

Micro-irrigation for small & marginal farmers

1. India's dependency on groundwater for agriculture

A scarce natural resource, water is fundamental to life, livelihood, food security and sustainable development. India is one of the most water-challenged countries in the world, with 16 per cent of the world's population and access to only 4 per cent of the world's water resources. About 90 per cent of the fresh water withdrawals go to agriculture in India, which is well above the global average of about 70 percent (Food and Agriculture Organization, 2016). A growing population and farmers' traditional use of inefficient flood irrigation have meant that groundwater levels have fallen over the years. Shortages with water for domestic use, including drinking water problems are rampant across the country. Of all the economic sectors, agriculture is the one where water scarcity has greater relevance. India is fast moving towards a crisis of ground water overuse and contamination (Kulkarni, et al., 2015). Heightened weather variability, increasing frequency of extreme weather events and other indicators of climate change only exacerbate this crisis. Longer dry spells and heavier precipitation events projected for South Asia are going to increase run off and hamper ground water recharge (Singh, et al., 2014)



Fig 1: Empty wells, a common sight as groundwater levels plunge across the country

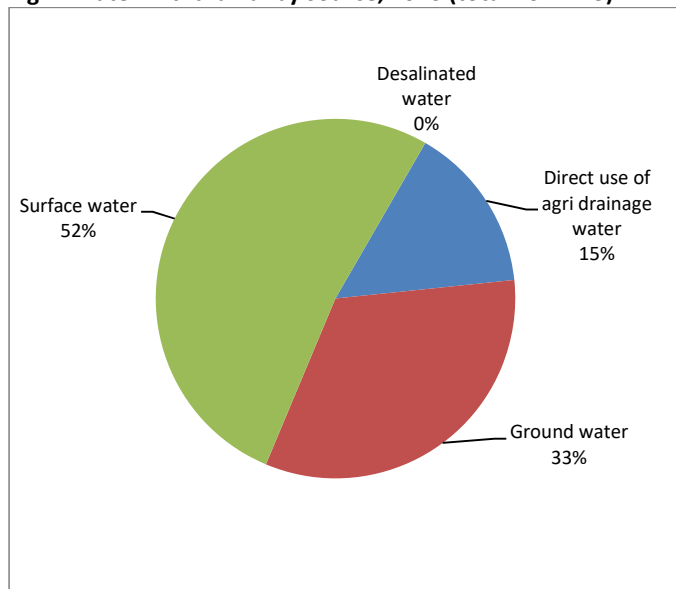
Inefficient use of water for irrigation

India uses a staggering 25 per cent of its water resources to grow rice. Of course, rice is not the only culprit. India is among the most inefficient agriculture producers in the world and all major crops — wheat, sugarcane, cotton — consume large quantities of water. According to a report of the Institute of Water Education (Chapagain & Hoekstra, 2010), the water footprint (the ratio of total volume of water used to the quantity of production) of rice production in India is 2,020 m³a year compared with 970 m³a

year in China and a global average of 1,325 m³ a year. This is an unfortunate inefficiency in the usage of a scarce and precious resource in a country with a teeming population.

Observations made on the source of water withdrawal are also alarming. About a third of the water withdrawal came from groundwater. Ground water is depleting very fast and there is no faster recharge mechanism considering it is a very long drawn process. Groundwater, when exploited from greater depth cannot be recharged by rainfall and therefore can no longer be a renewable resource

Fig 2: Water withdrawal by source, 2010 (total 761 km³)



Source: (Irrigation Association of India; Federation of Indian Chambers of Commerce and Industry, 2016)

Agricultural output is also heavily reliant on rain-water. Food production declined in 2014-15 due to a 12 per cent dip in the monsoons. This further highlights that ensuring adequate water supply for agriculture is essential. These conditions, in addition to the looming water scarcity, make the need for a prudent and efficient use of the land and water resources paramount. Agriculture therefore needs more efficient irrigation methods. Given its higher efficiency, micro irrigation systems can go a long way in addressing the issues faced by India's agricultural sector, particularly in a climate variability context.

