AgWater Solutions Project
Case Study

Accelerating Adoption of Drip Irrigation in Madhya Pradesh, India

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The AWM Project
The AgWater Solutions project was implemented in five countries in Africa and two states in India between 2008 and 2012. The objective of the project was to identify investment options and opportunities in agricultural water management with the greatest potential to improve incomes and food security for poor farmers, and to develop tools and recommendations for stakeholders in the sector including policymakers, investors, NGOs and small-scale farmers.

The leading implementing institutions were the International Water Management Institute (IWMI), the Stockholm Environment Institute (SEI), the Food and Agriculture Organization of the United Nations (FAO), the International Food Policy Research Institute (IFPRI), International Development Enterprises (iDE) and CH2MHill.

For more information on the project or detailed reports please visit the project website http://awm-solutions.iwmi.org/home-page.aspx.

Disclaimers

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EXECUTIVE SUMMARY

Rising demand for irrigation water in the face of its inefficient use amid concerns of growing water scarcity has brought into renewed focus the need for conserving water and improving water use efficiency. Given the difficulties and political considerations associated with bringing about effective policy reforms to achieve the objective of water conservation, the emphasis has generally focused on technological solutions. Micro irrigation technologies such as those based on drip and sprinkler systems are being increasingly propagated as ideal technological solutions for achieving water conservation. Of the two technologies, drip irrigation, in its various forms, has been a relatively more important mode of micro irrigation in India. Despite the numerous advantages and water saving potential drip technology offers, it has failed to capture the kind of market that would have been expected of such a technology. The present study attempts to enquire into some of the possible reasons for the slow uptake of this otherwise high potential water conserving technology and suggest interventions that could contribute towards accelerating the pace of adoption. Given that the main driver for the promotion of drip irrigation in India has been the provision of financial subsidies by the government, the study specifically assesses the efficacy of subsidies in promoting uptake of drip. While the present case study focuses primarily on the Indian state of Madhya Pradesh, the evidence drawn upon and the conclusions drawn from the study will have general applicability for other regions of the country.

Manufacturers and market estimates suggest that more than 95% of the drip sales in Madhya Pradesh are subsidy linked. Given that a substantial government subsidy to the tune of 70 to 80% of the capital cost of the system is available for purchase of a drip system, it is only natural that few farmers want to invest in a drip irrigation system without the subsidy.

The link between uptake of drip systems to the availability of the subsidy has stifled both the inertia of aggressive marketing strategies on the part of the manufacturers to promote sales of unsubsidized systems, and any attempts at bringing down the manufactured cost of drip systems through product designs or technological innovations. All efforts of manufacturers, dealers and other stakeholders are focused on making the most of the available government subsidy through sale of their products. The system has thus made manufacturers subservient to government favours and has led to a loss of their enterprise spirit. Similarly, the insistence on the drip products to carry the BIS mark as a seal of guarantee, and more so as a pre- condition for qualifying to become eligible for a government subsidy on drip, has led to adoption of unfair business practices.

Our assessment of the prevailing subsidy regime of the government together with the procedures set and manner in which subsidy disbursal takes place, suggest a strong connection between manufacturers and government departments entrusted with the administration of the subsidy program. The subsidy as currently administered is actually going to the manufacturers who claim it in the name of the farmers. The business model followed by companies is governed more by the state subsidy system and companies operate more like a cartel to benefit from the subsidy provisions of the program. Producers

and the chain of sellers involved in marketing micro irrigation technology emphasize building contacts with government officials at different levels to get their maximum share of the subsidy kitty. At the farm level, the aim is to convince the farmer that he/she would get a high cost product without having to pay the full amount. Rather than emphasizing the benefits that the farmer might get from use of the technology or details about maintenance, the focus is entirely on getting the necessary papers prepared for release of the subsidy amount. Even the decision about the choice of product and the company is determined by the agent who succeeds in approaching the farmer and getting his papers cleared. The farmer is often a passive participant in the entire process. The presence of a number of companies leads to competition among firms producing equipment and services of varying quality. The subsidy system is also responsible for unhealthy competition. Generally in any business, revenue is generated by the companies through sales and support, the cost structure of the product, and targeted profit. But in case of micro irrigation systems, the adoption of high cost drip equipment is directly related to the provision of subsidies.

Given the strong connection that has developed over time between different players involved in disbursing and receiving the available drip subsidies, in shaping the subsidy delivery system of the government to their advantage and indirectly constraining the spread of drip irrigation technology, one often wonders is the government, by providing subsidies, trying to promote a specific drip system kit or the concept of drip system in general? Why should eligibility conditions for a subsidy bind a farmer to a specific drip system configuration and not let a farmer choose components which in his view could serve the same purpose but at a somewhat lower cost without the use of all the pre-specified components? Is there a way to use the available government subsidies to achieve the goals they are intended to achieve? We propose that if the government were to dispense completely with the existing mechanism of subsidy delivery to the manufacturer and intermediary and arrange to make direct delivery of the drip subsidy to the beneficiary farmers themselves, the market prices and uptake of drip may change considerably.

Based on feedback from stakeholders, we postulate that if the subsidies on drip in its present form were to be withdrawn by the government, it is likely that the open market unsubsidized prices of manufactured drip systems will fall by at least 40 %. Increased open market competition may reduce further the cost of a system by another 5-10 %. The net result is a likely reduction in prices of manufactured drip systems by about 50%. This perception is shared by almost all the market players including some of the leading manufacturers and sellers of drip systems. This is also evidenced by the open market prices of drip systems being sold by the manufacturers and assemblers of non-BIS drip systems in the study region, although there may be some differences in the quality of equipment and performance between the two types of drip systems.

We propose an alternative subsidy delivery model. Rather than giving a one-time capital cost subsidy for investing in a drip system, the government gives an interest cost subsidy to farmers willing to invest in a drip system. Under the proposed scheme the government gives interest free loans for the entire cost of a drip system to all farmers large or small, who belong to a Scheduled Caste or Scheduled Tribe category and are willing to buy a drip system. These loans can be administered through the existing financial institutions in rural areas. The government provides interest free loans with capital repayable after five years.

The farmer is free to a buy drip system from any dealer or manufacturer, choose any configuration, and negotiate a price and after sales service conditions with the dealer. The farmer does not need to visit government offices to obtain approval, clearances or no-objection certificates before buying a system. The government plays its facilitative and regulatory role in ensuring that only good quality products are sold in the market and farmers are not cheated by manufacturers.

With a given amount of funds available, the proposed model can provide subsidies to a much larger number of farmers, can bring a much larger area under drip irrigation resulting in lower subsidy outgo per hectare of drip irrigated area, incentivise farmers to invest in drip systems, lower the cost of subsidy outgo, be more transparent, less prone to corruption, easy to manage and govern, less prone to interference and the whims and fancies of officials, and lead to more efficient use of available subsidy, without distorting the market for sales of drip systems. The proposed subsidy scheme of direct delivery of drip subsidy to farmers outweighs the existing subsidy scheme of subsidizing the manufacturers and providers of drip systems in the name of the farmers.

1. RATIONALE AND SCOPE

Rising demand for irrigation water amid concerns of growing water scarcity has brought into renewed focus the need for improving water use efficiency and raising crop water productivity. Great emphasis is being made on achieving water conservation through various demand side management interventions encompassing technological options and policy measures. Given the difficulties and political concerns associated with bringing about effective policy reforms to achieve the objective of water conservation, this emphasis has generally focused on technological solutions backed by soft policy interventions to aid and facilitate adoption of technological solutions by farmers.

Micro irrigation technologies such drip and sprinkler systems are being increasingly promoted as technological solutions for achieving water conservation. Of the two technologies, drip irrigation, in its various forms, has been a relatively more important mode of micro irrigation in India. Enough empirical evidence is available from different parts of the country to suggest that drip technology saves water and is cost effective and has significant economic and social benefits. Drip irrigation saves water and electricity for pumping water, uses less labour and leads to higher crop productivity (Palanisami *et al.,* 2012; Narayanamoorthy, 2009, 2004; INCID, 1994). In addition to these direct benefits, adoption of drip technology generates both positive and negative externalities (Dhawan, 2000). The positive externalities include reduction in well failure rates, reduction in the cost of deepening existing wells and cost of drilling new wells, and increased availability of irrigation water (Kumar *et al.,* 2008). The negative externalities include reduction in labour employment due to shifts in cropping patterns (Dhawan, 2000).

Despite its apparent advantages, the technology has not found widespread favour with farmers and adoption rates continue to remain abysmally low. While an important factor constraining widespread adoption of drip technology has been its high cost, there are several technological, socio-economic and policy related factors which have also contributed to slow adoption by the farmers. Most common drip irrigation systems are designed to serve large areas and cannot be adjusted for use on small plots cultivated by the large majority of farmers. Lack of awareness about the benefits of the technology, the lack of extension support, poor after sales service, clogging of drippers, problems associated in using this technology, absence of institutional and credit support, lack of standardisation of the technology for use with different crops, and lack of good quality water have contributed to slow adoption. In addition, prevailing irrigation pricing policies, especially related to pricing of surface water for irrigation and electricity for groundwater pumping, have dissuaded adoption by the farmers. There is an impression that except in over-extracted groundwater areas, farmers in other regions do not see minor irrigation technologies as a technology of immediate need (Palanisami *et al.,* 2012).

Of the various factors constraining widespread adoption, one of the most important factors has been its high cost. These water conserving irrigation technologies do not come without a price. They are expensive and require clean water to prevent clogging of delivery tubes. To partially offset the high capital cost and to encourage farmers to invest, the government in

India has been providing substantial financial incentives in the form of capital cost subsidies[1] to farmers willing to invest. Despite the economic, financial, yield enhancing and water conserving advantages of drip technology, availability of substantial government incentives to encourage farmers invest, a favourable benefit-cost ratio of investment, and a short payback period, the uptake of this technology by farmers has been rather sluggish and far lower than its potential[2].

To address the cost and some of the technological issues constraining adoption of drip technology by smallholder farmers, the International Development Enterprise (IDE) promoted low cost solutions to drip through affordable micro irrigation technologies (AMITs) suitable for even small parcels of land. The IDE claims to have successfully marketed this technology to a large number of farmers in several regions of the country without a government subsidy through donor supported programs. Available evidence shows that the adoption of even this low cost technology has also been much lower than the potential. The technology has failed to capture the kind of market that would have been expected given the significantly lower financial requirements in comparison with modern drip irrigation systems.

The present study enquires into the reasons for the slow uptake of this otherwise high potential water conserving technology and suggests some interventions that could contribute towards accelerating the pace of adoption. Given that the main driver for the promotion of drip irrigation in India has been the provision of financial subsidies from the government, the study assesses the efficacy of the subsidy instrument in promoting uptake. While the present case study focuses primarily on the Indian state of Madhya Pradesh, the evidence and the conclusions will have general applicability for other regions of the country.

1.1 Methodology

The study is based on extensive interviews with manufacturers, sellers, retailers and promoters such as NGOs and extension agencies of both high end and low cost drip technology in two selected regions of Madhya Pradesh. Officials of Madhya Pradesh Horticulture Department responsible for administering the subsidy program were interviewed. Individual farmers and farmer groups of adopters were interviewed to ascertain their experiences. The field survey was conducted in three locations,: Sagar, Dhar, and Indore districts of Madhya Pradesh. A total of 40 farmers (22 from Sagar, 10 from Dhar and 8 from Indore) were interviewed in addition to dealers and government officials in the districts. Identifying villages and farmers was not easy as the number of drip users are a few and spread over a wide area, hence, they were selected purposively depending on ease of operation and level of cooperation.

