing domestic and international demands; thus, there is a need to develop cultivation techniques for such species. A number of measures such as Joint Forest Management, 73rd amendment of Constitution and Panchayat Extension to Scheduled Areas Act, 1996, Biological Diversity Act, 2002, and Forest Rights Act, 2006 have provided elaborated institutional mechanisms from local to national levels. There is a need to strengthen a co-ordinated governance model for sustainable management of forests by involving local communities and government departments as envisaged by the Forest Rights Act. Afforestation is a cross-sectoral activity taken up under various central and state government schemes,

To achieve the comprehensive NDC targets, a holistic approach is needed wherein a strong financial and institutional framework plays a key role. A coordinated governance model for sustainable forest management along with the involvement of forest dwelling communities and other stakeholders is needed. A possible way to meet the financial gap can be by merging poverty alleviation schemes and forestry schemes to cater to income-generating activities in 173,000 forest fringe villages comprising more than 350 million people.

viz., National Afforestation Programme, Green India Mission, CAMPA (Ministry of Environment, Forest and Climate Change), National Bamboo Mission, Integrated Development of Horticulture (Ministry of Agriculture and Farmers' Welfare), Mahatma Gandhi National Rural Employment Guarantee Scheme, Integrated



Water Management Programme (Ministry of Rural Development), Catchment Area Rehabilitation under Namame Ganga Scheme (Ministry of Water Resources), etc. States also have externally aided projects operational in the forestry sector. Apart from central assistance, states allocate funds for afforestation activities from their annual budget. The National Afforestation Programme of MoEF&CC, which targets degraded lands, contributed about 20% of the total afforestation with an investment of about ₹ 1665 crore. Such governance models will contribute to India's attaining of the forestry NDC targets since local communities are not only dependent on the forests for their livelihoods but are also major partners in conservation by transforming forests into a net sink through sustainable management of forests. Thus, there is an urgent need of recalibration of the national financial requirement by establishing an innovative financial mechanism for achieving 2.5–3.0 billion tonne of CO₂e through additional forest and tree cover. A possible way to address and meet the financial gap could be by merging poverty alleviation schemes with forestry schemes to cater to the income-generating activities in 173,000 forest fringe villages, covering more than 350 million people. It is not possible to achieve the forestry NDC without the involvement of people, as well as other stakeholders including the private sector and other government departments. Thus, a robust institutional framework to enhance forest NDC achievement is provided.

Implementing MSP scheme for strengthening agroforestry

The current area under agroforestry in India is estimated to be 25.31 Mha or 8.2% of the total reporting geographical area of the country (Sharma, Tiwari, Verma, *et al.* 2017). At present, more than 80 percent of the national demand of wood and wood products are met from the agroforestry sector, 6% from natural forest, and 12% from imports. It is imperative to note that the aforementioned 25 Mha potential agroforestry area can sequester 34 MtCO₂e worth ₹ 1275 crore per annum. The average combined annual productivity from trees outside forests is considered as 10m³/ha/year (FSI 1987) for calculating the carbon sequestration potential.

To achieve the carbon sequestration potential, the government needs to provide a budgetary allocation of approximately ₹ 20,000 crore per annum for quality planting material, a statutory and institutional mechanism for certification of planting stock and clonal plants, regular timber markets to ensure transparent timber trade and prevent exploitation of farmers, provisions for harvesting and transportation of agroforestry produce should be made less stringent, an accreditation system should be developed for nursery planting stock, and working plans should be prepared for agroforestry.

Implementation of MSP schemes can help in creation of markets, good-quality planting material, and self-reliance for wood-based industries which can be achieved by the availability of indigenously grown timber through agroforestry – which will further lead to increased livelihood opportunities and doubling of farmer's income. It will also work as a motivation in the form of compensation for carbon sequestration.