2. Micro-irrigation to improve irrigation efficiencies and crop yields:

India has more than 140 million hectares (ha) of net cultivated area, and around 45 per cent of the area is irrigated. As of now, just about nine million ha is under micro-irrigation, of which drip irrigated area is about four million ha. The theoretical potential for micro-irrigation in the country is about 70 million hectares (Narayanamoorthy, 2006).

Research shows that sprinkler irrigation can use 30-40% less water, while drip can use about 40-60% less water as compared to flood irrigation methods (Narayanamoorthy, 2006; Narayanamoorthy, 2009). Productivity gain due to use of micro-irrigation is estimated to be in the range of 40 to 50 percent for

different crops (Indian National Committee on Irrigation and Drainage, 1994; Indian National Committee on Irrigation and Drainage, 1998).



Fig 3: Drip irrigation in Israipally village, Thalakondapally Block in Telangana

It also reduces weed problems, soil erosion and cost of cultivation substantially, especially in labour-intensive operations. The reduction in water consumption in micro-irrigation also reduces the energy use (electricity) that is required to lift water from irrigation wells (Narayanamoorthy, 2001).

3. Government support to micro-irrigation

The real thrust on promoting micro-irrigation (MI) adoption in India started with recommendations of the Report of the Task Force on MI in 2004. The report sought to increase emphasis on MI technology and recommended the Centrally Sponsored Scheme (CSS), which was later launched by the Ministry of Agriculture in January, 2006. In 2010, CSS on MI was scaled up to National Mission on Micro Irrigation (NMMI), which continued until 2013-14. From 2014, NMMI was subsumed under National Mission on Sustainable Agriculture (NMSA) and implemented as - On Farm Water Management (OFWM) during FY 2014-15. From 1st April 2015, the MI component of OFWM has been subsumed under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) which is being implemented as CSS for MI in FY 2015-16 (NITI Aayog, Government of India, 2017).

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

PMKSY has included MI within the scheme as an integral component. The scheme focuses on providing an end-to-end solution to the irrigation supply chain issues. The Government of India's manifesto talks

about “Har Khet Ko Paani” and “Per Drop More Crop.” While the infrastructure creation and development for irrigation projects, as mandated to be part of the Command Area Development & Water Management (CADWM) program is covered under Watershed Development activities, the implementation of bringing area under MI, is mandated to be part of the improving efficiencies in water usage component of this scheme.

Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)

Apart from the above and other extant schemes for funding MI and irrigation in India, MGNREGA scheme can be suitably channelized for the on ground implementation of MI and irrigation networks. This linking with MGNREGA would ensure efficient utilization of funds, in addition to achieving the overall objective of the scheme.

National Water Mission:

National Water Mission is one of eight Missions established under Ministry of Water Resource, River Development & Ganga Rejuvenation (MoWR, RD & GR). Government of India launched the National Action Plan on Climate Change (NAPCC) which inter-alia identified the approach to be adopted to meet the challenges of impact of climate change through eight Missions including National Water Mission (NWM) with the main objective of “conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within states through integrated water resources development and management”.

The Mission is to take into account the provisions of the National Water Policy and develop a framework to optimize water use by increasing water use efficiency by 20% (Ministry of Water Resources, 2011)

4. The challenge of reaching small and marginal farmers

In 2013, rural India had an estimated total of 9.02 crore agricultural households. Small and marginal farmers comprised about 57.8 per cent of the total estimated rural households of the country. If one considers the share of these farmers in terms of land holding, they account for almost 85% of the total landholders (National Sample Survey Office (NSSO), 2014).

