



POLICY BRIEF

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CRITICAL POLICY INTERVENTIONS TO FAST FORWARD MICRO IRRIGATION IN INDIA

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Introduction

India is an agrarian society and the agricultural sector accounts for 18% of India's gross domestic product (GDP) while providing employment to 50% of the country's workforce¹. India is one of the largest producers of fresh fruits and vegetables, milk, major spices, several crops such as jute, staples such as millets and castor oil seed. Apart from this, India is also the second largest producer of wheat and rice². India initiated its own Green Revolution programme in the field of plant breeding, irrigation development and financing of agrochemicals after 1960². The Green Revolution had several benefits, such as increase in production due to the use of high-yielding varieties of seeds, crop genetic improvements and irrigation, which led to widespread poverty reduction. However, the unabated adoption of unsustainable agricultural techniques and practices (high dependence on chemical fertilizers and pesticides) by farmers to produce more had an adverse impact on the environment. There were reports of loss of soil fertility, deteriorating state of water resources, pollution of groundwater and increase of salinity in groundwater. In 2018, the National Institution for Transforming India (NITI Aayog) also stated that around 600 million Indians are now facing high to extreme water stress situation because of growing population and the ever-increasing demand for food. High variations in the range of electrical conductivity (EC) between 2.25 and 5.0 ds/m and heavy metals concentration in groundwater indicate the high salinity problem exacerbated by groundwater withdrawals and contamination of groundwater³. The average annual water availability in India is estimated

to be 1869 billion cubic meters (BCM). However, due to hydrological, topographic and other constraints, the utilizable water is expected to be about 1123 BCM, out of which 690 BCM is from surface water and 433 BCM from replenishable groundwater⁴.

The increasing demand of water from other sectors along with inefficient methods of irrigation has aggravated the problems of water scarcity. In order to tackle water scarcity situation in India, particularly in the agriculture sector, Government of India has come up with many irrigation programmes and schemes from time to time. Earlier most of them were based on the open canal system concept, but there is a drastic shift in current and upcoming irrigation programmes and schemes from the traditional irrigation method based on canal flood irrigation to the modern micro irrigation system that uses drip and sprinkler irrigation methods⁵.

There is a huge scope for micro irrigation systems (drip and sprinkler) and many micro irrigation schemes offer subsidies ranging from 50% to 95%⁶. There have been various success stories and projects on community-based approach for supplying irrigation water to agricultural areas that were earlier under rainfed agriculture and faced crop failures due to scanty rainfall showcasing the benefits of increased crop production and reduced cost of production with minimal water and power consumption through micro irrigation method adoption.

¹ Madhusudhan, L. 2015. Agriculture role on Indian economy. *Business and Economics Journal* 6: 176. doi: 10.4172/2151b6219.1000176

² Newsroom: News Releases. CGIAR. Archived from the original on 26 June 2010. Retrieved 13 August 2010

³ CPCB (Central Pollution Control Board). 2001. *Pollution Control Acts, Rules, and Notifications issued Thereunder*, Fourth Edition. New Delhi: Central Pollution Control Board, Ministry of Environment and Forests, Government of India

⁴ Details available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=107733>, last accessed on 26 June 2019

⁵ Details available at http://planningcommission.nic.in/reports/genrep/rep_irr2112.pdf, last accessed on 26 June 2019

⁶ Details available at <https://cbps.in/wp-content/uploads/Micro-Irrigation-Study-final-14032013.pdf>

Current Irrigation Sector Scenario in India

As agriculture is the main water guzzling sector in India, there is a need for water management in water-scarce regions and other regions overall for meeting the water needs of agriculture in future. Irrigation sector currently consumes about 80% of the total water use. Owing to competing demands from other sectors, it is expected that water consumption in this sector will probably reduce to about 70% by 2050⁸. According to a World Bank report, groundwater has supported about 60% of irrigated agriculture, whereas around 40% of irrigated agriculture is supported by surface water⁹. This shows that irrigation is highly dependent on groundwater, resulting in over-extraction of groundwater in many areas and this issue needs to be addressed.

by enhancing the efficiency in agriculture sector by the use of micro irrigation techniques.

Table 1 represents the source-wise net irrigated area (in million hectares) and the percentage of the net irrigated area by source in India. As per the table, from 1960 to 2015, area under canal irrigation increased from 10.37 Mha (million hectares) to 16.8 Mha, whereas area under tube-well irrigation increased from 0.13 Mha to 31.60 Mha, and overall there had been an increase in the net irrigated area from 24.66 Mha to 68.38 Mha. The increase in net irrigated area as well as the shift in dependence from surface water to groundwater has had a detrimental impact on the water resources especially on groundwater resources. As water resources become increasingly scarce, there is an

Table 1: Source-wise net irrigated area and the percentage of the net irrigated area by source

Year	Canal		Tanks		Tube wells		Other wells		Net irrigated area Mha
	Mha	%	Mha	%	Mha	%	Mha	%	
1960/61	10.37	42.05	4.56	18.49	0.13	0.55	7.15	29.01	24.66
1970/71	12.83	41.28	4.11	13.22	4.46	14.34	7.42	23.88	31.10
1980/81	15.29	39.49	3.18	8.22	9.53	24.62	8.16	21.08	38.72
1990/91	17.45	36.34	2.94	6.13	14.25	29.62	10.43	21.73	48.02
1995/96	17.12	32.06	3.11	5.84	17.89	33.51	11.80	22.10	53.40
2000/01	15.71	28.65	2.51	4.59	22.32	40.71	11.45	20.88	54.83
2005/06	16.72	27.50	2.08	3.40	26.03	42.80	10.04	16.50	60.84
2010/11	15.64	24.6	1.98	3.10	28.54	44.8	10.63	16.70	63.66
2013/14	16.27	23.90	1.84	2.70	31.13	45.70	11.31	16.60	68.10
2014/15	16.18	23.66	1.72	2.52	31.60	46.21	11.35	16.60	68.38

Source: Details available at http://www.iasri.res.in/annualreports/ar2017-18/IASRI_AR_2017-18.pdf, last accessed on 30 May 2019

The National Water Policy (NWP), 2012 states that water saving in irrigation is of utmost importance¹⁰. The Goal 4 of National Water Mission (NWM), 2008 of India highlights the objective to improve water use efficiency at least by 20% in all sectors, including domestic, industrial, agricultural and commercial. This objective can be significantly supported

urgent need to manage irrigation water efficiently and the adoption of micro irrigation systems is the need of the hour.