India has been a net importer of wood and wood products. The demand for raw wood by different industries in the country increased from 52 million m³ in 1998 to 95 million m³ in 2010 and is projected to increase further due to economic growth and a rise in population (Vanam 2019). This increasing demand, on one hand, leads to an addition in the economic burden of over ₹ 388 billion (₹ 38,000 crore approximately) due to lack of financial mechanism for the production of timber in a subset of 25 Mha potential agroforestry area of the total culturable non-forest area of the country. While, on the other, it leads to the fiscal pressure due to import of wood and wood products.

Based on the afore mentioned analysis, it is the need of the hour to promote and support farmers in the implementation of MSP schemes and creation of markets. Wood-based industries can be made self-reliant for procuring the indigenously grown timber through agroforestry plantations. This can strengthen the livelihood opportunities of farmers and would also help to achieve doubling of their income by providing

compensation for carbon sequestration in the form of carbon finance as a motivational source of income. A simple formula has been worked out for MSP as explained:

$$\begin{aligned} \text{MSP} &= \text{Cost of collection subject to adjustment to macro-economic variables considering 10-year rotation of agroforestry species} \\ &= C1 + C2 + C3 + C4 + C5 \end{aligned}$$

wherein,

C1=Estimated value of family labour (minimum daily wage rate)

C2=Paid out cost (cost of seedlings, manure, cost of material to store and carry collected crop, transportation charges, premium of insurance to cover personal risk during the process of collection

and any other material inputs, depreciation of farm machinery, and other expenses)

C3 = Opportunity cost (interest on the value of owned capital assets, rent paid for leased-in land, and rental value of owned land)

C4 = Value of carbon sequestration for 70% of the locked carbon

C5 = 50% of C1 (Swaminathan Report: National Commission on Farmers recommended a 50% margin over C1. If the MSP were calculated just using the cost of production, not even a single crop can make a cut. The return over cost of all crops is over 50% for the first time. Therefore, MSP is set at 50% above the derived amount, i.e., cost of production)