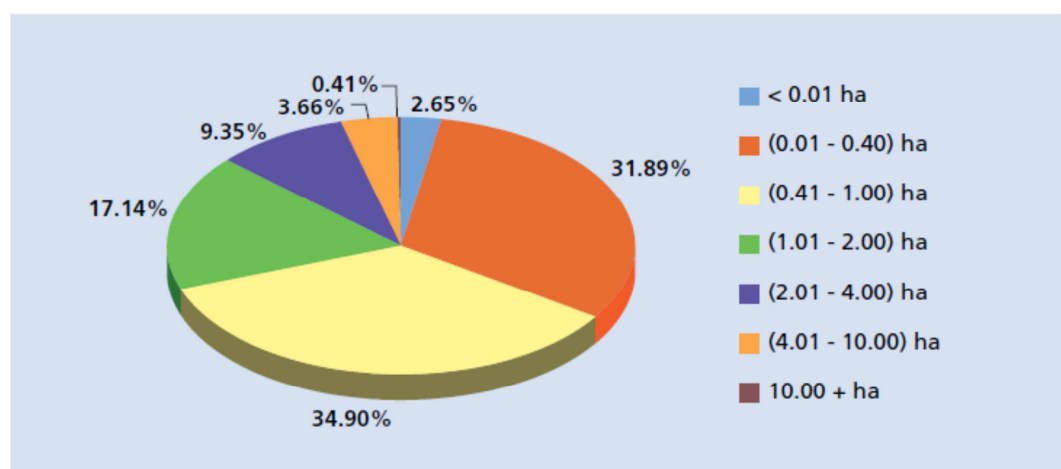


Fig 4: Size of landholdings and estimated number of agricultural households in India

It is easier for large (generally resource rich) farmers to access public and private sources of irrigation like canals and tube-wells as compared to small and marginal farmers, who are mostly dependent on groundwater that is already depleted and are therefore left to rely largely on rains for growing crops. Small and marginal farmers also suffer from a lack of funds to invest in seeds, fertilisers and other inputs and lack of access to water. Guarantee of a water resource is compulsory to avail the benefits of the micro-irrigation schemes.

This disparity in access to knowledge and inputs makes the 85% of small and marginal farmers vulnerable to productivity risks. Lack of agricultural growth has pushed the rural populations towards the non-farm sector, increasing non-farm rural employment by about 12 percent between 1999-2000 and 2011-2012 (Bhogan, 2016). Apart from the lack of resources mentioned above, small and marginal farmers have low risk taking ability, both for taking loans as well as trying out new methodologies, besides limited post-harvest infrastructure like storage facilities, and linkages to markets. The lack of water still remains the most critical resource in ensuring good production for the *rabi* crop as well as the rainfed *Kharif* crop. Many issues may be solved by bringing the farmers together in groups. Together they can also address water-budgeting, equity and the judicious use of water as well as encourage them to adopt better agricultural practices. Such groups of farmers can then develop their own infrastructure, access common irrigation facilities and have better bargaining power in the markets.

5. Group micro-irrigation - A way out?

In this context of scarce water availability and challenges of small and marginal farmers, WOTR has been undertaking action research projects to assess the possibility of enhancing agriculture productivity for groups of farmers. The focus is on pooling of the water resources, reaching out to a much larger group of farmers, sharing it through use of drip and sprinkler irrigation and supporting the farmers with improved agriculture practices.

Group irrigation through pooling of water resources

The concept of pooling water resources for agriculture (and not necessarily linking it to micro-irrigation) is not new and has been tested in a number of pilot studies (Reddy, et al., 2014). In Andhra Pradesh and Telangana there have been projects such as:

(a) Andhra Pradesh Farmer-Managed Groundwater Systems (APFAMGS) supported by the FAO which consisted of digging new bore wells for a group of households (HHs) not having access to water, with clear sharing, groundwater monitoring, and water use efficiency measures.

(b) Andhra Pradesh Drought Adaptation Initiatives (APDAI) supported by the Commissionerate of Rural Development (CRD), Government of Andhra Pradesh, followed an “area approach” for groundwater management where the bore well owners pool their individual bore wells to provide supplemental critical irrigation to a larger rain-fed area (entire block) for survival of rain-fed crops.