[1] Some of the available studies demonstrate that the investment in drip technology remains cost effective and financially viable even without government subsidy (Narayanamoorthy, 2012).

[2] Palinisami (2011) also notes that although the returns are high under minor irrigation (MI), farmers are reluctant to expand due to constraints like high initial capital cost, lack of technical knowledge and type of crops grown.

2. THE DRIP IRRIGATION TECHNOLOGY IN INDIA: SETTING, GROWTH AND POTENTIAL

Farmers in India generally practice flood irrigation resulting in low water application and use efficiency. The estimated surface irrigation water use efficiency in India is 35-40 %. With deteriorating surface water infrastructure and rapid declines in groundwater tables in large parts of the country, and in the face of increasing demand for water from all sectors of the economy, there is a widespread concern for using the available water more efficiently. Micro irrigation systems, comprised of drip and sprinkler technologies, have emerged as an effective tool for water conservation and improving water use efficiency. While drip irrigation is ideally suited for horticulture crops such as pomegranates, grapes, mangoes, bananas, guava, coconuts, *amla*, and cash crops such as sugarcane, it is being used for cultivation of other crops as well. Sprinklers are generally useful in undulating land planted with cereal crops. Despite substantial efforts in promoting demand side management technologies, in practice, drip and sprinkler technologies have been slow to be accepted by farmers. Of the two, drip irrigation is the more preferred technology.

Drip irrigation is an irrigation method which enables saving water by allowing water to drip slowly to the roots of plants, either on the soil surface or directly into the root zone. Drip irrigation methods range from simple bucket kit systems for small farms to automated systems linking release of water to soil moisture conditions measured continuously by tensiometers. Drip Irrigation technologies can be categorized into two groups based on their technical, economic and social attributes. These are low cost drip irrigation technologies and pressurised systems. The low cost drip irrigation technologies include the "pepsee[3]," easy drip, various kinds of affordable drip irrigation systems designed by IDE, and micro tube drip systems.

While drip technology in various forms has been in use since ancient times, it is only with the advent of modern plastics that major improvements have become possible. Water in a modern day drip system is delivered through a network of valves, pipes, tubes and emitters. Most large drip irrigation systems also employ some type of screen filters to prevent clogging of the emitter flow path by small waterborne particles. These modern drip systems also permit delivery of liquid fertilizers and other nutrients along with the water in a process known as fertigation. Fertigation and chemigation use chemical injectors such as piston pumps or venturi pumps. Fertilizer savings of up to 95% have been reported from some of the recent field tests using drip fertigation and slow water delivery as compared to timed-release and irrigation by micro spray heads (http://en.wikipedia.org/wiki/Drip_irrigation). Drip systems have been shown to achieve up to 95% water use efficiency. In addition to conserving water and fertilizers, drip irrigation can also help reduce the problems of salinization and water logging. In water scarce environments, drip irrigation may allow for agriculture in areas where furrow or flood irrigation would not be possible.

[3] See Verma et al (2004)

2.1 Drip Irrigation in India: current status and potential application

It is now possible to use drip and sprinkler irrigation to a wide variety of crops. Various estimates of potential and actual area[4] under micro irrigation technologies have been made available by different researchers and institutions.

The use of drip irrigation in India, starting from initial testing at Tamil Nadu Agricultural University in Coimbatore in 1970, increased rapidly to 55,000 hectares by 1992 (Pollock and Sivanapan, 1998)). The technology in India was introduced on a commercial scale only during the Eighth Five Year Plan (1993-98). Of the 69 MH net irrigated area in the country, only 0.5 MH had been brought under drip and 0.7 MH under sprinkler irrigation by 2003 (GOI, 2004). By the end of October 2008, the area under micro irrigation had risen to 3.88 MH, of which about 1.43 million (37%) was under drip and the remaining 2.45 million (63%) under sprinkler irrigation (Table 1). The task force on micro irrigation set up by Government of India had suggested a target of 17 MH to be brought under micro irrigation by 2012, of 12 MH would be under drip and 5 MH under sprinkler (GOI, 2004). The task force had hoped that this entire potential area would be under micro irrigation by 2030. Going by the progress made so far, these targets appear to be highly optimistic and nearly impossible to achieve.

Table 1. Selected area covered (in hectares) under micro irrigation as at 31 October, 2008

State	Drip	Sprinkler	Total
Rajasthan	17,002	706,813	723,815
Maharashtra	482,341	214,674	697,015
Haryana	7,136	518,367	525,502
Andhra Pradesh	363,073	200,950	564,023
Karnataka	177,326	228,621	405,947
Gujarat	169,689	136,284	305,973
Tamil Nadu	131,335	27,186	158,521
Madhya Pradesh	20,432	117,685	138,117
Uttar Pradesh	10,675	10,589	21,264
Kerala	14,119	2,516	16,635
Other States	36,276	288,995	325,272
Total	1,429,404	2,452,680	3,882,084

Source: Indiastat.com

[4] There is no systematic data collection and reporting of area brought under micro irrigation technologies in India.

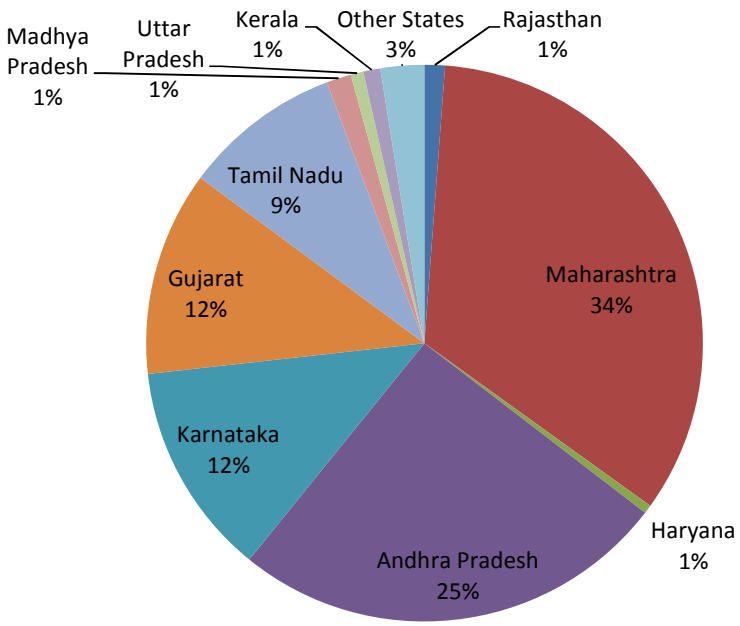

Figure 1. Percent drip area by state

Of the total area under drip irrigation in the country, almost 34% is in Maharashtra and 25% in Andhra Pradesh (Figure 1). Karnataka, Tamil Nadu, and Gujarat Pradesh are the other important states in the country for drip irrigation accounting respectively for 12, 9 and 12 per cent of the drip irrigated area in the country. Madhya Pradesh accounts for just 1 percent of the country's drip area.

2.1.1 Potential area that can be brought under micro irrigation

There are essentially two sets of estimates available on the potential area that can be brought under micro irrigation. The first set of estimates from GOI (2004) suggests the potential area that can be brought under micro irrigation to be 69.5 million hectares, of which, 39% can be brought under drip[5] and the remaining 61% under sprinklers (Tables 2, 3 and 4). The second set of estimates provided by Raman (2010) put the estimated potential area at a much lower level of 45.1 million hectares, of which 26% can be brought under drip, 68% under sprinkler and the remaining 6% under micro sprinklers.

Going by the progress achieved in the last 15 years or so this expectation has so far been belied. Going by the coverage achieved as of October 2008, the proportion of actual to potential area amenable for drip irrigation has varied between 5% (as per GOI 2004 estimates) to 12% (as per Raman 2010 estimates). As per some of the more recent data available, during the period between 2008-09 and 2009-10, 0.53 million hectares of new area have been brought under drip irrigation (Source: Indiastat.com).

[5] The Indian Committee on Irrigation and Drainage (ICID) estimates a potential of 10.5 million hectares for drip irrigation in India.

Table 2. Theoretical potential area for drip and sprinkler irrigation in India (million hectares)

Source	Drip	Sprinkler	Micro sprinkler	Total micro irrigation
GOI (2004)	27.0	42.5	-	69.5
Raman (2010)	11.8	30.5	2.8	45.1

Table 3. Estimated potential of micro irrigation according to crop groups (million hectares)

	As per GOI (2004)			Raman (2010)			
Crop	Drip	Sprinkler	Total	Drip	Sprinkler	Micro Sprinkler	Total
Cereals	-	27.6	27.6		21.4		21.4
Pulses	-	7.6	7.6	1.4	2.8		4.2
Oilseeds	3.8	1.1	4.9	1.3	4.5	0.4	6.2
Cotton	7.0	1.8	8.8	2.3			2.3
Fodder					1.8		1.8
Spices and condiments	1.4	1.0	2.4	0.7		0.7	1.4
Flowers and medicinal and aromatic plants	-	1.0	1.0				
Sugarcane	4.3	-	4.3	3.5			3.5
Fruits and vegetables	7.5	2.4	9.9	2.6		1.4	3.9
Coconuts, oil palm and other plantation crops	3.0	-	3.0				
Others						0.4	0.4
Total	27.0	42.5	69.5	11-8	30.5	2.8	45.1

Source: GOI (2004)

Table 4. State potential of micro irrigation in India (000 ha)

State	Drip	Sprinkler (including micro sprinkler)	Total MI
Andhra Pradesh	730	651	1,381
Bihar	142	1,781	1,923
Chhatisgarh	22	48	70
Goa	10	7	17
Gujarat	1,599	1,711	3,580
Haryana	398	2,009	2,408
Karnataka	745	880	1,625
Kerala	179	39	218
Madhya Pradesh	1,376	5,178	6553
Maharashtra	1,116	1,914	3,030
Orissa	157	174	331
Punjab	559	2,868	3,427
Rajasthan	727	5174	5,901
Tamil Nadu	710	326	1,052
Uttar Pradesh	2,207	8,959	11,166
West Bengal	952	731	1,713
Other states	195	485	680
Total (India)	11,823	33,268	45,055

Source: Raman, 2010

2.2 Impact of drip irrigation

Various studies undertaken to assess the impact of drip irrigation have shown encouraging impacts on farm variables . Drip irrigation has helped bring about crop diversification from rainfed crops to horticultural crops and brought cultivatable waste lands under horticultural crops. Water saving[6] expected from use of MIS has motivated the beneficiary farmers to shift from low duty crops to high duty crops. Savings in water due to the use of drip varied amongst horticultural crops in the range of 40-65% and in vegetables from 30-40%

[6] On the question of water saving impacts of drip irrigation, the opinions differ. While a majority of the studies agree that adoption of drip leads to significant savings in water application and use, others say this is not necessarily so. It has been argued that while drip does reduce evaporative losses, it is often associated with a switch to high value crops, and reduces fertilizer use when liquid fertilizer is added to the mix and delivered precisely to the root of the plant. While these productivity gains are often seen, it is not as simple as that. It usually works for the farmer but can encourage an expansion or intensification of cultivation that often leads to an increase in the total volume of water used. Thus, major gains are possible if drip is used as part of a program to build a restriction on individual consumption in combination with increasing farm productivity (Julia Bucknall in http://blogs.worldbank.org/climatechange dated 22 March 2010). It has also been argued that improving the efficiency of irrigation systems alone does not translate in to real world savings in the hydrological cycle. Often, these improvements lead to an increase in water consumption and reductions in aquifer recharge/return flows. (Rita Cessti in http://blogs.worldbank.org/climatechange dated 24 March 2010).