However, even though the overall potential of micro irrigation in India is projected to be about 70 Mha (million hectares), the micro irrigation coverage achieved by 2018 was only around 9 Mha in 15 years. Therefore, at the current coverage rate of 0.6 Mha/annum, it would take approximately more than 100 years to achieve the potential target of micro irrigation in India¹¹.

⁸ Details available at http://mowr.gov.in/sites/default/files/Guidelines_for_improving_water_use_efficiency_1.pdf, last accessed on 26 June 2019

⁹ Details available at <http://www.worldbank.org/en/news/feature/2011/09/29/india-water>, last accessed on 26 June 2019

¹⁰ Details available at http://mowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf, last accessed on 26 June 2019

¹¹ Details available at <https://www.nabard.org/auth/writereaddata/tender/0803190338NSP%20on%20Water%20Resources%20.pdf>, last accessed on 26 June 2019

Benefits of Micro Irrigation

Micro irrigation ensures conservation and the efficient use of water, minimal wastage of water and higher productivity of crops with less water consumption by the usage of the drip irrigation method and the sprinkler irrigation method¹². For optimal and efficient use of surface and groundwater sources for irrigation, micro irrigation method usage is one of the effective ways to grow more crops with less water.

Micro irrigation could be one of the solutions to the water resources management challenges and issues faced by Indian agriculture. The water use efficiency of the flood method of irrigation in India is estimated to be only around 40%. This is mainly due to the significant losses through conveyance, distribution and evaporation, whereas micro irrigation systems can provide water use efficiency from about 80% to 95%¹³. Micro irrigation systems are quite

efficient as they have nominal transmission losses, while losses through evaporation, run-off and deep percolation are also reduced significantly by using them¹⁴. Efficient water use results in additional benefits such as an increase in the area coverage under irrigation with the same amount of water as well as increasing the potential usage of marginal/degraded land using micro irrigation systems.

Listed below are several major benefits for adopting micro irrigation:

- Increase in water use efficiency
- Reduction in energy consumption
- Reduction in fertiliser consumption
- Productivity enhancement of fruits/crops and vegetables
- Irrigation cost saving
- Increase in Farmers' income

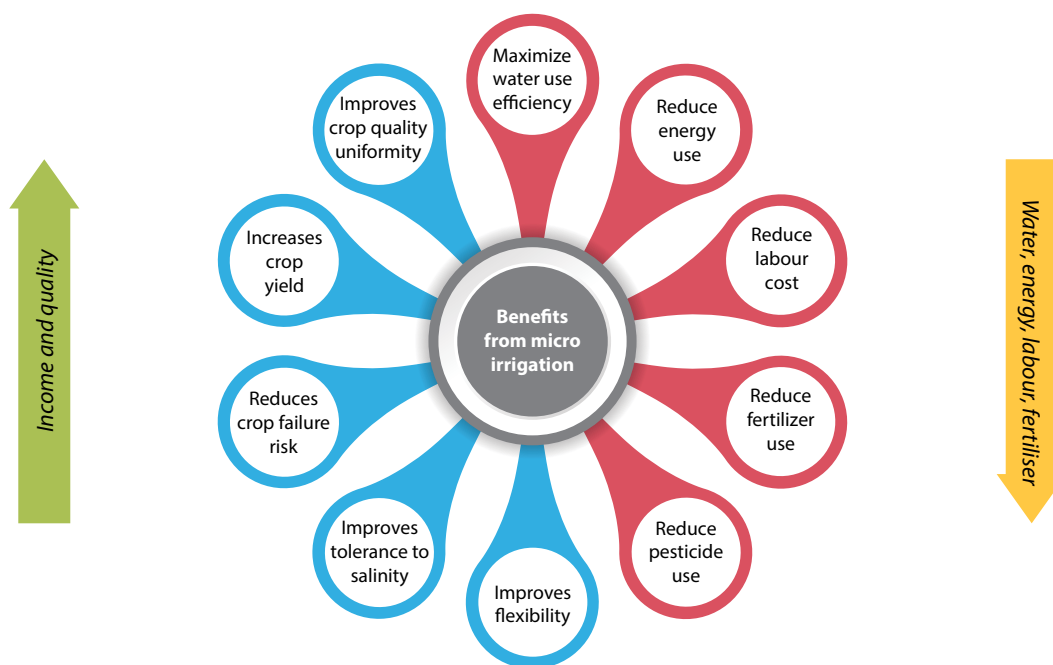


Figure 1: Benefits of micro irrigation adoption

¹² Details available at <http://nwm.gov.in/?q=goal-4>, last accessed on 27 June 2019

¹³ Details available at http://mowr.gov.in/sites/default/files/Guidelines_for_improving_water_use_efficiency_1.pdf, last accessed on 27 June 2019

¹⁴ Details available at <http://www.fao.org/tempref/docrep/fao/010/a1336e/a1336e.pdf>, last accessed on 27 June 2019