(c) the Social Regulations in Water Management at the community level (SRWM) an action-research project initiated in 2004 in Andhra Pradesh by the Centre for World Solidarity (CWS) initiated on a limited scale; and

(d) WASSAN's work in Andhra Pradesh and Telangana on pooling farmers to network and share water from a cluster of bore wells that included hydrogeology training and soil conservation practices (Dixit, et al., 2017).

Each had their set of rules between ground water sharers. Some have a knowledge based approach to make users aware of ground water status. Some adopt social regulations bringing about consensus among users such as ban on borewell drilling.

While these initiatives have been path-breaking in terms of dealing with ground water as a common property resource, issues like caste, religion, proximity of lands can have a huge influence on whether the collective groups agrees to work together or not.

WOTR's efforts have been focused on increasing water use efficiency and thereby increasing availability for small and marginal farmers. Considering the diversity of socio-economic situations and challenging access to natural resources in different parts of the country, WOTR has been experimenting with bringing groups of farmers together in different models in different contexts.

- 1) In Mandla district of Madhya Pradesh, tribal farmers were organized into groups of 3 farmer households with shared sprinkler irrigation sets and dug wells as the water source.
- 2) In Mahabubnagar district of Telangana, schedule caste community farmers were organized into a group of 18 farmers with water access from 3 bore wells.
- 3) In Jalna district of Maharashtra, a group of 14 farmers of same ancestry came together to set up a drip irrigation system with a single dug well as the source of water.



Fig 5: Sprinkler irrigation in Narayanganj block, Mandla district, Madhya Pradesh

Below are some highlights of the work done at the three locations and some of the results:

Sl No	Details	Madhya Pradesh	Telangana	Maharashtra
1	Location	<i>Mandla district, Madhya Pradesh</i>	<i>Mahabubnagar district, Telangana</i>	<i>Jalna district, Maharashtra</i>
2	Initiation date	<i>2012 and 2014</i>	<i>2012</i>	<i>2017 (kharif)</i>
3	Project scope	<i>48 groups and 128 farmers, covering around 173 acres in 2012. 79 groups and 211 farmers, covering around 284 acres in 2014</i>	<i>18 farmers and area of around 7.2 ha.</i>	<i>14 farmers in 1 group covering 32 acres</i>
4	Annual average rainfall at location	<i>1057.7 mm</i>	<i>Average rainfall in area is 650 mm, (in 2015-16 rainfall was only 301 mm)</i>	<i>725 mm</i>
5	Micro-irrigation type	<i>2HP pump and water supply pipes, shared sprinkler sets</i>	<i>Common drip system for a group of farmers with nearby/adjoining lands</i>	<i>Drip irrigation system linked to submersible pumps</i>
6	Water source	<i>Open dug wells</i>	<i>3 Bore-wells</i>	<i>Dug-well on land that is common to all the 14 families</i>