(Palanisami *et al.,* 2012, INCID, 1994). Use of drip has also led to a significant reduction of labour in irrigation, weeding, harvesting and eliminated drudgery in farm management.
Tables 5, 6 and 7 summarize some of the literature on impact of using drip on various farm variables, water use efficiency and the benefit-cost ratio of using drip technology under both subsidized and unsubsidized conditions. Estimates of impact of drip on different farm variables and economics of using drip varies, sometimes significantly, depending on the underlying conditions and crop regions being studied.

Table 5. Relative economics of drip and non-drip irrigated crops in Maharashtra (INR/ha)

Parameters	Crops	DMI	FMI	Gains over FMI (%)
Cost of Cultivation	Sugarcane	41,993	45,839	-13.50
	Grapes	134,507	147,915	-9.00
	Banana	51,437	52,739	-2.5
	Cotton	42,989	42,467	1.00
Gross Income	Sugarcane	106,366	85,488	24.00
	Grapes	247,817	211,038	17.00
	Banana	134,044	102,635	30.20
	Cotton	95,558	44,151	116.00
Farm Business income	Sugarcane	64,373	36,948	74.00
	Grapes	113,311	63,123	44.00
	Banana	82,607	50,196	64.50
	Cotton	52,569	1,684	3021.00

DMI-Drip method of irrigation; FMI Furrow method of irrigation
Notes: Cost of cultivation refers to Cost A2, except cotton, which is Cost A2+family labour; In the case of sugarcane, cost of harvesting, transport and marketing are not included as sugar factories bear these costs.
Source: Narayanmoorthy (2012)

Table 6. Benefit-cost ratio of drip irrigated crops under different scenarios in Maharashtra

Crop	Subsidy category	Life-period (years)	Discount rate (%)	BCR
Sugarcane	With subsidy	5	15	2.098
		5	10	2.289
	Without subsidy	5	15	1.909
		5	10	2.095
Grapes	With subsidy	10	15	1.795
		10	10	1.802
	Without subsidy	10	15	1.767
		10	10	1.778
Banana	With subsidy	5	15	2.343
		5	10	2.361
	Without subsidy	5	15	2.288
		5	10	2.253
Cotton	With subsidy	10	15	1.956
		10	10	1.983
	Without subsidy	10	15	1.789
		10	10	1.835

Source: Narayanamoorthy (2012)

Table 7. Water use efficiency with drip irrigation

Crop	Yiled Increase %	Water Saving %	Increase in WUE %
Banana	52	45	176
Chilly	45	63	291
Grapes	23	48	136
Groundnut	91	36	197
Sweet Lime	50	61	289
Pomegranate	45	45	167
Sugarcane	33	56	204
Tomato	50	31	119
Water Melon	88	36	195

Source: INCID (1994)

2.3 Factors constraining uptake of drip irrigation by farmers

Despite the demonstrated impact of drip systems on water conservation, on crop yields, on other farm variables and financial viability of investment in drip, why is it that only a few farmers have so far invested? Uptake by farmers has been far lower than the potential this technology offers. Why is it that not many farmers are coming forward to invest in a drip system? What is constraining farmers from investing in drip systems? The available literature and our primary survey of farmers in the selected regions of Madhya Pradesh point to some of the following factors:

Technology related

- Lack of awareness about the technology;
- Unsure about reliability of the technology;
- The problems associated with the use of the technology (laying pipe lines, storage during periods of non -use, choking and cleaning emitters);
- Poor quality of the system supplied;
- Unreliable and poor quality spares and non-availability of standard parts;
- Lack of knowledge of the users regarding the maintenance and operation of the system; and
- Lack of access to technical support for running and maintenance of the system.

Crop/farm size related

- Small size of holding;
- Drip system not suitable for cultivation of crops which the farmers are cultivating;

Cost/subsidy/finance related

- Non- access to government subsidy, difficult process to get a government subsidy;
- High upfront cost of investing in a drip system even with a subsidy; and
- Lack of access to institutional finance/ cost of finance.

Water related (quantity/quality/pricing etc)

- Water source related constraints;
- Water availability for irrigation not a problem; enough water available for growing crops and no need for water conservation; and
- Subsidies on surface water or free electricity for irrigation pumping.

Other

Non-availability and uncertainty of power supply.

While all or most of these factors affect to a varying extent the uptake of drip irrigation systems, one of the most important factors has been the high upfront cost of the technology.

3. DRIP IRRIGATION IN MADHYA PRADESH: A STATUS REPORT

The agricultural policy of Madhya Pradesh emphasizes increasing area under horticultural crops and promotion of agro-processing industries. Encouraging cultivation of medicinal crops and floriculture in each district is also part of the policy. Achieving these objectives requires efficient water management as an integral part of the policy. Like other states, Madhya Pradesh is also promoting more efficient methods of irrigation such as drip and sprinkler.

The adoption of drip program in Madhya Pradesh is relatively recent. Appendix Table 1 provides by district the number of beneficiaries who have adopted drip irrigation during the last four years. Five of the 50 districts in the state account for almost 73% of the total drip users in the state in the last four years (Table 8). Although incentives for investment in drip are available for all the districts in the state, the state government has been pushing drip more vigorously in these five districts. All these five districts are located in the south-western part of the state bordering Maharashtra and Rajasthan and are in two agro-climatic

zones of the Nimar Plains and the Malwa Plateau. Both are experiencing severe shortages of groundwater (Figure 2).

Table 8. Important districts for uptake of drip irrigation in Madhya Pradesh: Number of users adopting drip irrigation in recent years]

District	2006-07 Beneficiaries		2007-08 Beneficiaries		2008-09 Beneficiaries		2009-10 Beneficiaries	
	No	%	No	%	No	%	No	%
Badwani	39	8.7	205	8.4	932	9.4	1,253	10.0
Burhanpur	142	31.7	315	13.0	1,309	13.2	1,593	12.7
Dhar	12	2.7	333	13.7	1,884	19.0	2,231	17.8
Khargone	0	0.0	423	17.4	2,278	23.0	2,750	21.9
Ratlam	121	27.0	282	11.6	854	8.6	1,309	10.4
Other Districts	134	29.9	873	35.9	2,656	26.8	3397	27.2
Total State	448	100.0	2431	100.0	9913	100.0	12533	100.0

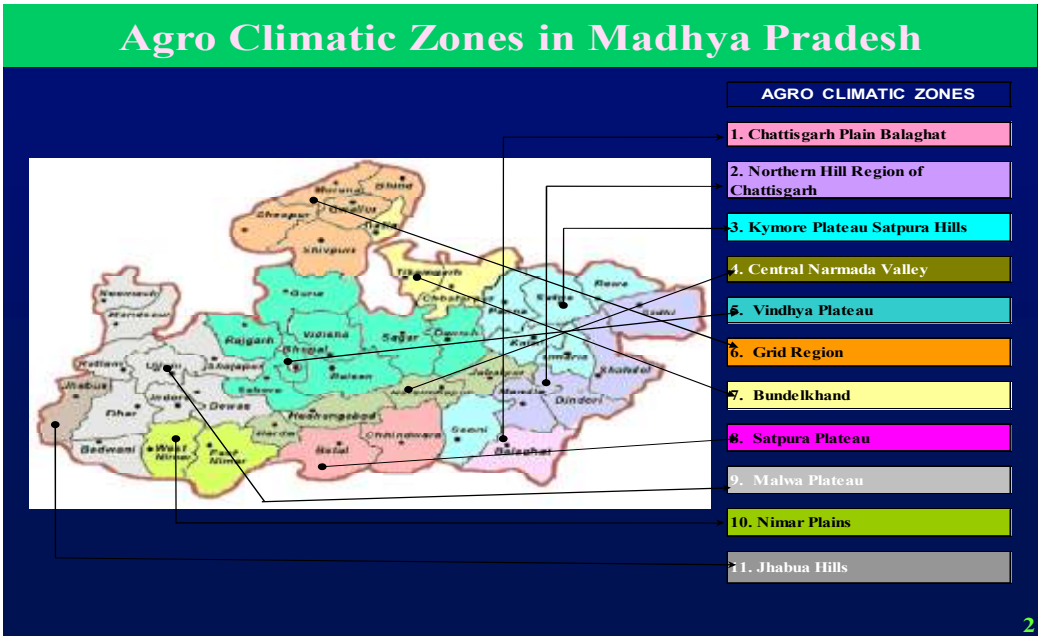

Figure 2. Agro-climatic zones of Madhya Pradesh

3.1 Market development for drip irrigation in Madhya Pradesh

The drip irrigation equipment market is fairly well developed in Madhya Pradesh. A number of large, medium and small companies provide irrigation equipment that includes drip and sprinkler sets. The available record shows there were 51 registered companies in the state engaged in the business. Most were selling sprinkler sets (45%), followed by both sprinkler and drip irrigation (43%) and exclusively drip equipment (12 %, Table 9).

Table 9. Number of companies providing irrigation equipment

Type of equipment	No. of companies	Distribution %	Distribution of companies %	
			Within the state	Outside the state
Drip & sprinklers	22	43	27	73
Sprinklers	23	45	22	88
Drip	6	12	8	82
All	51	100	24	76

One-fourth of the total companies are based in Madhya Pradesh and the remaining are from Delhi, Maharashtra, West Bengal, Rajasthan and Gujarat. Competition among these companies is strong. The range in terms of quality and cost is quite substantial. A few companies such as, Jain Irrigation and Netafim Irrigation are recognized for maintaining the quality of their products. Other products are considered relatively inferior in quality but the range is large.

4. SUBSIDIES FOR DRIP IRRIGATION TECHNOLOGY

4.1 Rationale

The decision of a farmer to invest in a new high cost technology such as drip irrigation is dependent on a large number of factors. Two factors that play a relatively more important role in decision making process are the financial viability of investing in the technology and the ease with which the technology can be used. Once a farmer is convinced of the economics of investment, the next important consideration is looking at the factors which could either constrain or facilitate the adoption of the technology. Availability of good quality equipment and access to financial resources[7] for meeting the upfront cost of investing in the technology[8] are some of the important factors that influence technology uptake and adoption.

Adoption of drip technology by farmers in India has been constrained by both set of financial concerns which influence its uptake– not too sure about the financial viability of the investment in the technology and lack of access to resources to invest in a high cost technology. While a number of studies have demonstrated the financial viability of investing in a drip technology the available evidence is specific to region, location, situation, farm size and crop (see, for example, Chandrasekaran and Kumar, 2012; Puran Mal *et al.,* 2010; Malik and Luhach, 2002; Sivanappan, 1994). The methodology employed to determine the financial viability of drip suffer from serious limitations (Dhawan, 2000) and therefore do

[7] Similar views have been expressed by the industry. Jain Irrigation, one of the leading players in the manufacture of drip irrigation products said that "The major obstacle we are facing in promotion of drip irrigation is availability of credit flow and finance to farmers. Although the governments are subsidizing the cost of drip irrigation systems by about 50%, the farmers need funds to meet the balance, which becomes a limiting factor. The governments and the banking sector need to look at this concept more pragmatically and increase their credit flow substantially. The banks should offer attractive interest rates and increase the allocation for financing drip systems."

[8] Palinisami (2011) also notes that although the returns are high under micro irrigation, farmers are reluctant to expand due to constraints like high initial capital cost, lack of technical knowledge and type of crops grown.

not instil the level of confidence that is required to encourage spontaneous and widespread adoption. For similar reasons farmers do not want to invest either their own money or borrow money to invest in the technology.