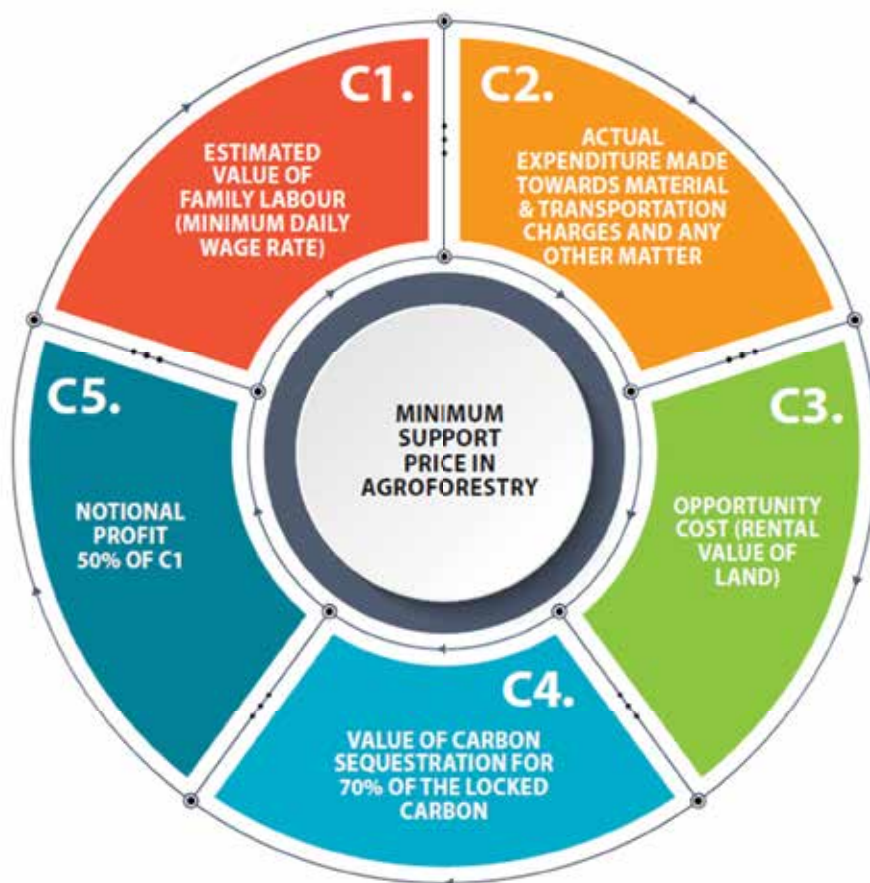


Figure 7. Minimum support price scheme

In addition to it, there is a necessity to relook at the EXIM policy of India for wood imports. Increasing import duty on wood and wood-based products shall result in increased share of domestic market and promoting farmers to grow more wood through agroforestry practices. Such an impetus to the agroforestry sector would enhance forest and tree cover of the country, contribute to achieve 2.5–3.0 billion tonne CO₂e sequestration, enhance ecosystem services, sustain and develop livelihood options for farmers including more than 100 million small and marginal farmers across India.

Policy interventions

The creation of the national market for carbon trading and carbon neutrality for the corporate/industrial sector will be required to achieve the target of sequestering additional 2.5–3.0 billion tonne of CO₂e. A need to formulate the national-level carbon neutrality policy for GHG emissions (beyond permissible limit) has been recently realized as the need of the hour. This can establish a direct link between GHG emissions of a product or process beyond permissible limit and the tax that must be paid on it by purchasing offsets. There exists a potential to purchase the offsets from the financial gains accrued from BAU. Carbon offset markets have been promoted as an important part of the solution to the climate crisis and there is a huge potential to sale carbon offsets through augmenting the carbon neutrality policy at the national level.

The enhancement of carbon sequestration potential, improving livelihood of forest-dependent communities, and water conservation are the key points of the National Forest Policy, 1988. A focus is also needed to 'grow more wood and use more wood' which would encourage farmers to plant more trees. The ban of single-use plastic will further create a market for fibre-based alternatives. Existing policies such as substitution of wood, ban on felling of green trees 1000 meters above the sea level, regulatory regimes for trees grown outside forests, and forest development activities restricted to the forest department are not conducive for sequestering more carbon. In this regard, policy interventions to enhance carbon sequestration are required.

Sustainable Forest Management

The trees grown on farm land and outside notified forests have been considered under the forestry sector. The

sustainable forest management includes conservation, restoration, and sustainable use of ecosystems, the sustainable management of all types of forests, halting degradation, restoring degraded forests globally, and increase in afforestation and reforestation. Unsustainable forest management results from deforestation, degradation, overgrazing, conversion to other land uses, forest fires, excessive fuelwood collection, and unsustainable harvests of NTFPs. The major driver of forest degradation in India is unsustainable harvest of timber, fuelwood, fodder, and minor forest produce. The total CO₂ emissions from fuelwood consumption in 2020 was estimated as 503.45 million tonne of CO₂e (TERI 2020). Using emission values of the previous years, the values for 2030 and 2050 were estimated. This impacts emissions and the sequestration potential due to fuelwood consumption from forests in India. Energy saving devices can be promoted. We have to promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests, and substantially increase afforestation and reforestation. Forest fires are also one of the major drivers of damage caused to forests in the country. Uncontrolled forest fires can lead to significant losses of forests and ecosystem services. The NDC roadmap suggested in this study is build upon a Sustainable Forest Management framework.

Potential of blue carbon in achieving forestry NDC target

Blue carbon is the carbon stored in coastal and marine ecosystems. Conserving mangrove forests, coral reefs, tidal marshes, and sea grasses adds to climate change mitigation efforts globally and nationally. A marine

A marine conservation and climate protection program will enable achieving the NDC target but due to lack of adequate information, it is a neglected area. Blue carbon ecosystem plays a vital role in climate change solutions due to its value for mitigation and adaptation. The Government of India must negotiate with the United Nations Framework Convention on Climate Change (UNFCCC) for recognizing the carbon sequestered through coastal ecosystem at the National level in achieving India's NDC targets and mitigating climate change.

conservation and climate protection programme can enable achieving the NDC target. This is a neglected area, where adequate information is not available and domain knowledge is restricted. The key role of blue carbon in mitigating climate change remains unrecognized with its considerable unutilized potential to meet climate targets.