Impact of Micro Irrigation Adoption – A Case Study of Himachal Pradesh

Himachal Pradesh (H.P.) has launched a state-wide micro irrigation scheme under which 80% subsidy is provided to farmers on the purchase of micro-irrigation systems. The Energy and Resources Institute (TERI) undertook an extensive sample based field survey of beneficiaries from Balh valley Sunder Nagar, Mandi, H.P. In order to visualise benefits of drip and sprinkler methods of irrigation, beneficiaries and key persons from the project management team were also interviewed. In this project, irrigation was provided to 7,500 beneficiaries, covering an area of 2740 Ha. Prior to this project, the area was rainfed with wheat–maize as the main crops. Under this project, for each 2 Ha of agricultural land, one irrigation water outlet was provided. After irrigation water was provided by the micro irrigation system, farmers started growing vegetables such as tomatoes, cauliflower, cabbage and peas and even rice cultivation was possible because of assured irrigation. Through this project the area under micro irrigation was found to have increased considerably. Also, the expenses on agricultural inputs such as seed, fertiliser and labour have decreased slightly. Due to the availability of water through the micro-irrigation system an increase of farmers’ income of approximately 1.5 times was seen in the area. The assured supply of irrigation water increased the production of crops in the range of about 35% to 82%. Also there were several farmers who were either practicing subsistence farming or who were not using their land for cultivation prior to these interventions. Post installation of MIS, these farmers are now able to generate significant amount of income from their farms. The successes of these farmers have increased the willingness to adopt MIS in the area.

Study conducted by the Indian Council of Food and Agriculture (ICFA) shows that farmers have an increase in income ranging from 24.5% to 70.5%, with an average increase in income of about 46.8% after micro irrigation systems adoption in different states. The increase in

farmers’ income after the adoption of micro irrigation systems needs to be highlighted and shared especially with other farmers to ensure that these benefits could be availed by them as well.

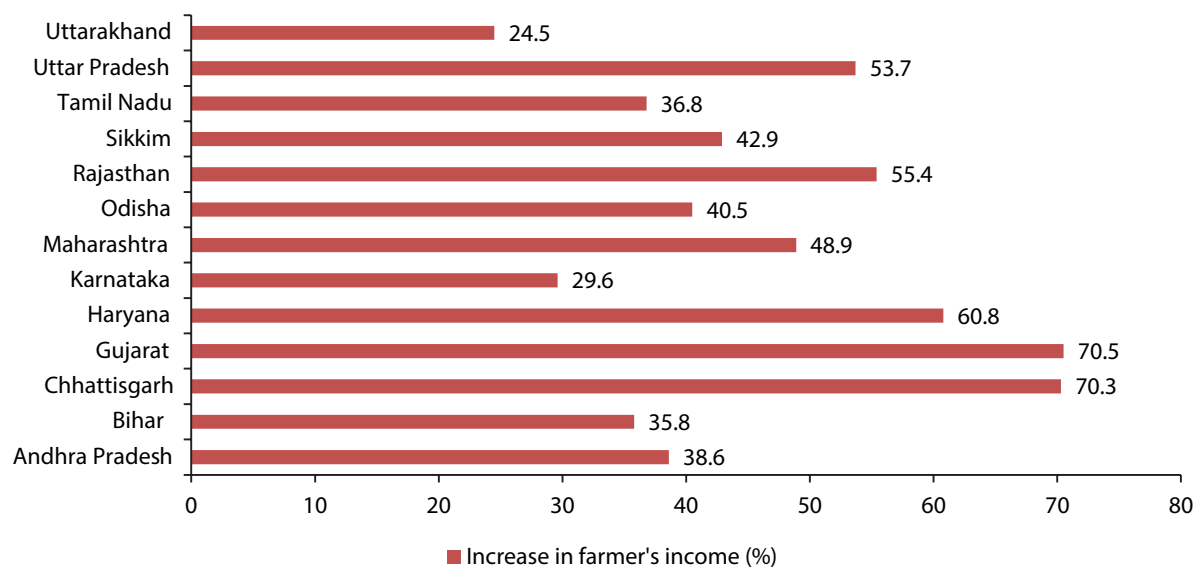


Figure 2: Increase in farmer's income

Source: Details available at <https://icfa.org.in/assets/doc/reports/indian-micro-irrigation-market.pdf>, last accessed on 15 May 2019

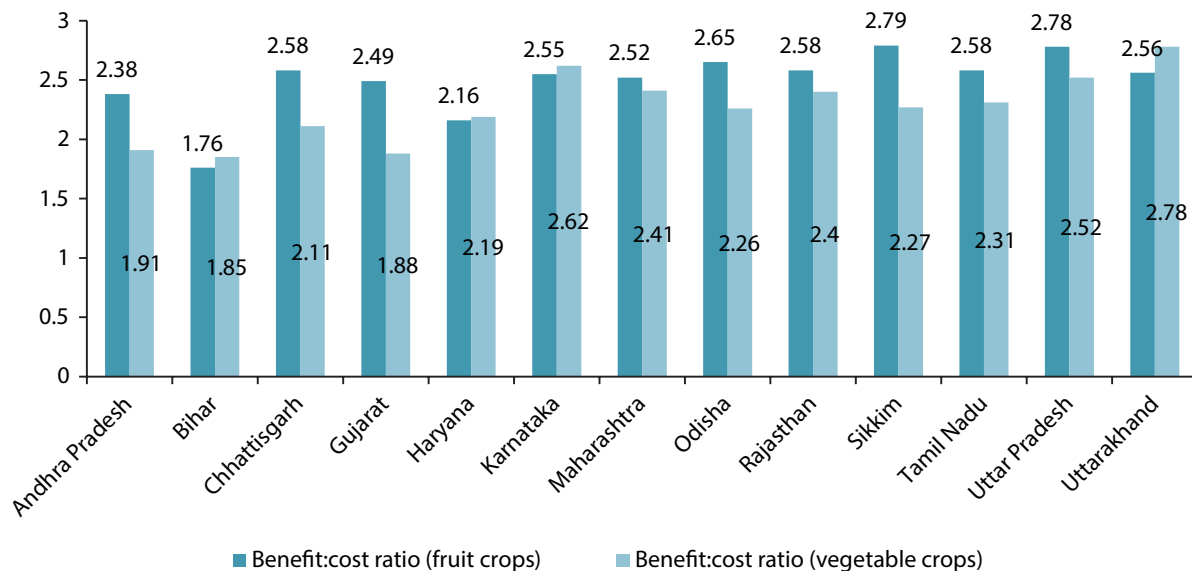


Figure 3: Benefit-cost ratio

Source: Details available at: <https://icfa.org.in/assets/doc/reports/indian-micro-irrigation-market.pdf>, last accessed on 15 May 2019