Given the pressing need for adoption of water conserving measures in the face of high upfront cost of the technology and not- too- certain private (and often social and water saving9) returns from adoption, the government has been using the capital cost subsidy as the primary vehicle for promoting uptake. The dual logic behind providing a capital cost subsidy is to reduce the high upfront capital cost of the technology and thereby make it possible for the farmer to invest with less personal capital and to improve the financial viability of private investment10. Subsidies have continued to be an important driving factor for promoting investments in and uptake of drip technology despite the limited funds allocated by the central and state governments, the institutional arrangements employed for subsidy disbursal, and the eligibility criterion and other conditionalities attached.

4.2 Evolution of subsidy program for drip

The subsidy for micro irrigation was introduced by the central and state governments between 1988-1991. A Centrally Sponsored Scheme (CSS) on use of plastics in agriculture was launched during the Eighth Five Year Plan (1992-97) of Government of India with an outlay of INR 2,500 million, of which an outlay of INR 2000 million was earmarked for promoting efficient methods of irrigation through drip and micro irrigation in the country. During 1994-96 the government was giving a subsidy at the rate of 50% of the cost of equipment to all categories of farmers. From 1997 to 1999-2000, for facilitating installation of drip systems, the government provided assistance at the rate of 90% of the cost of the system or INR 25,000 per hectare, whichever was less, for small and marginal farmers, Scheduled Tribe and Scheduled Caste farmers, and women farmers. For other categories of farmers the amount of assistance was limited to 70% of the total cost or INR 25,000 per hectare, whichever is less. Assistance was also provided for drip demonstrations at the rate of 75% of the system cost or INR 22,500 per hectare or whichever is less.

Following the above formula, the government disbursed subsidies uniformly irrespective of the size of the farm, the nature of the crop cultivated, or the amount of plant spacing. A Cost Committee constituted by the Ministry of Agriculture in 1997 suggested the following modifications to the disbursal program:

- Differential unit cost of systems for different plant spacing. The unit cost based on less than one hectare norms will be higher as compared to the unit cost for one hectare. There are also cost norms for 0.4 hectare, 1 ha and 4 ha.
- Components such as filters and venturi assemblies are to be included as optional items because of their restricted use by the farmers coupled with high cost.
- The cost of s drip irrigation system needs to be charged based on free competition and market forces.

[9] A number of studies have shown that adoption of drip technology does not lead to any savings in water.

[10] Some studies suggest that investment in unsubsidised drip systems is financially viable (see, e.g., Naryanamoorthy, 2012).

- The assistance needs to be lowered from 90% to 50% for Scheduled Tribes and Castes, small and marginal and women farmers, whereas it may be reduced from 70% to 35% for other categories of farmers subject to a ceiling of INR 25,000 per hectare.
- The assistance may be restricted for a maximum of 4 ha against the existing unlimited area rule.
- The registration of companies supplying imported and indigenous drip irrigation components needs to be done centrally at NCPA.
- Only those companies which manufacture at least two components of DIS i.e laterals and emitting devices, need be registered.

Based on the recommendations of the Committee, the pattern of assistance for micro irrigation was revised during the IX Five Year Plan (1997-2002) as per the details given below:

Table 10. Pattern of Assistance for Micro Irrigation in IX Plan

State category	Maximum ceiling for small, marginal, scheduled tribes and castes and women farmers (INR/ha) (50% of cost) for a crop spacing of 1.5 x 1.5m	Maximum ceiling for other categories of farmers (INR/ha) (35% of cost) for a crop spacing of 1.5 x 1.5m
A: Developed states	22,500	16,000
B: States other than those in the Himalayan region	26,000	18,200
C: All states in the Himalayan region except the NE	28,500	20,000

This pattern of assistance continued until the end of Ninth Plan (2001-02). Thereafter, with effect from 2002-03 during the Tenth Plan, assistance was reduced to 25% of the cost of the system for all categories of farmers.

4.3 Current status of subsidies on micro irrigation in India

Continuing with the past approach of promoting the use of micro irrigation through the provisioning of financial subsidies on the cost of the equipment, the government launched in 2005-06 and subsequently upscaled during the Eleventh Five Year Plan (2007-12) a "National Mission on Micro Irrigation (NMMI)" as a Centrally Sponsored Scheme (CSS) for promotion and uptake of minor irrigation through provision of financial subsidies[11]. Under this CSS, 40% of the cost of a micro irrigation system is borne by the central government,

[11] Components of drip and sprinkler irrigation systems are at present also included in some other CSS such as National Food Security Mission (NFSM), Integrated Scheme of Oilseeds, pulses, oil palm and maize (ISOPOM) and the technology mission on cotton (TMC). These programs however also conform to the same norms and pattern of assistance as stipulated under NMMI.

10% by the state government and the remaining by the beneficiary either through his or her own resources or through a loan from financial institution. Additional assistance of 10% of the cost of the system is borne by the central government in respect of small and marginal farmers. Many state governments are providing even higher than the required minimum subsidy of 10%. Some of the eligibility requirements and the institutional arrangement for the delivery of subsidies as per the NMMI scheme are[12]:

- All categories of farmers are eligible for assistance under this scheme.
- Assistance to farmers is limited to a maximum area of five hectare per beneficiary.
- Assistance is available for both drip and sprinkler irrigation for widely spaced as well as closely spaced crops. However, assistance for sprinkler irrigation systems is available only for those crops where drip irrigation is uneconomical. All types of drip irrigation systems such as on line drip, in line drip, sub-surface drip, and micro jets are eligible.
- Assistance is available for irrigation systems for protected cultivation including greenhouses, polyhouses and shadenet houses.
- Assistance is available for implementation of advanced technology like fertigation with fertilizer tanks, venturi systems, sand filters, media filters, hydrocyclone filters, sand separators and other types of filters and valves.

The NMMI also suggested an elaborate institutional arrangement and prescribed a set of procedures for disbursal of subsidies. The NMMI provided the estimates of the nominal cost of a micro irrigation system for different crop spacings and for different sizes of farms for use by states to calculate the eligible amount of subsidy. For the purpose of fixing the nominal price of a drip system and therefore for determining the amount of subsidy, the states have been categorized. States where more than 20,000 hectares have been brought under drip irrigation come under Category A for which the costs have been worked out by NMMI. This includes the states of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu. All the states except those covered under Category A and those falling in the Himalayan region come under Category B. All the Northeastern states, Sikkim, Himachal Pradesh, Jammu and Kashmir, Uttarakhand and Darjeeling District of West Bengal come under Category C. Keeping in view the level of awareness, proximity to the manufacturing units, distance involved in transportation, potential for drip irrigation, the cost of drip systems in Category B states is estimated to be 15% higher than Category A states, while for Category C states it is estimated to be 25% .

Table 11 provides illustration of the cost of drip irrigation systems, in respect of a few of the various farm sizes-crop spacing combination, that is used for calculating the amount of eligible subsidy in Category A states.

[12] Source; Government of India. 2010. National Mission on Micro Irrigation: Operational Guidelines. New Delhi: Ministry of Agriculture, November 2010.

Table 11. Indicative Costs of Drip Irrigation Systems for subsidy calculation for different sizes of farms and different lateral spacing (Costs in Rs)

Lateral spacing (m x m)	Crop spacing	Farm size						
		0.2 ha	0.4 ha	1.0 ha	2.0 ha	3.0 ha	4.0 ha	5.0 ha
12x12	Wide	8,057	13,785	18,820	29,928	46,467	57,809	73,611
8x8	Wide	8,673	15,088	22,028	36,217	56,087	70,893	89,964
4x4	Wide	11,177	18,621	31,793	55,725	86,926	113,812	135,459
2x2	Wide	18,319	31,616	63,598	123,441	179,332	249,134	305,797
1.2x0.6	Close	24,063	43818	97,598	185,565	280,886	378,946	474,070

4.4 Subsidy on drip in Madhya Pradesh

Under the prevailing subsidy regime in Madhya Pradesh, the extent of the subsidy varies between 70 and 80% of the cost of the system shared between central and state governments. While the central government provides for 50% of the equipment cost in the case of small and marginal farmers, the subsidy is 40% in the case of other categories of farmers. The state government additionally provides between 20 and 30% of the cost as a subsidy. The total subsidy as a percentage of the cost of equipment thus varies between 70 and 80% for different categories of farmers (Table 12).

Table 12. Subsidy on micro irrigation in Madhya Pradesh (effective 1 January 2011)

Category of farmer	Category	% Subsidy		
		Central Govt	State Govt	Total
Small and marginal	Scheduled Caste/Tribe	50	30	80
Other	Scheduled Caste/Tribe	40	30	70
Small and marginal	General	50	20	70
Other	General	40	30	70

Source : Office of the Micro Irrigation Committee, Bhopal.

For the purpose of calculation, the indicative cost for different farm sizes and different crop spacings are the same as suggested by NMMI and presented in Table 10. Table 13 shows the various components that form the standard drip irrigation system for two of the illustrative farm sizes and crop spacing combinations. These are the components which go into determining the cost of drip irrigation as given in Table 10 and thus for estimation of the eligible amount of the subsidy. The subsidy is available on the unit as a whole and not on individual components of the system.

Table 13. Components and material requirements for a standard drip irrigation system.[13]

Widely spaced crops 0.2 hectares	Widely spaced crops 5 hectares
PVC Pipe 75 mm; Class II ; 4kg / cm2	PVC Pipe 90 mm; Class II ; 4kg / cm2
PVC Pipe 63 mm; Class II ; 4kg / cm2	PVC Pipe 75 mm; Class II ; 4kg / cm2
PVC Pipe 50 mm; Class II ; 4kg / cm2	PVC Pipe 63 mm; Class II ; 4kg / cm2
Lateral 16 mm Class II ; 2.5 kg / cm2	Lateral 16 mm; Class II; 2.5 kg / cm2
Lateral 12 mm Class II ; 2.5 kg / cm2	Lateral 12 mm; Class II; 2.5 kg / cm2
Emitter 4 / 8 lph	Emitter 4 / 8 lph
Microtube 6 mm	Microtube 6 mm
Control Valve 75 mm	Control Valve 90 mm
Control Valve 63 mm	Control Valve 75 mm
Control Valve 50 mm	Control Valve 63 mm
Flush Valve 63 mm	Flush Valve 75 mm
Flush Valve 50 mm	Flush Valve 63 mm
Air Release Valve 1"	Air Release Valve 1.5"
Non Return Valve 1.5"	Non Return Valve 1.5"
Throttle Valve 1.5"	Non Return Valve 2.5"
Screen Filter 10 m3 / hr	Throttle Valve 1.5"
By-pass Assembly - 2"	Throttle Valve 2"
By-pass Assembly – 1.5"	Throttle Valve 2.5"
Venturi & Manifold 2"	Screen Filter 20 / 25 m3 / hr
Venturi & Manifold 1.5"	Screen Filter 10 m3 / hr
	By-pass Assembly – 2.5"
	By-pass Assembly - 2"
	By-pass Assembly – 1.5"
	Venturi & Manifold 2.5"
	Venturi & Manifold 2"

Source: Government of India (2010)

4.5 Subsidy disbursal

The Horticulture Department in the state government has issued detailed procedures and timelines for each stage, from submission of application to disbursal of the subsidy (Appendix II). To what extent these procedures and timelines are actually followed in practice is difficult to know, although several farmers and agents we spoke to suggested wide differences between the two. The salient features of the process are summed up in the following flow diagram. The complicated procedures prescribed for getting a subsidy entail filling out several forms[14], attaching documentary evidence, obtaining 'no-objection' and clearances from different agencies, shunting documents between different government departments; a strong disincentive for an otherwise enthusiastic farmer to consider applying on his own without the assistance of an intermediary or an agent. Figure 3 provides a glimpse of the step-by-step process for subsidy application and approval.