Coastal ecosystems not only store massive amounts of carbon and offer additional CO₂ sequestration opportunities, but also deliver several adaptation and coastal protection benefits. The increased awareness of the importance of coastal systems for both adaptation and mitigation of climate change is reflected in the submissions of the NDCs, which are the national top-level policy and action plans meant to implement the Paris Agreement on the national level of the signatories. Among the 195 parties to the Paris Agreement, 28 countries included some kind of reference to coastal wetlands in their mitigation actions, while 59 countries included coastal ecosystems or coastal zones in their adaptation strategies and referred in their NDCs to at least one blue carbon ecosystem such as seagrass, salt marshes, and mangroves (Herr and Landis 2016).

Political awareness of the climate values of coastal wetlands and other nature-based solutions have been developed considerably since the first NDCs were submitted. The specific motivations for the inclusion of coastal wetlands in the NDCs may vary between countries and may include the following:

- **High mitigation benefits:** Coastal wetlands sequester carbon at higher rates, per unit area, than terrestrial forests, storing carbon within both their biomass (leaves, roots, wood, and stems) and carbon-rich organic soil.
- **High adaptation benefits:** Coastal wetlands provide services essential for climate change adaptation, including protection from storm surges, flooding, sea-level rise, and coastal erosion. Investment in these forms of 'blue infrastructure', such as living coastlines, provides other essential ecosystem services, such as food security, local livelihoods (small-scale fisheries), and biodiversity, and is often more cost-effective than 'grey infrastructure', such as seawalls and breakwaters.
- **NDC progression:** The Paris Agreement encourages countries to move towards economy-wide mitigation targets, ultimately covering all the economic sectors and emissions sources. The integration of land sector

emissions, including those from coastal wetlands, is a major milestone on this path.

- **High implementation value:** The inclusion of conservation, restoration, and/or sustainable management of coastal wetlands in an NDC serves as a strong signal of national importance, which in turn drives resources and actions that can result in better identified policy levers for the implementation.
- **Climate finance:** NDCs are one of many entry points for securing climate finance to support blue carbon-related actions. Under the provisions of the Katowice Climate Package concerning climate finance reporting, both the donor and the recipient countries must report how a particular financial support or flow contributes to the achievement of the recipient country's NDC. The inclusion of the protection of a coastal line within an NDC is therefore an important way for a variety of potential climate funds.

Blue carbon has received international attention for its potential role in mitigating CO₂ emissions. With its value for both mitigation and adaptation, blue carbon ecosystems play a vital role in any climate change solution. The Government of India must negotiate with the United Nations Framework Convention on Climate Change (UNFCCC) for recognizing the carbon sequestered through coastal ecosystems at the national level in achieving India's NDC targets and mitigating climate change. India lacks in the mapping of seagrass whereas tidal salt marshes are not at all surveyed. These two carbon pools need to be surveyed and mapped. The Government of India should also take measures to conserve the existing mangrove cover and also to increase the cover which can lead to an additional sequestration potential of 207.91 million tonne of CO₂e. Therefore, conserving blue carbon ecosystems can maintain carbon sequestration in future and prevent emissions from land-use change. However, severe data limitations need to be addressed if the role of blue carbon in meeting the targets of the Paris Agreement has to be robustly demonstrated. As Sustainable Development Goal 14 (Life Below Water) outlines, the health of our ocean and coastal ecosystems is of fundamental importance for human well-being and sustainable development, while also playing a key role in both slowing climate warming and helping humans deal with climate change impact. These ecosystems should therefore feature prominently in the NDCs of the nations with major coastlines.