The study also estimates the benefit-cost ratio shown in figure 3, which ranges from 1.76 (Bihar) to 2.79 (Sikkim) for fruit crops, whereas it ranges from 1.85 (Bihar) to 2.78 (Uttarakhand) for vegetables crops with the adoption of micro irrigation methods (Figure 3). An average benefit-to-cost ratio for the crops grown

in each state indicates the benefits to the farmers for adopting micro irrigation system. Benefit-cost ratio also shows that fruit crops seem to be more profitable as compared to vegetable crops in majority of states such as Andhra Pradesh, Chhattisgarh, Gujarat, Odisha and Sikkim, where farmers have adopted MIS.

Issues and Challenges of Micro Irrigation in Improving Irrigation Water Use in India

In spite of the well-known benefits of modern irrigation methods such as surface or sub-surface drip and sprinkler irrigation systems, they are not widely adopted on large scale by farmers because of high capital cost, non-reliable sources of water for the system, marginal and scattered agricultural landholdings, unavailability of subsidy at the required time or the delayed release of funds for installation of MIS that have already been approved, and the absence of easy financing mechanisms for farmers. Another hindrance for the poor adoption of these technologies is due to farmers' preference for traditional methods of irrigation owing to lack of knowledge of the benefits of MIS and lack of a dedicated team to support micro irrigation on field for farmers.

Moreover, due to periodic changes in components/schemes related to National Mission on Micro Irrigation, National Mission for Sustainable Agriculture and Prime Minister Krishi Sinchayee Yojana, several stakeholders

have stated that there seems to be lack of focus on micro irrigation in India¹⁵. Through literature survey and consultation with stakeholders (Government, industry, farmers, etc.) the following four major issues hindering the growth of micro irrigation were identified:

1. Tedious financing machinery to beneficiaries

Financing for beneficiaries continues to be a major obstacle, as a result of which they continuously face difficulties in securing financing options. Through consultation with stakeholders it was found that there is a persistent problem with the unavailability of funds in some states, resulting in further delay in fund disbursement from the state government to the dedicated cell/officer responsible for promoting and initiating MIS schemes at the state level. This in turn leads to lengthy cycles of subsidy. There is a necessity to find ways to guarantee availability of funds on time and for simpler funding norms for farmers on priority¹⁶.

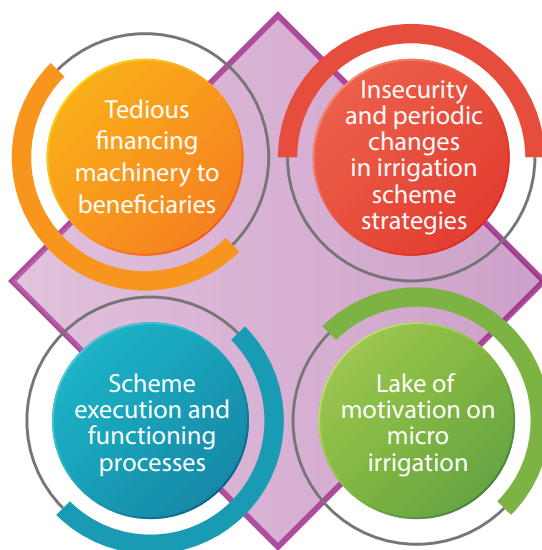


Figure 4: Major issues in micro-irrigation growth

¹⁵ Details available at <https://www.grantthornton.in/globalassets/1-member-firms/india/assets/pdfs/micro-irrigation-report.pdf>, last accessed on 27 June 2019

¹⁶ Details available at <http://agricoop.nic.in/sites/default/files/NCF3%20%281%29.pdf>, last accessed on 27 June 2019

2. Insecurity and periodic variations in irrigation scheme strategies

Owing to the lack of effective and long-term strategies, most of the schemes are operational only for a limited period of time at the state level. In this context, Federation of Indian Chambers of Commerce and Industry (FICCI) report has revealed that on average schemes are operative only for 5 months in a year to the farmers¹⁷. As a result, farmers could not avail the benefits of the scheme during peak water demand months. Also, this could result in the farmers missing the cropping season, leading to their inability to gauge the real benefits of the micro irrigation system¹⁸.

3. Scheme execution and functioning processes

Most of the micro irrigation schemes are inefficient in terms of their execution and functioning, particularly in terms of the time taken and length of the process of scheme execution. In a few states, the scheme implementation and launch process occurs during the months of August and September, as a result of which there is a lag in irrigation water supply and timely irrigation to the field.

By the time a scheme actually starts to provide water for crop, the main season has already ended¹⁹. Therefore, beneficiaries are not able to get the optimal benefit of the available micro irrigation technology. Thus, there is a need for timely completion of the process (preferably before monsoon season) for better synchronisation with the farmers' interest and demands. The lack of a robust monitoring system makes the task of managing scheme execution and functioning extremely difficult. This has a detrimental impact on the efficiency of implementing MIS.

4. Lack of motivation on micro irrigation

The perception of a diluted focus on the micro irrigation scheme is still prevalent, with the Government of India (GoI) providing funds for MIS since 2014–15 as a component of government schemes and not through the dedicated mission such as the previous National Mission on Micro Irrigation (NMMI). This is also followed to a large extent at the state level as only a few states have a dedicated team to promote micro irrigation, and most others do not provide the due importance needed, thus leading to deceleration in the growth of MIS²⁰.