[13] Requirement may vary depending upon lateral to lateral dripper spacing

[14] In all up to 14 documents are required to be arranged by the individual beneficiaries for self finance and about 18 for bank finance.

BLOCK DEVELOPMENT OFFICER

Receipt and registration of Gram Sabha approved applications with documents on "first come first served basis" from farmers through Village Horticulture Extension Officer, Horticulture Extension Officer and other sources like regional workers/dealers of micro irrigation companies.

Field visit to the farm with Village Horticulture Extension Officer for information verification. Send applications in an ordered list to District Horticulture Officer.

MEMBER SECRETARY, DISTRICT MICRO IRRIGATION COMMITTEE (DMIC)

Estimation of area and cost on basis of received applications, formulation of District Action Plan and forward DMIC's sanction plan to state Micro Irrigation Committee (SMIC).

MEMBER SECRETARY, STATE MICRO IRRIGATION COMMITTEE (DMIC)

Preparation and approval of state level action plan by SMIC. Forward to central government's Department of Agriculture and Cooperation (DAC), New Delhi.

Sharing of information received about district action plan approved by DAC with DMIC.

MEMBER SECRETARY, DISTRICT MICRO IRRIGATION COMMITTEE (DMIC)

Forwarding of block applications to micro irrigation companies selected by farmers for survey drawing/design etc. along with bank loan application approved by bank for further action.

MICRO IRRIGATION COMPANY

Survey drawing/designing etc. and sending to BDO and Senior Horticulture Development Officer.

BLOCK DEVELOPMENT OFFICER

Physical verification of irrigation water and energy for purposed micro irrigation system and sending documents with recommendations to Member Secretary, DMIC.

MEMBER SECRETARY, DISTRICT MICRO IRRIGATION COMMITTEE (DMIC)

Issue of administrative approval and work orders to micro irrigation company.

MICRO IRRIGATION COMPANY

Establishment of irrigation system, training of farmer along with Hindi manual. Sending Satisfaction Certificate obtained from farmer and bills to Member Secretary, DMIC.

NOMINATED GROUP OF OFFICERS

Physical verification and inspection of system installed. Processing of payment to micro irrigation

BENEFICIARY

Submission of affidavit with documents to Assistant Director, Horticulture and Joint Secretary, DMIC stating system installed will not be transferred or sold. Give in writing that no benefit has been drawn before from any similar government Scheme.

4.6 Extent of subsidy available and uptake of drip technology

The performance of the Drip Irrigation Program in Madhya Pradesh in recent years can be observed from Table 14. The table shows the status with respect to physical and financial targets and their achievement in the last five years.

Table 14. (title needed)

(Physical in hectares and financial in INR 100,000)

Year	Physical			Financial						
				Allocation			Expenditure			
	Target	Achievement	Achievement %	Total	Proportionate share of		Total	Proportionate share of		Expenditure as % of funds allocated
					Central	State		Central	State	
2006-07	3,528	875	25	704	82	18	165	82	18	23
2007-08	7,486	7,846	105	2,677	41	59	1,508	68	32	56
2008-09	30,153	38,146	127	8,534	54	46	7,516	58	48	88
2009-10	33,308	35,604	107	7,407	47	53	8,791	49	51	119
2010-11	42,166	9,382	22	6,580	56	44	2,333	76	24	35
Total	116,641	91,853	79	25,903	52	48	20,313	57	43	78

Source: Presentation in Annual meeting 2010-2011, of Department of Horticulture, M. P.

The data Table 14 shows there is no consistency in allocation of funds and the physical targets specified. The program is significantly dependent on the availability of central funds that may or may not be released on time due to several administrative reasons such as non-availability of previous year's use and audit certificates or for deficiencies found in implementing the program according to central government guidelines. Except in 2009-10 when use was more than funds allocated, in all other years use varied between a low of 23% in 2006-07 to a high of 88% in 2008-09. Government officials during discussions accepted that there is the potential for realising improved physical targets for micro irrigation, but for lack of availability of funds at the required time. Generally, the subsidy fund available in a given year is quite low compared to the demand.

In terms of the number of new adopters of drip irrigation, during 2006-07, 448 new farmers adopted drip irrigation which number increased to 12,533 new users during 2009-10 as a result of greater availability of subsidies (see Table 15). A majority of the drip sales are concentrated in just five districts of the state. During the year 2009-10, 73% of new users of drip were located in these five districts: Badwant, Burahampur, Khargone, Dhar and Ratlam (Figure 4).

Table 15: Uptake of drip irrigation in important districts of Madhya Pradesh

District	2006-07 Beneficiaries		2007-08 Beneficiaries		2008-09 Beneficiaries		2009-10 Beneficiaries	
	No	%	No	%	No	%	No	%
Badwani	39	8.7	205	8.4	932	9.4	1,253	10.0
Burhanpur	142	31.7	315	13.0	1,309	13.2	1,593	12.7
Dhar	12	2.7	333	13.7	1,884	19.0	2,231	17.8
Khargone	0	0.0	423	17.4	2,278	23.0	2,750	21.9
Ratlam	121	27.0	282	11.6	854	8.6	1,309	10.4
Other Districts	134	29.9	873	35.9	2,656	26.8	3397	27.2
Total State	448	100.0	2,431	100.0	9,913	100.0	12,533	100.0

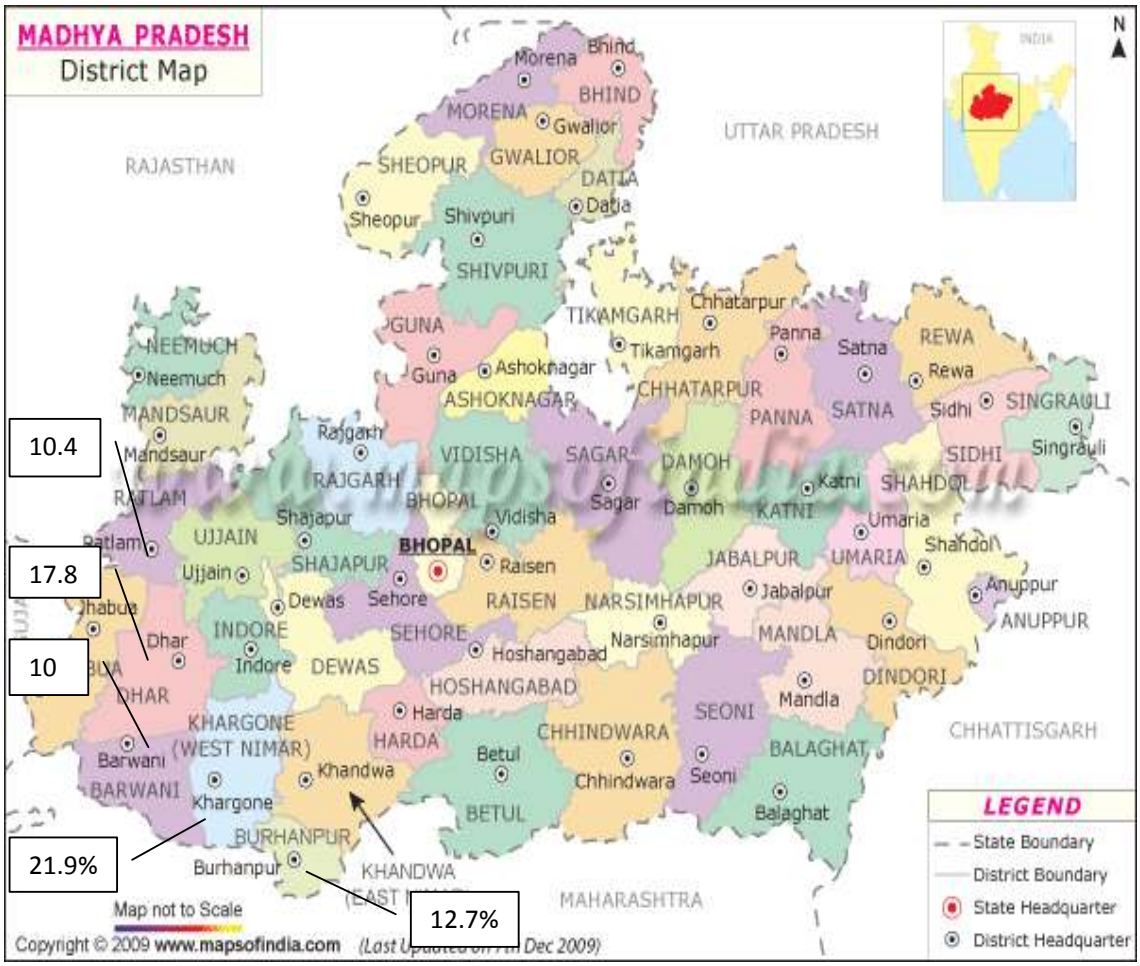

Figure 4. Location of districts with highest number of beneficiaries of drip irrigation subsidy 2009-10

4.7 Availability of subsidy and uptake of drip

Manufacturers and market estimates suggest that more than 95% of the drip sales in Madhya Pradesh are subsidy linked[15],[16]. If the subsidy on drip were to be withdrawn, the sales of drip would collapse and there would be very few new buyers. This line of reasoning is being advanced to justify continuing with the existing subsidy regime and possibly to increase the percentage of subsidy to encourage more farmers to invest. This argument is also being advanced to encourage and persuade governments to increase the total amount of annual financial allocations for subsidy disbursal so that at the prevailing subsidy levels a much larger number of farmers could benefit. To support this line of argument, all the intermediaries involved in manufacturing and selling drip systems show a long list of pending farmer demand which indicates that a farmer has to sometimes wait for one to two years before his turn comes up. Given that substantial government funds to the tune of 70 to 80% of the cost of the system is available for purchase of a drip system, it is natural to expect that not many otherwise willing farmers would like to invest without a subsidy.

The link between uptake of drip systems to availability of subsidy[17] has stifled the inertia of developing aggressive marketing strategies on the part of the manufacturers to promote sales of unsubsidized systems, and any attempts at bring down the manufactured cost of drip systems through product designs or technological innovations. All efforts of manufacturers, dealers and other stakeholders are focused on making the most of the available government subsidy through sales of their brand. The system has thus made the manufacturers subservient to government favour and has led to the loss of their enterprise spirit and is impeding the growth of market for drip[18]. Similarly, the insistence that drip products carry the BIS mark as a guarantee and more so as a pre-condition to be eligible for a government subsidy has led to the adoption of unfair business practices[19],[20].

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[15] This in fact is true not only for Madhya Pradesh but all other states of India. With the introduction of the Centrally Sponsored Scheme, the implementation of micro irrigation has gradually accelerated in all states and the physical performance has been of the order of 800% in Madhya Pradesh during the period between 2006-08. (Palanisami *et al.,* 20110).

[16] The government data on area under drip irrigation in different states is also derived on the basis of systems sold through the subsidy program, implying the government also does not expect that any additional area will come under drip irrigation without subsidies.

[17] Narayanamoorty (2009) said that "most of the development (in drip and sprinkler) has been due to support (subsidy) from State agencies.