Proposed state-wise distribution of NDC target and financial outlay

The target has been distributed and further rationalized among the states in the country based on the area under forest cover and potential area under agroforestry, which is as follows:

Conclusion

India's performance on achieving its NDC target has been progressive and impressive. According to the First Biennial Update Report of India (BUR1), India's emission intensity of GDP decreased by 12% between 2005 and 2010. But to achieve the additional carbon sink of 2.5–3 billion tonne,

Table 4: Proposed state-wise distribution of the NDC target and financial outlay

State	Area under forest cover (km ²)	Potential area under agroforestry (km ²)	Target (in million tonne of CO ₂ e)	Total grant (in crores/ year)	Total grant (in crores) till 2030 (2015 taken as baseline year)
Andhra Pradesh	28,147	16,730	183.22	3664.49	54,967.35
Arunachal Pradesh	66,964	180	197.79	3955.86	59,337.84
Assam	28,105	2670	98.61	1972.12	29,581.78
Bihar	7299	7950	69.22	1384.35	20,765.32
Chhattisgarh	55,547	6990	205.18	4103.60	61,554.03
Goa	2229	110	7.21	144.18	2162.67
Gujarat	14,757	10,890	108.79	2175.89	32,638.31
Haryana	1588	3520	25.82	516.37	7745.61
Himachal Pradesh	15,100	0	44.36	887.14	13,307.17
Jammu & Kashmir	23,241	940	73.92	1478.42	22,176.29
Jharkhand	23,553	5340	101.28	2025.60	30,383.94
Karnataka	37,550	12,930	188.01	3760.20	56,402.96
Kerala	20,321	940	65.34	1306.87	19,602.99
Madhya Pradesh	77,414	13,450	308.24	6164.76	92,471.39
Maharashtra	50,682	19,160	264.03	5280.52	79,207.76
Manipur	17,346	0	50.95	1019.10	15,286.50
Meghalaya	17,146	0	50.37	1007.35	15,110.25
Mizoram	18,186	0	53.42	1068.45	16,026.77
Nagaland	12,489	50	36.99	739.75	11,096.32
Odisha	51,345	8040	199.15	3982.93	59,743.97
Punjab	1837	4200	30.64	612.73	9191.01
Rajasthan	16,572	20,510	171.94	3438.77	51,581.56
Sikkim	3344	80	10.30	206.08	3091.20
Tamil Nadu	26,281	6880	118.55	2370.97	35,564.49
Tripura	7726	260	24.26	485.16	7277.44
Uttar Pradesh	14,679	19,710	161.57	3231.40	48,471.01
Uttaranchal	24,295	740	75.82	1516.30	22,744.57
West Bengal	16,847	4050	73.83	1476.56	22,148.43
Puducherry	53.67	20	0.28	5.56	83.36
Delhi	192.41	60	0.93	18.52	277.74
Total	680,836.08	166,400	3000	60,000	900,000

Source: FSI 2019; Rizvi, Dhyani, Newaj, et al. 2014

India needs to almost double its forest cover. A holistic approach with balanced political, financial, legal, and institutional efforts is much needed. It needs to sustain the momentum of increasing its energy efficiency along with a high rate of afforestation to achieve the 2030 NDC targets. Despite India being a developing country, its NDC goals are quite ambitious and highly significant commitments have been made. Though several initiatives have been taken by MoEF&CC, FSI, and TERI which has helped to understand the activities to be undertaken to achieve India's forestry NDC target, still some clarity is required in the target statement regarding the baseline year, the concept of additionality as it is always above Business as Usual, and regarding the additional forest and tree cover. There is very less time left to achieve the target and India needs a well-framed strategy taking into account various factors such as India's large forest cover, agroforestry, forests along the road side, wastelands, river side, and other types of lands for the same. This target should be taken as an opportunity where all the related activities contributing to it will enhance ecological security and improve the vast open forests of the country.