^{17,19} Details available at <https://www.grantthornton.in/globalassets/1-member-firms/india/assets/pdfs/micro-irrigation-report.pdf>, last accessed on 27 June 2019

¹⁸ Details available at <https://icfa.org.in/assets/doc/reports/indian-micro-irrigation-market.pdf>, last accessed on 15 May 2019

²⁰ Details available at https://www.worldfoodprize.org/documents/filelibrary/youth_programs/borlaug_ruan_international_internship/2017_student_papers/BATTLESFINAL_BR_REPORT_672DF0AFDC363.pdf, last accessed on 27 June 2019

Central Government Schemes for Micro Irrigation: A Critical Analysis

National Mission on Micro Irrigation, 2010

Recognising the need for better water productivity in the agriculture sector, the government has taken various initiatives since 1992 for promoting micro irrigation system (MIS)²¹. The year 2006 saw real momentum when the Government of India (GoI) launched a Centrally Sponsored Scheme (CSS) for micro irrigation. This scheme was later upgraded to the National Mission on Micro Irrigation (NMMI) and implemented through the year 2013–14 by the Ministry of Agriculture & Farmers Welfare. However, by 2014–15 the National Mission for Sustainable Agriculture (NMSA) was made operational and micro irrigation activities were implemented under the On Farm Water Management (OFWM) component of the scheme²².

• **Enabler of the scheme**

- a. Specific focus on micro irrigation
- b. Scheme implementation for a sustained time period
- c. Allow for higher efficiency and transparency
- d. The focus on providing after-sale service helped to maintain the farmers' interest
- e. Provisioning of subsidy support by government for the demonstration of the micro irrigation systems
- f. Increase in awareness among farmers

• **Hinderer of the scheme**

- a. Disbursement of funds was seen as being inefficient as the funds have to go through numerous steps and are not directly transferred to the farmer or the micro irrigation supplier/ implementer
- b. The area ceiling limit of 5 Ha per beneficiary²¹ impedes the growth of micro irrigation. Several

experts feel that increasing the cap to 10 Ha per beneficiary would be very beneficial²²

- c. Lack of uniform scheme implementation: The implementation of the scheme varied drastically from state to state. In some states, the parallel involvement of more than one department with the MIS implementing agency resulted in inefficiencies and confusion
- d. Inadequacy of guidelines, especially with respect to the cost structure of micro irrigation components for subsidy release (BOQ's for drip and sprinkler systems), resulted in improper estimation of cost and subsidy amounts

National Mission for Sustainable Agriculture (NMSA), 2014

Micro irrigation comes under 'On Farm Water Management' component of National Mission for Sustainable Agriculture. This component has the objective of enhancing water use efficiency by promoting technological interventions and adopting efficient on-farm water management technologies and processes. Effective harvesting and management of rainwater in combination with the Rainfed Area Development (RAD) component was also prioritised²³.

• **Enabler of the scheme**

- a. Focuses on enhancing water use efficiency by promoting efficient on-farm water management technologies and equipment as well as effective harvesting and management of rainwater
- b. Promoting location-specific agronomic activities

²¹ Details available at <https://ncccd.gov.in/PDF/Guidelines-NMML.pdf>, last accessed on 16 July 2019

²² Guidelines Micro Irrigation through Public Private Partnership "From The Source To The Roots" - Draft Concept Note, NITI AAYOG (Government of India) PPPAU Division, October 2017 Details available at https://niti.gov.in/writereaddata/files/document_publication/Draft%20Concept%20Paper%20on%20PPP%20in%20Microirrigation_Oct%202017.pdf

²³ Details available at http://agricoop.nic.in/sites/default/files/Final_guidelines.pdf, last accessed on 27 June 2019

- **Hinderer of the scheme**

- a. Inadequacy of guidelines especially with respect to the cost structure of micro irrigation components for subsidy release (BOQ's for drip and sprinkler systems) resulted in incorrect interpretation of cost and subsidy amounts²⁴
- b. Area ceiling limit of 5 Ha per family²⁵ impedes the growth of micro irrigation

Prime Minister Krishi Sinchayee Yojana, 2015

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) scheme under the Ministry of Water Resources, River Development and Ganga Rejuvenation (now Ministry of Jal Shakti) and the Ministry of Agriculture & Farmers Welfare focuses on providing an end-to-end solution to the irrigation supply chain. The government's strategy at this time is on "Har Khet Ko Paani" (water for every farm) as well as "Per Drop, More Crop". PMKSY was launched in 2015, with the integration of micro irrigation in the flagship scheme as a fundamental component²⁶. The objective of the scheme is "to achieve convergence of investment in irrigation at the field level, and expand cultivable area under assured irrigation." PMKSY scheme principally focuses on increasing gross irrigated area, bridging the gap between irrigation potential and utilized potential, strengthening

the water distribution network and augmenting water use efficiency and management.

- **Enabler of the scheme**

- a. Focus on an end-to-end solutions including source creation, distribution, management, field application and extension activities
- b. Scheme convergence and removal of redundancies
- c. Greater accountability at the district level by district magistrates for successful implementation of this scheme

- **Hinderer of the scheme**

- a. Funds are unable to keep up with increasing demand in some states²⁷
- b. The scheme does not address the delays in subsidy disbursement that have been observed in other schemes such as NMMI, NMSA
- c. Scheme does not lift area ceiling cap, although several experts have suggested that raising the cap to 10 Ha from the current ceiling of 5 Ha would be very beneficial²⁸

^{24,27} Details available at <https://www.grantthornton.in/globalassets/1.-member-firms/india/assets/pdfs/micro-irrigation-report.pdf>, last accessed on 27 June 2019

²⁵ Details available at https://nmsa.dac.gov.in/pdfdoc/NMSA_Guidelines_English.pdf last accessed on 18 July 2019