[18] Shah and Kellor (2002) note that "15 years ago when drip irrigation came to be commercially marketed for the first time, some of the leading players—especially, Jain Irrigation—invested heavily in market development and were beginning to reap the benefits. But in the 1990's, GoI introduced the subsidy for drip systems. The major industry players—like Jain irrigation—. are frustrated by the distortions caused by the subsidy. In reality, it has increased competition for them. The subsidy has attracted a large number (40-50 companies are registered) of shady players in the drip business who peddle low quality products, and often claim a subsidy without selling systems. Getting the ISI registration involves a one-time bribe of INR 6-8 lakh; but then the manufacturer becomes entitled to market his products under the subsidy scheme. This has made big players uncompetitive; it has also created quality problems and impeded market growth due to diminishing farmers' faith in the technology."

[19] Quoting the views of a dealer, Shah and Kellor (2002) refer this to "ISI mark + subsidy = fraud".

[20] The subsidy system breeds corruption and tends to benefit the least needy; see A Note on Drip Irrigation available at ifmr.ac.in/wiki/images/d/d4/Note_on_Drip_Irrigation.doc.

Our assessment of the prevailing subsidy regime of the government, together with the procedures set and the manner in which the subsidy disbursal takes place, suggests a strong connection between manufacturers and implementing agencies of the government entrusted with the administration of the subsidy program . The subsidy, as currently being administered, is actually going to the manufacturers who claim it in the name of the farmers[21]. Since a subsidy is provided as a percent of the price (which earlier used to be capped by the government department for the purpose of calculating the maximum amount of eligible subsidy but is no longer the case now) the higher the quoted price, up to the normative prices fixed by the government for the purposes of subsidy calculation, the higher the amount of subsidy. It is therefore in the interests of the manufacturers to jack up the prices of drip sets in the name of higher manufacturing costs and claim a bigger subsidy without any commensurate benefit going to the farmer.

The manufacturers have adopted competitive strategies to create a sustainable competitive advantage for promotion of their businesses. Companies follow various methods for delivering water saving technology at the farm level, such as demonstrations using outreach materials and establishing personal contacts between farmers and company representatives and dealers. Demonstrations of the technology on the farms of progressive and influential farmers are organized. This has had an unintended negative effect of excluding small farmers and thus depriving them of knowledge about the technology. The actual business model followed by companies is governed more by the state subsidy system. Demonstrations on big farms strengthen the connection between dealers, companies, officials and farmers.

Companies operate more like a cartel to benefit from the subsidy provisions of the program. Producers and the chain of sellers involved in marketing micro irrigation technology emphasize building contacts with government officials at different levels to get the maximum share out of the subsidy fund. At the farm level, the attempt is to convince the farmer that he/she will get a high cost product without having to pay the full amount, rather than emphasizing the benefits the farmer might gain from the technology or details about maintenance. The focus is entirely on getting the necessary papers prepared for release of subsidy from the government. Even the decision about the choice of product and of the company is determined by the agent who succeeds in approaching the farmer and getting

[21] Shah and Kellor (2002) also refer to the strong connection between the subsidy regime and siphoning off the subsidies by both manufacturers and government officials involved in subsidy delivery. They say that "Governments are now cutting subsidies on drip irrigation and this is creating a new generation of problems for the industry mainstream which has got hooked on the opiate of subsidies over several years. Until last year when the subsidy was as high as 90%, the marketing dynamic of the drip system was fired by the subsidy culture. Indeed, the manufacturers and dealers, including the leading brands, were after the 'unearned profit' in the form of subsidies more so than manufacturing and marketing margins from serving satisfied customers. Since ISI-marked products enjoy a degree of monopoly in the form of subsidy access, their manufacturers hiked their prices pretty much to levels where they and the bureaucrats empowered to approve subsidies claimed the bulk of the subsidy. However, since claiming the subsidy involved between 1-3 years and 15-20% bribe money, there was always a market for non-subsidy drip systems and products. Now that the subsidy has been reduced to 30%, the profits in ISI marked drip systems have taken a plunge. All players with major names in the ISI-sector are facing declining fortunes; they have been progressively cutting their prices to stimulate their non-subsidy sales; but here they face stiff competition from the non-ISI players who sell unbranded products at rock bottom prices."

his papers cleared. The farmer is often a passive participant in the entire process. Extra economic factors such as social and local political influence, rapport with the government officials, and relations with the company agent play a more important role than the techno-economic considerations necessary in choice of technology and product. The deciding factor for the amount of subsidy sanctioned is linked to the margin of service charges and profit of the dealer. Dealer margin in good quality products is relatively small. Therefore, the agents promote lower quality products with higher value pro-forma invoices to increase the margin. These connections pressurizes the farmers to choose equipment of poor quality by offering them different incentives including fast processing of files and some discount, ultimately lending up to pay much more than his expectation.

The presence of a number of companies leads to competition among firms producing varying quality of equipment and services. The subsidy system is also responsible for unhealthy competition. At present, there are only two companies known for high cost good quality product; Jain Irrigation and Netafim Irrigation. IDE supplies a low cost alternative which is outside the subsidy regime. Between high and low cost products, there are a number of companies providing equipment of varying quality. Most, if not all, systems are locally available and the location of source of supply is not a constraint for obtaining technology. In the business of irrigation equipment, the connections among the participants is shown in Figure 5. This is the result of the subsidy system. The facilitators are middlemen for speeding up the bureaucratic process.

On the suppliers' side, there is a chain of producers, dealers and sub-dealers. Their objective is to increase sales and maximize the share of the subsidy. The chain also includes facilitators and mediators who manage the links among dealers, government officials and farmers.

Generally the revenue is generated by the companies through sales and support, the cost structure of the product, and targeted profits. But in case of micro irrigation systems, the adoption of high cost drip equipment is directly related to the provision of subsidies. Socio-political factors play an important role in allocation of subsidies because of indirect political involvement in decision making and the prescribed differential rates of subsidy.

From another perspective, the subsidy regime indirectly incentivises both the manufacturers and sellers of the drip systems as well as the government agencies administering the program and targets mainly medium and large farmers for sale of drip systems[22]. We illustrate this by an example.

With an annual hypothetical government subsidy budget (combined budget of central and state government) of INR 50 crores[23] for drip installation, this amount can provide subsidies to about 64,000 farmers to install drip on 0.2 hectares of land, cultivated with widely

[22] Namara *et al.* (2005) also reported that the majority of the farmers who adopted drip and sprinkler irrigation systems in Gujarat and Maharashtra are rich to very rich farmers. Palanisami *et al.* (2012) also report that a majority of farmers adopting drip irrigation in Tamilnadu, Mahrashtra, Rajsthan and Gujarat are large farmers. Ahuja *et al.* (2012) report that about 68% of farmers who bought drip in Haryana has holding size larger than 2 hectares.

[23] 1 crore = 10 million

spaced crops with lateral spacing of 4 m by 4 m, resulting in an area of 12,781 hectares being brought under drip irrigation. In contrast, the same amount of subsidy can be exhausted by installing drip systems on 5,273 large farms of 5 hectares each leading to 26,365 hectares of land being brought under drip irrigation. The implicit subsidy per hectare of drip area in the former case at INR 39,120 is more than two times the per hectare subsidy cost of INR 18,964 in the latter case (Table 16). Thus, by focusing on a small number of relatively well informed and financially better-off farmers for subsidy disbursal, the manufacturers and sellers gain by saving on marketing efforts and advertising. The officials administering the subsidy disbursal also gain by a significant reduction in their overseeing efforts, including need for visiting a much smaller number of farmers for physical verification, while at the same time getting the credit for bringing a much larger area under drip and in meeting their targets with a given amount of subsidy.

Table 16. Illustrative estimates of beneficiaries from a drip subsidy of INR 50 Crores for wide spaced crop lateral spacing (4 m x 4 m)

Farm size	Drip cost INR	Subsidy 70%	Number of farmers benefitting	Area brought under drip	Per ha subsidy cost
0.2	11,177	7,824	63,907	12,781	39,120
5.0	135,459	94,821	5,273	26,365	18,964

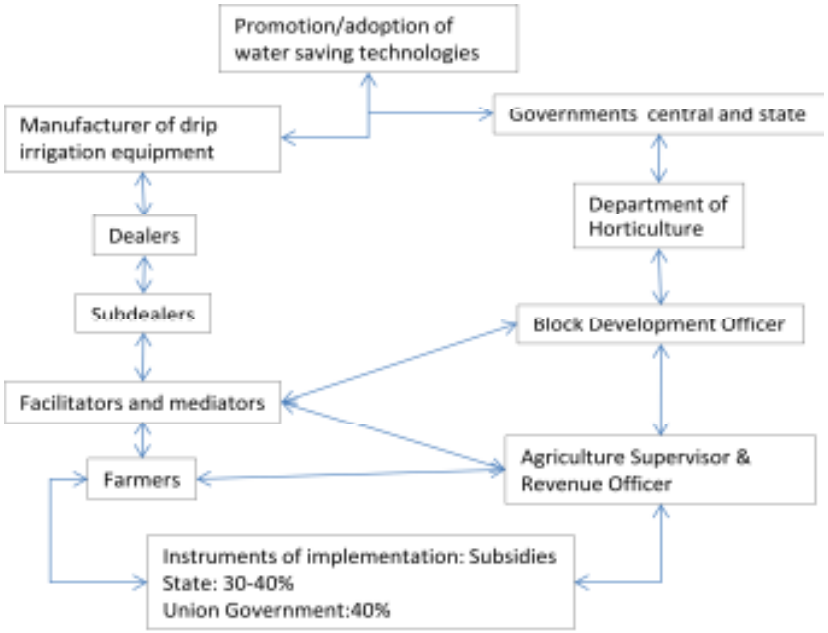

Figure 5. Subsidy delivery connections between different actors.

4.8 Towards an alternative model of subsidy delivery

Given the strong nexus that has developed over a period of time between different players involved in disbursal and receivers of the available drip subsidies, in shaping the subsidy delivery system of the government to their advantage and indirectly constraining the spread of drip irrigation technology, one often wonders is the government, by providing subsidies, trying to promote a specific kit of drip system or the concept of drip system in general? Why should eligibility for a subsidy bind a farmer to a specific configuration and not let them choose components which could serve the same purpose but at a somewhat lower cost without the use of all the pre-specified components? To illustrate, the specified configuration of drip systems includes components for fertigation. There is no denying the fact that accrual of benefits of drip irrigation to a significant extent depend on the practice of fertigation, because if fertilisers are applied separately from the water application the fertiliser efficiency declines as the nutrients are not dissolved in the dry zones where the soil is not wetted. Further, the costly water soluble fertilisers may or may not be available at all places. Even if available, the lack of knowledge about its application and possible benefits may constrain its adoption. While data on extent of use of fertigation practices by users of drip irrigation is not available, the informed estimates suggest that the adoption of fertigation is still far from satisfactory. Fertigation as an accomplishment of drip irrigation has not penetrated that much as it should have been (Soman and Narayanan, 2012).

Is there a way out of exiting this nexus and use the available government subsidies to achieve the goals that these subsidies are intended to achieve? We premise that if the government were to dispense with completely the existing mechanism of subsidy delivery to the manufacturer/ intermediary in the name of giving subsidy to the farmer, and arrange to make direct delivery of drip subsidy to the beneficiary farmers themselves, the scenario of market prices and uptake of drip by farmers may change considerably.