7	Project results: additional (new area) brought under irrigation	<i>Irrigated area for the 2012 project went up from 173 acres to 432 acres. In 2014 project, irrigated area went up from 284 acre to 711 acres</i>	<i>Area under Kharif unchanged. Area under rabi increased and could vary from 2.4 to 7.2 ha depending on the rainfall. Some land irrigated for 3rd crop as well.</i>	<i>32 acres brought under irrigation for Rabi as well as some crop-saving irrigation under Kharif</i>
8	Project results-yield	<i>Productivity in kharif increased by 3-4 qtls and in rabi by 2-3 qtls per acre. Around 50% of farmers of the group shifted from single to double cropping</i>	<i>Agriculture has been diversified and 4-5 different vegetables, flowers are grown</i>	<i>Poor rains in 2017 meant that the full potential of the drip system could not be tested. But we might get better results in 2018, if rainfall is normal</i>
9	Project results-others	<i>Area increase in vegetable cultivation. optimum utilization of water</i>	<i>The changes were not just in the system of irrigation, but also many other sustainable agricultural practices like SCI¹</i>	
10	Project cost & funding	<i>6.57 lakh for the 2014 project</i>	<i>Total Project investment : 9 lakhs</i>	<i>Total of 19 lakhs – 14 lakh was a grant amount and 5 lakh was local contribution</i>
11	Project results-economic	<i>Rs.10000-12000 per year per acre or 20-30% rise in yield and profits</i>	<i>Agriculture income nearly doubled post-project</i>	<i>Not yet calculated. Expecting data from 2018-19 cropping seasons</i>
12	Funding source	<i>SDC, RBSF and HDFC banks</i>	<i>Swiss Agency for Development and Cooperation (SDC), WOTR and local contribution</i>	<i>GIZ project, and local contribution. Mobilization for Water Stewardship through HUF</i>
13	Objective of the funding	<i>Natural resource management and Climate change adaptation Water budgeting, crop planning, ensured rabi cultivation. Voluntary contributions ensure more farmers get access to equipment which simultaneously enhances crop productivity.</i>	<i>A comprehensive model for groundwater management, agriculture productivity enhancement and livelihood security for small holder farmers.</i>	<i>Funds from GIZ part of a comprehensive project on agriculture titled “Soil Rehabilitation and Protection for food Security in India” Ensuring crop productivity through water budgeting and sharing, water budgeting, and sustainable agriculture</i>
14	Maintenance fund (MF)	<i>No MF created, Shramdan collected was added into the sanctioned fund</i>	<i>Maintenance fund accounts have been opened. The funds are also used for leasing agriculture equipment</i>	<i>A contribution of 100 rupees per farmer per month is made to take care of all the maintenance and running costs (electricity)</i>

Table 1: summary of group micro-irrigation initiatives across 3 states

¹ SCI is System for Crop Intensification

Participants speak: First hand experiences of farmers engaged in Group Micro-irrigation



"We are Gond farmers with really small patches of land (often just 2-3 acres). We decided to form groups of 3 because that would give each one opportunity to irrigate every 5-6 days and then it would be perfectly in time for the next round of watering.

*Its working very well and we now have a full rabi season for agriculture, where earlier we left the land fallow", say **Gopal Singh, Mann Singh and Long Singh** from Mandla in Madhya Pradesh*

"Mobilisation by the WOTR team motivated us to plan according to available groundwater. This is something that we have never done before. But this is the need of the hour.

*Frequent drought conditions have been leading to crop losses. These water saving techniques not only provided critical water to save crop the kharif, but also to grow an additional crop during rabi", says **Ramdas Narayan Dhavale** from Jalna in Maharashtra.*



Ganesh Goud, lead farmer from Badunapur in Telangana says, *"I used to undertake flood irrigation prior to Group MI. The water in my bore well enabled me to irrigate only 0.5 acres. Through drip I have increased the area under irrigation. This is what motivated me.*

Sharing water helps increase the amount of water available to farmers. It also reduces water wastage. Farmers in our group are also sharing motor repair costs, which is beneficial".

6. Analyses and lessons learnt:

There have been various studies on the benefits of micro-irrigation in the country and across the world (Rao & Bendapudi, 2015). In WOTR's projects as well, the expected benefits of i) decrease in water use, ii) increase in yield, iii) more area under irrigation, iv) crop diversification, v) decrease in use of other

inputs like fertilisers and pesticides, vi) increase in profit margins, etc were observed. But, as mentioned in section 4, we would like to focus on the issues of small and marginal farmers and therefore list some of our key observations and learnings from the initiative to carryout micro-irrigation in groups:

- **Access to a common source of water:** In all 3 cases of WOTR's intervention, it was seen that each group of farmers needed a dedicated source of water, whether this is a dug well or a borewell. The group must understand that the resource (water) is a common property and everyone in the community has an equal right to it.
- **Lands in proximity:** for sharing the common resource, it would make practical sense to cover lands that are close-by or adjacent. There would be need for laying out infrastructure, monitoring, maintenance, etc which would all be more economical if the lands were close by. WOTR through its project implementation also found that the concept of a 'common' property or resource is easier to communicate for those with lands in proximity.
- **Local contribution for maintenance and sustainability:** In all 3 cases discussed, WOTR ensured that there was group ownership of the initiative through some part of the funds coming directly from the farmers. Community contribution would ensure that the procurement and setting up of the equipment is of good quality. It would make sure that there is adequate attention for maintenance and upkeep of all the fixtures.
- **Financial inclusion of small and marginal farmers:** While it is important to have a sense of group ownership, it is also essential to make financial contributions towards the activity.
- **Groups come from similar families/castes:** The sharing of a 'precious' common resource like water requires a great amount of understanding and co-ordination amongst the famers. Often such a complex social relationship can sustain only if there are strong bonds such as groups of family members or farmers belonging to the same caste/religion having lands adjacent to each other.
- **Target of government scheme and subsidy for MI doesn't necessarily benefit the poorest:** Accessing government subsidies on micro-irrigation requires the guarantee of water availability and so most of the time it is only the middle and large farmers who have a dedicated source of water in their farms who are able to access these funds. However, WOTR's intervention to bring small and marginal farmers together in groups ensures that they too benefit from the government schemes in an inclusive manner.
- **Inclusion of sustainable agriculture practices:** An important factor is that the drip system is not considered a stand-alone input but is complemented by other supporting interventions. Introduction to the system for crop intensification (SCI) helped farmers improve their crop productivity. The focus was on soil management, crop spacing based on plant type and variety, the systematic application of locally prepared organic inputs like *Amruth Khad* and *Amruth paani*; and the application of micronutrients to manage loss due to crop specific physiological conditions.

- **Rainfall is crucial to its success:** While after the initial good results in the pilot project in Telangana, the following years had low rainfall. The new groups of farmers were delayed in setting up the GMI system and the original group reduced the area under cultivation. Particularly if borewell water is used, a study of the aquifers helps in planning the area for drip irrigation.

7. Scaling up of the initiatives

The initial results of WOTR's pilot projects in the group model of micro-irrigation, although fairly new, has already met with some demands for its extension.

In **Madhya Pradesh**, the original group consisted of 128 farmers in 48 groups when work started in 2012. This has later been extended to include an additional 211 farmers in 79 groups. The extension in the project has been in similar setting as the original project – groups of 3 tribal farmers sharing sprinkler irrigation sets and open wells as the water source.

In **Telangana**, the original pilot group consisted of just 1 group of 18 farmers. As the ground water levels here are very low, the source of water has to be a bore-well which comes at a high cost. This seems to be the only way in which small and marginal farmers can get access to a bore-well and use the water efficiently. The initial pilot project of 18 farmers has now been extended. Today 149 farmers organized into 11 groups, cover an area of around 72 ha while sharing the water source.

In **Maharashtra**, the success of the group micro-irrigation in Jalna and promotional activities by WOTR has led to requests by farmers in new locations within and outside the district. Another plan initiated is in the Parner block in Ahmednagar district. Initially, 7 farmers came together with a proposal to irrigate an area of 2.1 ha. The total cost of their irrigation infrastructure would amount to about 12 lakhs. The costs here are high side due to the proposed use of “automated drip systems”, that allow controlling water flow from remote locations via phones. Since this is a totally rainfed area and water is available in a nearby river, an additional 3.5 crore irrigation project that involves an 8 km pipeline to lift water from closest river is also expected to begin implementation soon. The plan is to expand the area under irrigation to 40 ha while including sustainable agricultural practices and linkages to markets.

These examples show the tremendous need and demand that group micro-irrigation has in the semi-arid drylands of central India. With the help of appropriate government subsidies and schemes and guidance it helps include the small and marginal farmers in the benefits and reach a much larger scale.

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