²⁶ Details available at <https://pmksy.gov.in/>, last accessed on 27 June 2019

²⁸ Guidelines Micro Irrigation through Public Private Partnership "From The Source To The Roots" - Draft Concept Note, NITI AAYOG (Government of India) PPPAU Division, October 2017 Details available at https://niti.gov.in/writereaddata/files/document_publication/Draft%20Concept%20Paper%20on%20PPP%20in%20Microirrigation_Oct%202017.pdf

State-wise Analysis for Effective Implementation of PMKSY Scheme

The states of Maharashtra, Andhra Pradesh, Karnataka, Gujarat and Rajasthan account for over 80% of the estimated micro irrigation (MI) potential in India.²⁹ Under PMKSY (Per Drop More Crop) for 2016-17, 83.6% of the funds are allocated to the seven major states, which are Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Telangana, Gujarat and Madhya Pradesh. Therefore, a brief analysis was done to review the implementation of the scheme and observations are presented for measures to be taken to accelerate the subsidy-driven scheme.

Andhra Pradesh

In Andhra Pradesh, Andhra Pradesh Micro Irrigation Project (APMIP) has a dedicated team to promote micro irrigation while monitoring and data transparency is achieved through Information Technology (IT) operations, but there are several issues that APMIP still facing. There was a lack of awareness of the scheme amongst the farmers as well as suppliers and officials of the implementing agency. The Planning Commission report highlighted that high proportions of 83% and 52% of the beneficiaries of Warangal and Kurnool districts, respectively, in Andhra Pradesh report this lack of awareness. Training needs assessment was seen as requirement before initiating a capacity building programme³⁰.

Through consultation with stakeholders, it was found that delayed payments from the state agriculture department to Andhra Pradesh Micro Irrigation Project (APMIP is a special purpose vehicle to initiate MIS) leads to prolonged cycles of subsidy. IWMI has also reported that the prescribed time for release of payments is around 40 – 45 days. However, MIS manufacturers' have stated that release of payments is sometimes delayed by a few months and in some cases even almost a year.³¹ The delay in the transfer of funds is a major hindrance towards attracting investments, thereby limiting the scope of business in this sector.

^{29,32,33} Details available at <https://www.grantthornton.in/globalassets/1.-member-firms/india/assets/pdfs/micro-irrigation-report.pdf>, last accessed on 27 June 2019

^{30,34} Details available at http://planningcommission.gov.in/reports/peoreport/peo/peo_microagri.pdf, last accessed on 27 June 2019

In the case of Gujarat Green Revolution Company Limited (GGRC) model, there is comparatively less uncertainty for the micro irrigation system supplier with regard to mobilizing funds. Through consultation with few micro irrigation suppliers in the area, it was reported that the state treasury in Gujarat usually releases the final payment to the implementing agency within 90 days without any delay.

Gujarat

GGRC also has a dedicated team that is promoting micro irrigation and monitoring. Data transparency is backed by efficient Information Technology (IT) operations. However, MIS implementation process is comparatively lengthier due to extensive online and offline documentation work, time-consuming delays in undertaking technical and design evaluation and release of work orders which needs to be addressed³². Also, delays in the issuing of work orders would result in delayed micro irrigation system installations. As a result, the benefits of micro irrigation system are either not visible or even at times the farmer is unhappy with the progress and abandons the plan to adopt MIS. Additionally delays in inspection of micro irrigation systems installed at site by third party inspection agencies and further in release of final payments would affect the credit cycle of the micro irrigation industries, which could result in low MIS coverage. The entire process of documentation and evaluation should be streamlined for the efficient implementation of the PMKSY scheme³³.

It was also reported that there was poor performance in terms of provisioning of training, showcasing through demonstration farm and other capacity building activities. There is a need to intensify the efforts and provide a fresh push on this aspect³⁴.

³¹ Details available at http://www.iwmi.cgiar.org/iwmi-tata/PDFs/2012_Highlight-43.pdf, last accessed on 17 July 2019

Maharashtra

Maharashtra has taken a number of initiatives in the field of micro irrigation. Subsidy programme is one of the major initiatives taken to popularize micro irrigation even during the mid-1980, but at present the entire subsidy process is facing certain pitfalls that have hampered the growth of MIS³⁵.

The main issue prevailing in Maharashtra is undue delays in disbursement of subsidies to farmers for installing micro irrigation systems. As the subsidy is processed through the Direct Benefit Transfer (DBT) model, the farmer has to make an upfront investment,³⁶ which is a major issue for poor and marginalized farmers who may not have the capital to invest in MIS. Additionally, delays in disbursement of subsidies would have a detrimental impact on farmers.

The study conducted in Maharashtra by Namara *et al*³⁷ also highlights that majority of micro irrigation users belong to a relatively affluent farmers group, while the poorer section of the farming community have not been able to garner much benefit from inventions in micro irrigation due to financial constraints and cropping patterns. Micro irrigation at times ends up being unsustainable for poor and marginal farmers because government schemes and financial assistance programmes do not cover the re-procurement of drip and sprinkler systems in case the system becomes outdated and damaged prior to the period of next available assistance.

Maharashtra Government needs to evaluate the current micro irrigation system subsidy process and make the entire subsidy process time bound to reduce the impact on poor and marginalized farmers. Training and capacity building in Maharashtra needs to be prioritised. Moreover,

³⁵ Business Line. 2019. Tap drip irrigation to save water. The Hindus, 08 June [online]. Details available at <https://www.thehindubusinessline.com/opinion/tap-drip-irrigation-to-save-water/article27688289.ece>, last accessed on 11 June 2019

³⁶ Details available at <https://pmksy.gov.in/Microlrrigation/Archive/GuidelinesMIRRevised250817.pdf>, last accessed on 27 June 2019

³⁷ Namara, R. E., Nagar, R. K and Upadhyay, B. 2007. Economics, adoption determinants, and impacts of micro-irrigation technologies: empirical results from India. *Irrigation Science* 25: 283–297

majority of farmers in the state were not satisfied with the after-sales service.³⁸ In order to overcome this, an integrated effort needs to be adopted for exercising an effective control on the after-sales service and for providing capacity building programme to farmers.