A comparison of prevailing market prices of some of the components used in the high end drip systems , and as accounted for their product costing by some of the reputed drip manufacturers point to the scope for price reduction. To illustrate, the manufacturers of drip systems cost an important component of the system, a venturi, at around INR 4,800-5,000. This component is available on the market for INR around 2,400. Similarly, the filter is valued at around INR 11,000 in a manufacturer assembled system, while it is available at around INR 5,000 in the open market. The wholesale prices of these components would be lower still than the quoted retail prices and to that extent indicate the scope for further reduction in prices of the final product. Similar differences in prices exist in other components. If the subsidies were withdrawn by the government it is very likely that the open market (unsubsidized) prices of manufactured drip systems would fall by at least 40%[24]. Increased open market competition may reduce further the cost of a system by another 5-10 %. The net result is a likely reduction in prices of manufactured drip systems by

[24] This level of price reduction is possible and is based on the opinion shared by several dealers and manufacturers we spoke to during our field visits in the study area. Shah and Kellor (2002) also point to similar or larger price reductions when they say “non-ISI marked products which are nearly as good as the best available in the market are selling at 60-70% lower price.”

about 50% in a free (unsubsidized) market[25],[26]. This perception is shared by almost all the market players including some of the leading manufacturers and sellers of drip systems. This is also evidenced by the open market prices of drip systems being sold by the manufacturers and assemblers of non-BIS marked drip systems in the study region, although there may be some difference in quality and performance between the two types of systems.

4.8.1 An alternative model for subsidy delivery

Based on the above premise and possibilities of a likely reduction in open market prices of a drip system in the event of government withdrawing the current capital subsidy scheme for drip systems, we propose an alternative subsidy delivery model which would still incentivise farmers to invest in drip systems, lower the cost of subsidy outgo, be more transparent, less prone to corruption, easy to manage and govern, less prone to interference, and lead to more efficient use of the available subsidy fund without distorting the market[27].

Rather than giving a one-time capital cost [28] subsidy, we propose that the government gives an interest cost subsidy to farmers willing to invest in a drip system. Under this scheme, the government gives interest free loans for the entire cost of a drip system to all farmers-small, large, belonging to a Scheduled Tribe and Schedules Castes category and willing to buy a drip system. These loans can be administered through the existing financial institutions[29] available in rural areas. The government provides interest free loans with capital repayable after five years. The farmer is free to buy drip system from any dealer or manufacturer, choose the desired configuration, and negotiate a price and after sales service conditions with the dealer. The farmer does not need to visit government offices to obtain approval or clearances before buying the system. The government does play its

[25] An employee of Jain Irrigation Systems said, "One needs to keep a margin for all the bribes that need to be paid to get this done. This accounts for a good 30 to 35% of the cost. In fact, we often encourage farmers to buy directly from us instead of taking a subsidy. In this case we can offer him a 30 to 35% discount, which is the amount of subsidy available now." (as quoted in 'A Note on Drip Irrigation' available at ifmr.ac.in/wiki/images/d/d4/Note_on_Drip_Irrigation.doc

[26] In addition to the scope for price reduction through open market competition, the system cost can also be reduced through better economic design. There is scope for reducing the system cost by slight modifications in the agro-techniques of which paired row planting is very promising. Its advantage in reducing the system cost to the tune of 25 to 30% is proved by field experiments at different Precision Farming Development Centres in various states. Enough orientation needs to be given to the manufacturer, dealers and farmers such that the most economic crop specific design is made (Raman *et al.,* 2012, Palanisami *et al.,* 2012).

[27] Poulok and Sivanapan (1998) also argue for change in the subsidy regime system on drip irrigation. Without elaborating on the details of an alternative subsidy delivery model they nevertheless suggest the need for an alternative delivery mechanism. They said that "to stimulate its wider adoption, the Government of India has provided subsidies for drip irrigation in the Sixth, Seventh, and Eighth Five Year Plans. While the subsidy has encouraged some farmers to install drip systems, it has had paradoxical results. For example, delays as long as one year in releasing subsidy payments to manufacturers produce price increases for subsidized equipment. Changing the design of drip systems so that they can be sold profitably by the private sector at a price lower than the existing subsidized price opens up the possibility of replacing subsidies with an alternative that produces the intended impacts without the disadvantages."

[28] The capital cost required to install drip irrigation is high, which dissuades a considerable number of farmers, particularly if they are growing low value crops (Narayanmoorthy, 2009).

[29] Financial institutions are currently providing loans to farmers to meet their share of capital cost of the drip system i.e total cost minus the amount of eligible subsidy.

facilitative role in ensuring that only good quality products are sold in the market and farmers are not cheated by manufacturers.

Table 17 provides illustrative calculations under the two subsidy scenarios for two of the farm size groups we discussed above. In the first case, we consider drip installation on widely spaced crops (lateral 4 m x 4 m) on a 0.2 hectare farm, while in the second case we consider installation of a similar system on a 5 hectare farm. To make a comparative assessment of the two scenarios, we assume that the same number of systems, as are feasible with a subsidy budget of INR 50 crores under the prevailing subsidy regime will be installed under the proposed scheme. Thus, under the existing subsidy scenario, either 63,907 drip systems of 0.2 hectares or 5,273 drips of 5 hectares can be installed with a subsidy budget of INR 50 crores (Table 15).

We set up three scenarios depicting the likely impact of withdrawal of the existing subsidy regime on the open market price of drip systems. Under Scenario 1, we assume that market prices will be lower by 50% of the existing nominal prices fixed by the government. In the other two scenarios, we assume a reduction of 40 and 30% on the currently prevailing prices. Depending on the assumption made about possible price reduction, the total cost of installing 63,907 drip systems for 0.2 hectares or 5,273 drip systems for 5 hectares vary between INR 35.7 to INR 50 crores (Table 17).

Table 17. Illustrative Calculations for Cost of drip irrigation systems under alternative assumptions about reduction in market prices consequent upon withdrawal of current subsidy scheme

Farm size for drip	Current market price INR	Scenario number	% reduction in market price	New open market price INR	Number of systems to be installed; number of farmers benefitting*	Total cost of systems INR crores
0.2	11,177	1	50	5,588	63,907	35.7
0.2	11,177	2	40	6,702	63,907	42.9
0.2	11,177	3	30	7,824	63,907	50.0
5.0	135,459	1	50	67,730	5,273	35.7
5.0	135,459	2	40	81,275	5,273	42.9
5.0	135,459	3	30	94,821	5,273	50.0

This is the same number as currently feasible to install with a subsidy budget of INR 50 crores. For details see Table 15.

We present in Table 18 some of the comparative statistics for the two subsidy delivery models. Under the prevailing subsidy model, the farmer has to pay upfront from his own resources the difference between the cost of the system and the eligible subsidy. Thus, for a 0.2 hectare drip system the farmer has to pay INR 3353 and for a 5 hectare system INR 40,638. Under the proposed subsidy delivery system, since an amount equivalent to the entire upfront market cost of a drip system will be provided as an interest free loan, the

farmer is not required to contribute any amount from his own resources. The total capital outlay of the government under the three price scenarios in the proposed model vary between INR 35.7 crores to INR 50 crores as compared to INR 50 crores in the existing model. In the proposed model the government provides interest free loans to farmers repayable after five years. Assuming the opportunity cost of capital to be 10%, the government at the end of five years would have incurred between INR 21.8 and INR 30.5 crores as cost for providing the entire cost of drip systems as interest free loans as against INR 50 crores spent in year 1 for providing subsidies on an equivalent number of drip systems under the prevailing scenario. The subsidy cost to the government for a 0.2 hectare farm varies between INR 3,412 to INR 4,777 under the proposed subsidy scenario as against INR 7,824 in the prevailing scenario. For a 5 hectare farm drip system, the corresponding subsidy costs are between INR 41,350 and INR 57,889 as against INR 94,821 under the prevailing regime. Similarly, the subsidy outgo per hectare is much lower in the proposed subsidy scheme in comparison with the existing subsidy scheme (Tables 18 and 19).

Table 18. Comparative select statistics on drip irrigation under the prevailing subsidy scenario and alternative scenarios under the proposed subsidy delivery model

	Farm size 0.2 hectares				Farm size 5 hectares			
	Scenario	Alternative scenarios			Scenario	Alternative scenarios		
	Currently prevailing	1	2	3	Currently prevailing	1	2	3
Upfront cost payable by each beneficiary from his own resources (INR)	3,353	0	0	0	40,638	0	0	0
Total Government Capital Outlay (INR crores)	50.0	35.7	42.8	50.0	50.0	35.7	42.8	50.0
Cost to the Government (Subsidy) INR crores	50.0	21.8	26.2	30.5	50.0	21.8	26.2	30.5
Subsidy/Beneficiary INR	7,824	3,412	4,094	4777	94,821	41,350	49,619	57,889
Area brought under drip (hectares)	1,2781	12,781	12,781	12,781	26,365	26,365	26,365	26365
Subsidy/hectare	39120	17,059	20,471	23883	18,964	8,270	9924	11578

Table 19. Illustrative calculations of Impact of allocating government subsidy budget of INR 50 crores to different size groups of general category farmers on number of farmers benefited and area brought under drip irrigation

Farm size (ha)	Drip cost (INR)	Subsidy (70%)	Number of beneficiary farmers	Area brought under drip (ha)	Implicit subsidy cost per hectare of drip installed area (INR)
widely spaced crops lateral spacing 4 m X 4 m					
0.2	11,177	7,824	63,907	12,781	39,120
0.4	18,621	13,035	38,359	15,344	32,587
1	31,793	22,255	22,467	22,467	22,255
2	55,725	39,008	12,818	25,636	19,504
3	86,926	60,848	8,217	24,652	20,283
4	113,812	79,668	6,276	25,104	19,917
5	135,459	94,821	5,273	26,365	18,964
closely spaced crops lateral spacing 2.5 m x 0.6 m					
0.2	15,463	10,824	46,193	9,239	54,121
0.4	26,791	18,754	26,661	10,665	46,884
1	54,909	38,436	13,009	13,009	38,436
2	100,906	70,634	7,079	14,157	35,317
3	154,213	107,949	4,632	13,895	35,983
4	214,153	149,907	3,335	13,342	37,477
5	262,885	184,020	2,717	13,586	36,804

4.9 Subsidy Regime and Development of Low Cost "Innovative Drip" Technologies

Faced with the problems of high cost or non- availability of subsidized drip, and following on the model of low cost Krishak Bandhu (KB) "drip" promoted by IDEI, several improved and "hybrid" variants of "drip" systems have been introduced in the market both by established and lesser known manufacturers. These systems generally use better quality pipelines than the KB drip and rather than punching holes manually in the pipeline as is done in KB pipes, these pipelines come fitted with "chapins" which act as drippers and are more efficient and apply water more uniformly. These chapin cost between INR 3.00 to INR 3.50 per meter as compared to INR 1.00 per meter for a KB pipe. Although more expensive than the KB pipe they last for 3-4 years as compared to 1-2 years for a KB pipeline. Although not as efficient and convenient to use as a high cost drip fitted with pressure pumps, filters and venturi, these chapin fitted pipelines can serve nearly the same purpose as an expensive drip system. These pipelines do not carry any government subsidy or support and are freely available in the market. Since according to official statistics such systems are not counted as "drip" systems, information on extent of their use and adoption is not collected. During our field work in the study region we also could not collect any data although we did get an impression that their adoption has so far been relatively slow as compared to the potential because they were introduced only about 2-3 years ago. Farmers prefer to wait for their turn for a subsidy for an expensive system.