There are a lot of challenges in achieving the aforementioned forestry NDC target. The target can be achieved by following the measures as follows:

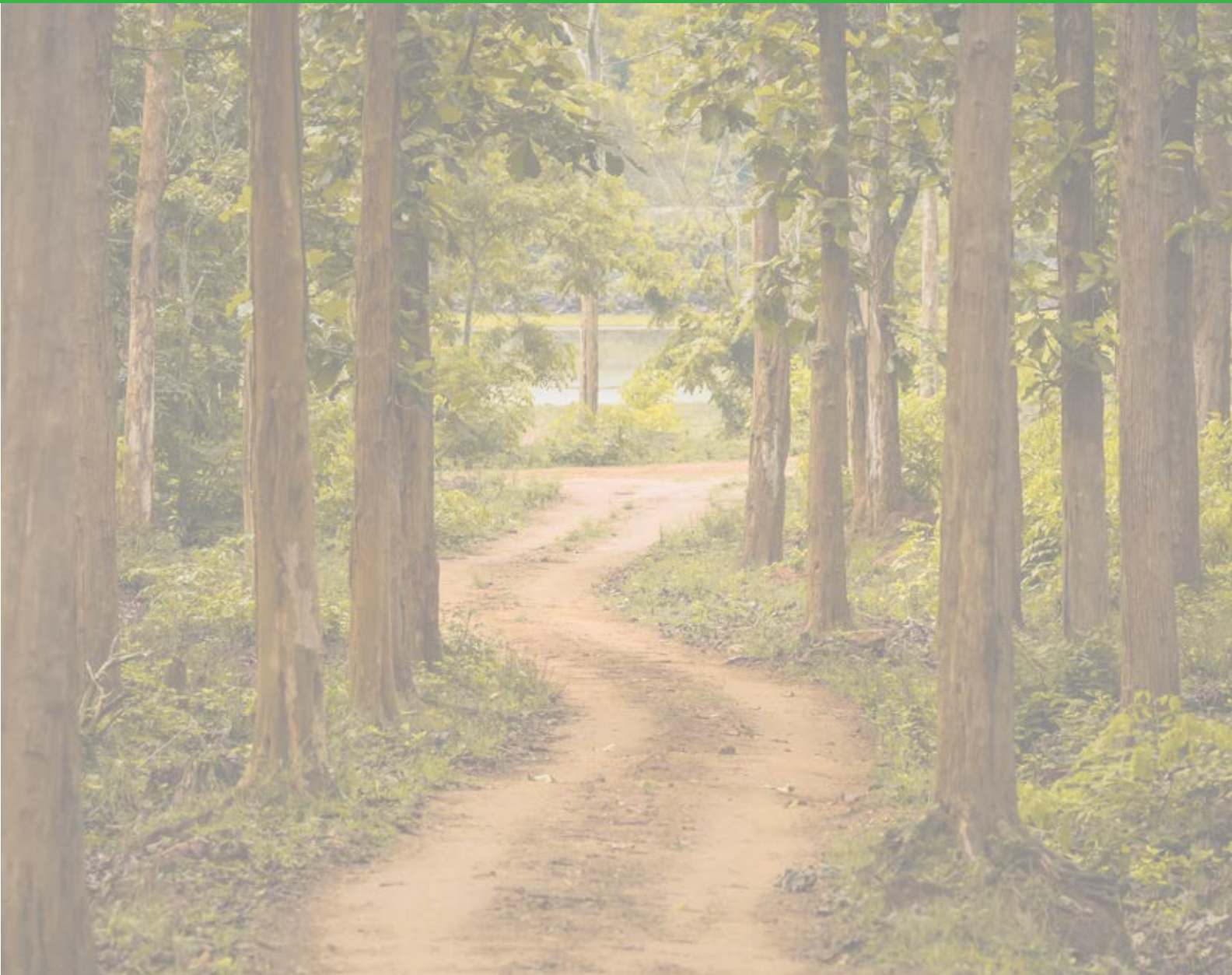
- The baseline year should be decided as 2015 in order to quantify the India's forestry target to be achieved by 2030.
- The NDC targets must be distributed among the states/UTs on the basis of Culturable Non-forestry Area (CNFA) and forest and tree cover.
- The Carbon Neutrality Policy should be promoted at the national and state levels which will help in improving quality and health of forest and will also provide fair compensation to the forest-dwelling communities.
- Reduction in emission through adaptation and carbon sequestration should be considered for achieving the India's NDC target of 2.5–3 billion tonne of CO₂e.
- Also, we need to focus on the Blue Carbon Initiative of IUCN to include blue carbon to achieve the NDC targets.
- A framework should be developed which allows accounting of forest carbon addition as well as loss due to forestry activities undertaken anywhere in the country so that status of forest carbon sink in the country is known at any given time.
- Agroforestry has a huge potential to contribute towards achieving India's forestry NDC target, hence it should be promoted. MSP and institutional strengthening are also the important factors to focus to avoid market failure in agroforestry.
- Innovative finance mechanism through carbon market should be established at the MOEF&CC level or agency recognized by the Government of India to regulate the transaction at the national level, and also at the international level later considering success of the financial mechanism.