Haryana

The state of Haryana offers subsidy of up to 90% in order to promote drip irrigation in the state; however, the sought-after results are yet to be seen³⁹. There needs to be a change in the strategy, such as the introduction of MIS demonstration farms and conducting exposure visits showcasing the benefits accrued by the progressive farmers that could help bring in the desired result.

In order to make micro irrigation scheme implementation smooth and flexible for farmers, streamlining the processes in MIS implementation is required. There is a need for a nodal agency which is responsible for the projects related to micro irrigation to reduce confusion and improve the progress in micro irrigation scheme implementation.

Other States

In other states such as Uttar Pradesh, Jharkhand, Karnataka, it has been found that in the current DBT model, the farmer is required to pay upfront cost of the micro irrigation system. In this model, it is observed that usually 100% of the cost is to be paid in advance to MIS suppliers, which most farmers lack the ability or willingness to do so. The lack of knowledge of benefits results in farmers not opting for loans, specifically for installation of MIS.

Other important reason for the poor adoption of MIS even in the water-scarce regions is the easy access and availability of subsidized canal water and electricity for irrigation. Considering the actual cost of these resources, an appropriate pricing on canal water and electricity could encourage farmers to adopt this technology⁴⁰.

^{38,39} Details available at http://planningcommission.gov.in/reports/peoreport/peo/peo_microagri.pdf, last accessed on 27 June 2019

⁴⁰ Details available at https://www.researchgate.net/publication/304056255_Lukewarmly_Response_of_Microlrrigation_Adaptation_in_India_Problems_and_Prospects, last accessed on 27 June 2019

Also, in several states, it was observed that there is an absence of inviolable deadline which in turn encourages the authority in charge to execute the scheme in their own crafted time frames, and many times this result in unnecessary delays.

Through consultation with stakeholders, recommendations were made that apart from the DBT model there should be an option for Non Direct Benefit Transfer (Non-DBT) model as well. In the Non-DBT model, whenever a farmer is unable to make the full payment upfront, there could be a provision of No Objection Certificate (NOC) from the farmer stating that the subsidy payments upon successful completion of MIS installation could be transferred to the entity that had borne the upfront payment directly by the department responsible for MIS.

In case of Vijayapura district of Karnataka, clogging of emitters, damage caused by rodents, poor quality of products, high installation cost, poor after-sales service, delays in loan and subsidy approvals, and lack of technical support are key obstacles for the adoption of micro irrigation by the farmers in the region⁴¹.

Officials in the state of Punjab have stated that the micro irrigation systems distributed under the scheme do not last for full 10 years. This results in the situation where the beneficiaries have to either wait for a few more years before they become eligible for another round of subsidy or give up on using micro irrigation altogether. In order to solve this issue, the officials have recommended decreasing the duration for the re-eligibility for subsidy from the present 10 years to 5 years⁴². Also strengthening after-sales services would build the confidence of beneficiaries for adopting MIS.

⁴¹ Kumar, N. A. and Poddar, R. S. 2015. Economic evaluation of micro-irrigation programme in Vijayapura district. *Karnataka Journal of Agricultural Science* 28 (3): 373–376

⁴² Details available at http://planningcommission.gov.in/reports/peoreport/peo/peo_microagri.pdf, last accessed on 27 June 2019

Policy Recommendations for Wider Adoption of Micro Irrigation in India

The following are the policy recommendations to enhance the adoption of micro irrigation in India.

- **Institutional set-up for synergy among the nodal institutions responsible for implementing PMKSY scheme**

There is a need to ensure a closed loop system for effective implementation of PMKSY scheme. The current silo-based approach of Ministry of Water Resources, Ministry of Agriculture and State Watershed Departments will not be effective enough. In order to achieve effective implementation, there is a need for the creation of a fully empowered special purpose vehicle (SPV) (which has funds from the nodal ministries and departments) that is responsible for effective implementation micro irrigation under PMKSY scheme. This SPV should be responsible for all the activities, including on-ground implementation as well as monitoring and meeting the MI targets. Considering the importance and benefits of SPV, there is a need to set up SPV in various states of India where SPV is not available along the lines of GGRC and APMIP for operative implementation of PMKSY throughout the country⁴³.

- **Proposition for effective implementation of existing schemes**

At present, in some states such as Punjab, Haryana, Rajasthan and Maharashtra, farmers are required to pay for the upfront cost of the micro irrigation system. The farmers have to bear the initial cost ranging from 50% to 100% of the total cost to be paid in advance to the MIS suppliers, which puts further strain on most of the farmers⁴⁴. The lack of firm guidelines tends to result in poor implementation of MIS. There could be a provision of NOC from farmers stating that the subsidy payments

upon successful completion of MIS installation could be transferred to the entity that had borne the upfront payment directly by the department responsible for MIS.

In 80% of the states, the lack of proper guidelines for subsidy funds disbursement could result in delays in implementation of the scheme⁴⁵. There is a need for greater transparency in the micro irrigation implementation process. Information should be easily accessible by all stakeholders in order to ensure proper monitoring and completion of MIS within deadlines and reduce hassles for the farmers. Information Technology (IT) should be used to enhance monitoring, showcasing of best practices and improving transparency in the sector.

- **Capacity building of the farmers and other stakeholders**

Majority of the district and block officials of different states have advised to enhance capacity building of both stakeholders, that is, beneficiaries and officials, on the operation and maintenance of micro irrigation systems. A report by the Planning Commission has also stated that around 61% of beneficiaries have demanded for increasing both awareness and capacity building through training and demonstrations⁴⁶.