If the government were to withdraw subsidies on drip systems it is quite possible that similar new and less expensive innovative models will get developed and adopted by

farmers who cannot otherwise afford to invest in an expensive system. These "not so perfect" drip systems serve almost the same purpose of enabling a farmer to more efficiently use the available water for productive purposes. The efficiency of water use may or may not be as good as with a better designed drip systems, but we need to carefully weigh the benefits foregone in terms of the extent of water savings and impact on crop yields through use of innovative low cost drip systems as compared to an expensive drip system and the costs associated with administering subsidies.

5. Summing Up

There is an increasing emphasis on conserving water and using it more efficiently. Micro irrigation technologies based on drip and sprinkler irrigation systems provide some hope for achieving this. The government has been providing substantial financial incentives in the form of capital cost subsidies to farmers to invest in these technologies. The present system of subsidy delivery, besides breeding inefficiencies and encouraging corrupt business practices, has distorted the market for drip irrigation and stifled the inertia of developing aggressive marketing strategies and investing in development of alternative product designs by manufacturers. Most drip equipment sales in the study area of Madhya Pradesh are subsidy driven. Manufacturers and market estimates suggest that more than 95% of the drip sales are subsidy linked. Partly as a result of the existing subsidy delivery mechanism, drip technology has failed to capture the kind of market that would have been expected given the many advantages and water saving potential the technology offers.

Given the high benefit-cost ratios, both financial and social, of investing in drip technology and given the high upfront cost we feel that continued government support for promotion and wider adoption of drip technology is required at least for some more years. We also find that the present form for delivery of public support in the nature of a capital cost subsidy is constraining both to the widespread adoption of the technology by farmers and to innovation in technology development and marketing. This has made the entire gamut of manufacturing, sales, adoption, and use of drip technology subservient to government support. The present study has put forward an alternate system wherein the subsidy is given directly to farmers willing to invest in a drip system. With a given amount of funds available, the proposed model can provide subsidies to a much larger number of farmers, can bring a much larger area under drip irrigation resulting in lower subsidy outgo per hectare of drip irrigated area, would still incentivise the farmers to invest in drip systems, lower the cost of subsidy outgo, be more transparent, less prone to corruption, easy to manage and govern, less prone to interference and whims and fancies of officials, and lead to more efficient use of available subsidy without distorting the market. Thus, on all indicators, the proposed subsidy scheme of direct delivery far outweighs the existing subsidy scheme of subsidizing the manufacturers in the name of the farmers.

Appendix 1. District percent of beneficiaries using drip irrigation.

District	2006-07 Beneficiaries		2007-08 Beneficiaries		2008-09 Beneficiaries		2009-10 Beneficiaries	
	No	%	No	Per cent	No	Per cent	No	%
Anupur	0	0.0	0	0.0	0	0.0	22	0.2
Ashoknagar	0	0.0	0	0.0	14	0.1	34	0.3
Badwani	39	8.7	205	8.4	932	9.4	1253	10.0
Balaghat	0	0.0	1	0.0	6	0.1	22	0.2
Betul	3	0.7	49	2.0	179	1.8	134	1.1
Bhind	0	0.0	0	0.0	0	0.0	0	0.0
Bhopal	10	2.2	42	1.7	28	0.3	28	0.2
Burhanpur	142	31.7	315	13.0	1309	13.2	1593	12.7
Chhatarpur	3	0.7	6	0.2	10	0.1	24	0.2
Chhindwara	0	0.0	25	1.0	234	2.4	230	1.8
Damoh	2	0.4	11	0.5	6	0.1	141	1.1
Datia	0	0.0	0	0.0	0	0.0	30	0.2
Dewas	0	0.0	31	1.3	329	3.3	545	4.3
Dhar	12	2.7	333	13.7	1884	19.0	2231	17.8
Dindori	0	0.0	0	0.0	0	0.0	3	0.0
Guna	1	0.2	4	0.2	3	0.0	2	0.0
Gwalior	0	0.0	2	0.1	9	0.1	7	0.1
Harda	0	0.0	18	0.7	75	0.8	25	0.2
Hoshangabad	15	3.3	2	0.1	2	0.0	0	0.0
Indore	4	0.9	112	4.6	415	4.2	586	4.7
Jabalpur	0	0.0	3	0.1	2	0.0	13	0.1
Jhabua	33	7.4	115	4.7	240	2.4	228	1.8
Katni	0	0.0	0	0.0	1	0.0	1	0.0
Khandwa	45	10.0	146	6.0	367	3.7	261	2.1
Khargone	0	0.0	423	17.4	2278	23.0	2750	21.9
Mandia	0	0.0	0	0.0	18	0.2	30	0.2
Mandsaur	0	0.0	20	0.8	54	0.5	106	0.8
Morena	0	0.0	1	0.0	0	0.0	2	0.0
Narsinghpur	0	0.0	0	0.0	29	0.3	30	0.2
Neemuch	0	0.0	12	0.5	34	0.3	61	0.5
Panna	0	0.0	1	0.0	11	0.1	46	0.4
Raisen	0	0.0	22	0.9	11	0.1	7	0.1
Rajgarh	0	0.0	21	0.9	60	0.6	57	0.5
Ratlam	121	27.0	282	11.6	854	8.6	1309	10.4
Rewa	0	0.0	4	0.2	0	0.0	58	0.5
Sagar	0	0.0	2	0.1	53	0.5	240	1.9
Satna	0	0.0	0	0.0	22	0.2	31	0.2
Sehore	0	0.0	0	0.0	23	0.2	56	0.4
Seoni	2	0.4	4	0.2	6	0.1	3	0.0
Shahdol	0	0.0	0	0.0	4	0.0	39	0.3
Shajapur	0	0.0	138	5.7	168	1.7	86	0.7
Sheopur	0	0.0	3	0.1	0	0.0	6	0.0
Shivpuri	0	0.0	1	0.0	13	0.1	22	0.2
Sidhi	0	0.0	0	0.0	0	0.0	4	0.0
Tikamgarh	0	0.0	3	0.1	11	0.1	29	0.2
Ujjain	16	3.6	44	1.8	177	1.8	99	0.8
Umaria	0	0.0	2	0.1	6	0.1	8	0.1
Vidisa	0	0.0	28	1.2	36	0.4	41	0.3
Total State	448	100.0	2431	100.0	9913	100.0	12533	100.0

Source: Department of Horticulture, Govt. of Madhya Pradesh.

Appendix 2. Process for implementation of micro irrigation scheme

The Block Development Officer will receive Gram Sabha approved applications with the required documents on basis of **"first come first served"** basis, from the farmers interested in availing benefit under the scheme through Village Horticulture Extension Officer, Horticulture Development Officer and other sources such as regional workers/dealers of registered manufacturing companies.
Action: Block Development Officer

At Block Development level, the compiled applications will be put in a register according to priority and registered number and date will be assigned. The registration number and date will be informed to beneficiary in written. **(Form-One)**
Action: Block Development Officer

Within three days of receiving the application, a visit to farmer's field will be made with Village Horticulture Extension Officer to confirm the information entered in application and field notes will be compiled in a folder. **(Form-Two)**
Action: Block Development Officer
Time Limit: Three days

After the field visits, the applications will be arranged in an ordered list and sent to District Horticulture Office along with application form-three. A copy of list and application will remain with Block Development Officer. **(Form-Three)**
Action: Block Development Officer
Time Limit: Four days

At district level, development block wise received list will be registered and kept in same order in block wise registers. From every Block Development list each application will be accepted in order.
Time Limit: Three days
Action: Member Secretary, District Micro Irrigation Committee (DMIC)

The estimation of proposed area and cost will be made according to received applications, district level integrated Action Plan will be formulated and District Micro Irrigation Committee's sanction proposal will be sent to State Micro Irrigation Committee.
Time Limit: Ten days
Action: Member Secretary, State Micro Irrigation Committee (SMIC)

On the basis of district level Action Plans, state level Action Plan will be prepared and after approval from State Micro Irrigation Committee (SMIC) will be sent to central government's Department of Agriculture & Cooperation, New Delhi.
Time Limit: Ten days
Action: Member Secretary, State Micro Irrigation Committee (SMIC)

Part-Two

The information received about district wise Action Plan approved by central government's Department of Agriculture & Cooperation will be shared with DMIC.
Time Limit: Three days
Action: Member Secretary, State Micro Irrigation Committee (SMIC)

(a) After receiving information about approved Action Plan for district, each block wise registered application will be forwarded to manufacturing companies which were selected by farmers for survey drawing/design etc., in an order. **(Form- Four)**
Time Limit: Three days
Action: Member Secretary, District Micro Irrigation Committee (DMIC)
(b) After getting the approval from the bank, bank loan application will be send to the micro irrigation Company for the further required action.

Micro Irrigation Company will prepare drawing, design, etc. of the farmer's field in which system has to be established and make them available to Block Development Officer and Senior Horticulture Development Officer.
Time Limit: Three days
Action: Micro Irrigation Company

After receiving documents from Micro Irrigation Company, Block Development Officer will visit concerned farmer's field and will make initial physical verification of irrigation water and available energy for the proposed system which is to be established.
After initial physical verification, required documents along with recommendation of Block Development Officer should be sent to Member Secretary, DMIC. **(Form: Five)**
Time Limit: Three days
Action: Block Development Officer

After receiving approved applications from Block Development Officer within stipulated time limit, Member Secretary, DMIC will issue administrative approval and give work orders to micro irrigation Company to accomplish work. **(Form- Six)**
Time Limit: Three days after receiving applications
Action: Member Secretary, District Micro Irrigation Committee (DMIC)

After receiving work direction from Member Secretary, District Micro Irrigation Committee (DMIC), Micro Irrigation Company will establish system in working condition at the site selected by concerned farmer. It will give required training to farmer and manual in Hindi. The satisfaction certificate will then be obtained from farmer should be sent to Member Secretary along with bills. **(Form- Seven)**
Time Limit: Seven days
Action: Micro Irrigation Company

After receiving information about system establishment from micro irrigation companies, group of nominated officers from DMIC will physically verify the established system and report will be presented in prescribed form. After receiving correct physical verification report, the approved grant payment will be issued in prescribed form **(Form-Nine)** and action for payment will be ensured. **(Form- Eight)**
Time Limit: Ten days
Action: Nominated Group for physical verification

Note: (1) The process of making payments to the suppliers of materials under scheme should be made after physical verification and other necessary formalities have been completed. The payment should be made according to priority.
(2) During physical verification concerned officials will see that system has been established according to the drawing/design presented initially by micro irrigation Company. The standard material has been provided in prescribed quantity. The distribution of irrigated water is uniform at all the places. The farmer has been trained to operate the system, maintain it etc. and manual in Hindi has been provided.
If during physical verification the facts are presented showing incomplete provision of system and supply of non-standard material, Member Secretary will have a responsibility to inform micro irrigation Company that it should establish the system according to the presented proposal. The physical verification of system should be done again before taking action to make payment to company.
Time Limit: 3 days
Action: Member Secretary, DMIC

It will be responsibility of Head, DMIC that the above action is taken in stipulated time.
Action: Head, DMIC
The person getting benefit out of micro irrigation scheme has to submit an affidavit on a 5 rupees stamp paper along with the necessary forms to the Assistant Director, Horticulture, Joint Member Secretary, District Micro Irrigation Committee declaring that he will not transfer the drip/sprinkler system to any other farmer neither sell it. **(Form- Ten)**
Action: Beneficiary
Answerable: Block Development Officer

The beneficiaries of this scheme will have to give in written that they or any member of their family (if combined) has not taken benefit from any Govt/ state Govt scheme of providing drip/sprinkler for irrigation. **(Form- Eleven)**
Action: Beneficiary
Answerable: Block Development Officer

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