References

- AITPN. 2006. India's Forest Rights Act of 2006 – Illusion or Solution?, Indigenous Issues, The occasional briefing papers of the Asian Indigenous and Tribal Peoples Network, 15 December, New Delhi.
- Bhargav, P. 2007. Legal Framework for Wildlife Conservation in India, Reworked from Critical Ecosystem Partnership Fund (CEPF) Report May 2007 with inputs from Praveen Bhargav, Wildlife First.
- CAIT, W. 2012. World Resources Institute, Climate Analysis Indicators Tool (WRI, CAIT). *WRI CAIT, Washington, DC.*
- Chopra, Kand GK Kadekodi. 1997. Natural Resource Accounting in the Yamuna Basin: Accounting for Forest Resources. Project Report, Ministry of Environment and Forests, New Delhi.
- CRISIL. 2015. Details available at <https://www.crisil.com/en/home/our-analysis/reports/2015>
- FAO. 2010. Global Forest Resources Assessment, FAO Forestry Paper 163 (Rome, 2010).
- FAO. 2015. Food and Agriculture Organization of the United Nations (FAO) Global Forest Resources Assessment. Forestry Paper No. 1, Food and Agriculture Organization of United Nations, Rome
- FSI. 1987. State of Forest Report 1987. New Delhi: Forest Survey of India (FSI), Ministry of Environment, and Forests (MoEF)
- FSI. 2003. State of Forest Report 2003. New Delhi: Forest Survey of India (FSI), Ministry of Environment, and Forests (MoEF)