The capacity of Water Users Associations (WUAs) should be enhanced with the support of public and private sector in India to improve water use efficiency by providing trainings on the operation and maintenance of MIS on field. The networks of Precision Farming Development Centres (PFDC) that have been established in India and are available in every state to promote precision farming for hi-tech horticulture need to be strengthened and equipped to function as training centres to impart training to large numbers of farmers⁴⁷.

^{43,46} Details available at http://planningcommission.gov.in/reports/peoreport/peo/peo_microagri.pdf, last accessed on 27 June 2019

⁴⁴ Details available at <https://pdfs.semanticscholar.org/a9a6/b8f0299b5577e0d0b71bfc6889f87a757903.pdf>, last accessed on 27 June 2019

⁴⁵ Details available at <http://planningcommission.gov.in/plans/mta/mta-9702/mta-ch31.pdf>, last accessed on 27 June 2019

⁴⁷ Details available at <https://www.ncpahindia.com/faqs#second>, last accessed on 27 June 2019

- **Awarding “Infrastructure” status to micro irrigation sector**

Granting infrastructure status to the micro irrigation sector could result in single-window clearance for micro irrigation projects in different states, thereby saving time. The infrastructure status in the micro irrigation sector would encourage private agencies to take part in restructuring the decades-old irrigation infrastructure, leading to better management of existing irrigation water supply networks and better planning of future irrigation water projects. For example, under the water and sanitation category, Reserve Bank of India (RBI) has notified, “Infrastructure” status to Water Supply Pipe Lines and to Irrigation (Dams, Channels and Embankments); this facilitates international investments directly and easy access to infrastructure funds.

Similarly, it is important that micro irrigation (MI) sector is declared as infrastructure entity and prioritized sector, so that it would be eligible for the benefits entitled to major/medium/minor irrigation projects and specifically facilitate the access to international finance and infrastructure funds. Moreover, it will help to reduce the operating cost for MIS manufacturers, who should in turn pass on the benefits in order to reduce the burden of MIS cost on farmers.

Concluding Remarks

Agriculture is an important sector for a developing nation, but this sector in India consumes significant amount of water resources. In India, there is a huge scope of micro irrigation systems. Although the government had come up with few central and states sponsored schemes, the scale of adopting micro irrigation methods is relatively low. Some of the key suggestions are as follows:

- There is a need to formulate and opt or implement State Water Policy in consonance with irrigation schemes and the National Water Policy. Systematic policy focus and administrative initiatives such as revision of the State Irrigation Acts are imperative for achieving water use efficiency in the irrigation sector. Policies focusing on an integrated approach involving all stakeholders are necessary for the wider adoption of micro irrigation technologies.

- Participatory Irrigation Management should be a common approach involving all stakeholders, particularly Gram Panchayats, Water Users Associations (WUAs), local bodies and NGOs. Induction of NGOs could be considered to motivate users and educate farmers in efficient water use and management of the irrigation system.
- Policy wise regulatory changes could be made in order to accelerate subsidy process for the rapid execution of the scheme. While framing or modifying the policies for the promotion of micro irrigation, all stakeholders, which include state governments, Panchayati Raj Institutions (PRIs), farmers, bankers and industries, should be involved in order to bring all of them on one platform.
- One of the major hindrances for widespread adoption of micro irrigation is the capital cost in its installation. The government has come up with different subsidies, but lack of awareness of the benefits of MIS has resulted in poor adoption of these technologies. There is a need to sensitise farmers by helping them visualise the benefits of using the micro irrigation through pilot demo farms. Educating farmers regarding various precision irrigation methods such as micro irrigation has to be a primary agenda of agricultural and water-related departments.
- Policies and programmes for irrigation sector development should have a greater focus on increasing availability of water and simplifying the process of availing incentives/subsidies to farmers for adoption of micro irrigation systems to promote “Per drop, More Crop – Micro Irrigation (MI)” and “Har Khet Ko Pani” initiative under PMKSY scheme.
- Most of the micro irrigation schemes have a current area ceiling limit of 5 Ha per family; however, several irrigation experts have suggested that increasing this limit to 10 Ha would be very beneficial to farmers and aid the accomplishment of the targets for MI in India.
- Special purpose vehicle (SPV) could be set up in all the states in order to streamline all the institutions responsible for micro irrigation scheme implementation on one platform to facilitate farmers to implement MIS easily on ground, which ultimately advances water

use efficiency. There is an enormous opportunity to increase micro irrigation area coverage while also increasing the GDP of the country and ensuring food security for growing population.

- Water saving and water use efficiency schemes and strategies promoting awareness campaigns on micro irrigation techniques, training and capacity building programmes on sustainable agriculture and stakeholders consultation related to micro irrigation systems must be adopted and scaled up.
 - There is a need for better transparency in micro irrigation implementation process. Information should be easily accessible by all stakeholders in order to ensure proper monitoring and completion of MIS within deadlines and reduce hassles for the farmers. There should be IT supported operations in every state to enhance monitoring, showcasing of best practices and improving transparency in the micro irrigation sector.
 - Acknowledging the fact that several small and marginal farmers may not be able to afford upfront payment
- which is required in the DBT model, there should be an option for Non Direct Benefit Transfer (Non-DBT) model that is able to effectively address this issue
- Certain states in India have made usage of micro irrigation systems mandatory for water guzzling crops such as sugarcane in order to conserve water, especially in water stressed areas. This initiative could also be taken up at the national level with the inclusion of other water guzzling crops. Moreover, a special subsidy programme might be introduced for use of MIS for water guzzling crops such as sugarcane, etc.
 - In order to encourage adoption of micro irrigation and its promotion among the poor and marginal farmers, a special scheme could be introduced that links the bank loan facility for digging wells with electricity connection for pump sets to those farmers who are ready to adopt the micro irrigation system. However, care must be taken to ensure that water resources are replenished and overexploitation is checked.

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