- FSI. 2005. India State of Forest Report 2005. New Delhi: Forest Survey of India (FSI), Ministry of Environment, and Forests (MoEF)
- FSI. 2009. India State of Forest Report 2009. New Delhi: Forest Survey of India (FSI), Ministry of Environment, and Forests (MoEF)
- FSI. 2011. India State of Forest Report 2011. New Delhi: Forest Survey of India (FSI), Ministry of Environment, and Forests (MoEF).
- FSI. 2013. India State of Forest Report 2013. New Delhi: Forest Survey of India (FSI), Ministry of Environment, and Forests (MoEF)
- FSI. 2015. India State of Forest Report 2015. New Delhi: Forest Survey of India (FSI), Ministry of Environment, and Forests (MoEF)
- FSI. 2017. India State of Forest Report 2017. New Delhi: Forest Survey of India (FSI), Ministry of Environment, Forests and Climate Change (MoEF&CC)
- FSI. 2019a. India State of Forest Report 2019. New Delhi: Forest Survey of India (FSI), Ministry of Environment, Forests and Climate Change (MoEF&CC)
- FSI. 2019b. Technical Information Series, Volume I, No. 3. India's Nationally Determined Contribution of Creating and Additional Carbon Sink of 2.5 to 3 billion tonnes of CO₂eq through additional forest and tree cover: Possibilities, scale and costs for formulating strategy
- FSI. 2020. Assessment of Dependence of Inhabitants of Forest Fringe Villages (FFVs) on Forests for Fuelwood, Fodder, Small Timber & Bamboo: Quantified Estimation of Removals
- Heissenbuttel, J, C Fox, G Gray, and G Larsen. 1992. UNCED. Principles for Sustainable Management of Global Forests: Review of the Forest Principles and Agenda 21, Chapter 11, 'Combating Deforestation'. Bethesda, MD: Global Forestry Coordination and Cooperation Project
- Herr, D and E Landis. 2016. Coastal blue carbon ecosystems: Opportunities for nationally determined contributions. Washington D.C.: IUCN, Global Marine and Polar Programme; The Nature Conservancy
- Husbandry, B A. 2019. Animal Husbandry Statistics Division. *Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India*. Details available at https://dahd.nic.in/sites/default/files/BAHS%20%28Basic%20Animal%20Husbandry%20Statistics-2019%29_1.pdf/
- ICFRE (Indian Council of Forestry Research and Education). 2010. Forest Sector Report India 2010.
- Jain, A and R Sharma. 2015. The Indian Forest Rights Act, 2006: Salient Features, Scope and 2012 Amendment Rules. *International Journal of Social Science and Humanities* 4(2): 95–108
- Mall, R. 2019. Effect of education on adaptation & sustainability of Pradhanmantri Ujjawala Yojana. *Gen*, 5(06.58), 166
- Ministry of Tribal Affairs. 2010. Report of National Committee on Forest Right Act. New Delhi: Ministry of Tribal Affairs, Government of India
- MoEF&CC. 2007. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006. New Delhi: Ministry of Environment, Forests and Climate Change, Government of India
- MoEF&CC. 2009. India Forestry Outlook Study, Asia-Pacific Forestry Sector Outlook Study II, Working Paper Series, Working Paper No. APFSOS II/WP/2009/06
- MoEF&CC. 2014. Reference Document for REDD+ in India. New Delhi: Ministry of Environment, Forests and Climate Change, Government of India
- MoEF&CC. 2006. Report of the National Forest Commission. Details available at <http://www.envfor.nic.in/divisions/1-8.pdf>

- Rizvi, R H, S K Dhyani, R Newaj, P S Karmakar, and A Saxena. 2014. Mapping agroforestry area in India through remote sensing and preliminary estimates.
- Sharma, P, P Tiwari, K Verma, and M Singh. 2017. Agroforestry systems: Opportunities and challenges in India. *Journal of Pharmacognosy and Phytochemistry* 953–957
- Sharma, J V. 2009. *The scheduled tribes and other traditional forest dwellers (recognition of forest rights) act, 2006: impact on forest conservation in India* (Doctoral dissertation, IIPA, New Delhi). TERI.
2012. International REDD+ Architecture and its Relevance for India. New Delhi: TERI
- TERI. 2016. Sustain biodiversity for better future. Details available at http://www.teriin.org/index.php?option=com_featurearticle&task=details&sid=990&Itemid=157
- TERI. 2020. Policy brief on Estimation of the Current Emission and Sequestration, As Well As Future Potential of Sequestration/Emission Reduction to Achieve Land Degradation Neutrality in India. New Delhi: TERI
- UNDP. 2012. Recognition of Community Rights under Forest Rights Act in Madhya Pradesh and Chhattisgarh: Challenges and Way Forward. Final Report—July 2011. New Delhi: Centre for Development Support
- Vanam, D B. 2019. Timber Trade in India—Challenges and Policies. *EPRA International Journal of Multidisciplinary Research (IJMR)*
- Vanam, B. 2019. *EPRA International Journal of Multidisciplinary Research (IJMR). Timber Trade in India: Challenges and Policies* 5(12): 119–122



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