IWMI Working Paper

151

AgWater Solutions Project
Country Synthesis Report

Investing in Agricultural Water Management to Benefit Smallholder Farmers in Madhya Pradesh, India

Alexandra E. V. Evans, Meredith Giordano and Terry Clayton, Editors

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Improved livelihoods for smallholder farmers

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Project

The AgWater Solutions Project was implemented in several countries in Africa and Asia between 2009 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 smallholder farmers. This report synthesizes the research findings and contributions made by the team and stakeholders in Madhya Pradesh, India, over the project period.

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

For more information on the project or for detailed reports, please visit the project website (http://awm-solutions.iwmi.org/home-page.aspx) or contact the AgWater Solutions Project Secretariat (AWMSolutions@cgiar.org).

Contents

Summary

This Working Paper summarizes research conducted as part of the AgWater Solutions Project in the State of Madhya Pradesh, India, from 2009 to 2012. Agriculture accounts for 21% of the gross domestic product (GDP) of Madhya Pradesh and state agriculture contributes substantially to India's total annual wheat, pulses and soybean production. While the incidence of poverty has declined, it remains well above the national average of 21%.

Researchers from the AgWater Solutions Project explored rainwater harvesting, drip irrigation and how investors might leverage the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). Research methodologies included rapid rural appraisals, interviews, survey questionnaires and literature reviews.

The main findings indicate that: 1) small private rainwater harvesting structures would increase farm incomes, but development requires more flexible financing options for smallholder farmers; 2) replacing the current subsidy system with interest-free loans would be cheaper for the government, give farmers more choice and stimulate private sector innovation in drip irrigation; and 3) farmers would like more involvement in the decision-making processes of the MGNREGS, which already funds thousands of agricultural water management structures every year. Soft loans and pump rental markets for water-lifting and distribution systems would stimulate further development.

INTRODUCTION: SMALLHOLDER AGRICULTURAL WATER MANAGEMENT

Across Africa and Asia a growing number of smallholder farmers are finding ways to better manage water for agriculture to increase yields and income, and diversify their cropping and livelihood options. Farmers buy or rent irrigation equipment, draw water from nearby sources, and individually or collectively build small water storage structures. This development is often overlooked by external investors, yet the smallholder agricultural water management (AWM) sector is contributing to food security, rural incomes, health and nutrition. While small-scale AWM practices could potentially benefit hundreds of millions of farmers, this potential is far from being realized.

The AgWater Solutions Project examined this trend together with the opportunities and constraints associated with smallholder AWM in two states in India, Madhya Pradesh and West Bengal, and five countries in Africa, Tanzania, Burkina Faso, Ghana, Ethiopia and Zambia. Through this, the project identified a number of ways in which the sector's potential can be realized, including:

- **Building supportive institutional structures:** Existing governing bodies typically cater for public irrigation systems and are often not adapted to capitalize on the opportunities and to handle the challenges posed by this alternative mode of irrigation development. Traditional agricultural institutions rarely focus on market-oriented smallholder crop production, such as high-value vegetable production in the dry season.
- **Overcoming value chain inefficiencies:** Market inefficiencies negatively affect farmer decision-making and technology access. Inefficiencies include: poorly developed supply chains; high taxes and transaction costs; lack of information and knowledge on irrigation, seeds, marketing and equipment; and uneven information and power in output markets.
- **Improving access to technology for all sectors of society:** Better-off farmers have greater access to information and technology than their poorer counterparts and women who face several hurdles: high upfront investment costs, absence of financing tools, and limited access to information to make informed investment and marketing choices.
- **Managing potential trade-offs:** While smallholder AWM can be beneficial for an individual farmer, its uncontrolled spread can have unexpected consequences. If not managed within the landscape context, the many small dispersed points of water extraction, can negatively impact downstream users and cause environmental damage.

Addressing these challenges requires a fresh look at new and existing AWM technologies, products and practices to enhance the potential of the smallholder AWM sector and find solutions.

WHY INVEST IN SMALLHOLDER AWM IN MADHYA PRADESH?[1]

Madhya Pradesh covers an area of 30.8 million hectares (Mha) (9.4% of the geographical area of the country) and has a population of 60.38 million, which constitutes nearly 6% of the country's population (Government of India 2001).

[1] Based on AgWater Solutions Project 2010.

The incidence of poverty in Madhya Pradesh has declined, but with about 38% of people living below the official poverty line it is well above the national average of 21% (Department of Agriculture and Cooperation 2010). According to Ray et al. (2009), "between 55 to 63 per cent of the population in MP also suffer from `food-inadequacy'." Nearly three-quarters of the rural population depend on agriculture (Government of India 2001).

Agriculture accounts for 21% of the gross domestic product (GDP) of Madhya Pradesh (Department of Agriculture and Cooperation 2010). Wheat, paddy, oilseeds, maize and pulses are the most important crops. The state produces 10% of India's wheat, 23% of pulses (40% of gram) and 25% of oilseeds (55% of soybean). Madhya Pradesh has 7.36 million operational landholdings. Of this, 65% of individual landholdings are defined as small (1-2 hectares (ha)) or marginal (less than 1 ha), but the total area covered by small and marginal landholdings is only 26% of the operated area. Of the 15 Mha of net sown area, about 38% is irrigated, while the proportion of gross irrigated area to gross cropped area is about 30%. Surface water sources account for less than 20% of the net irrigated area and the remainder is contributed by groundwater (Commissioner Land Records & Settlements 2001).

There are 11 agro-climatic zones in the state, each with a unique set of resources and topography; some have sufficient groundwater, others have over-exploited groundwater resources; some are hilly while others are flat. Therefore, a variety of AWM options tailored to local conditions are needed. Various policies support AWM, including the Madhya Pradesh Irrigation Acts of 1931, 1976 and 1990; the Science and Technology Policy, 2007; and the State Water Policy, 2003.

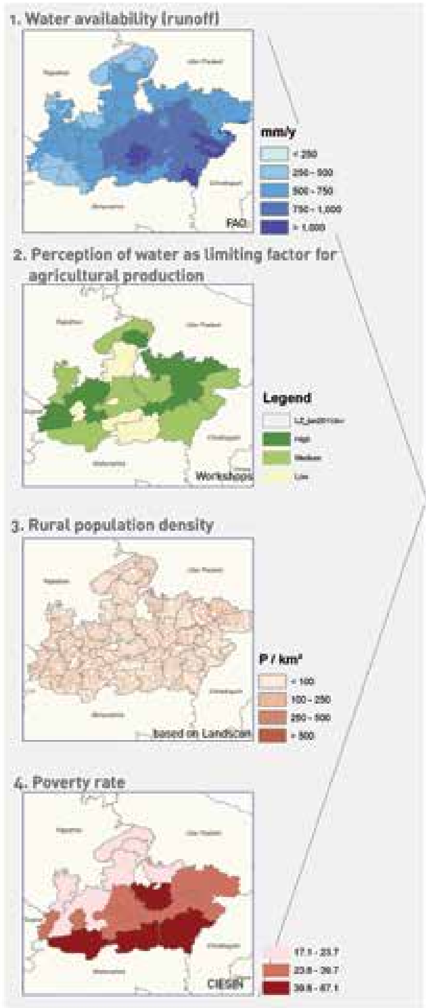
The opportunities for AWM come not only from land and water availability and a supportive policy environment (Ray et al. 2009), but also from the need for the enterprise of farmers and NGOs to introduce AWM initiatives, including rainwater harvesting, motor pumps, treadle pumps and gravity irrigation systems.

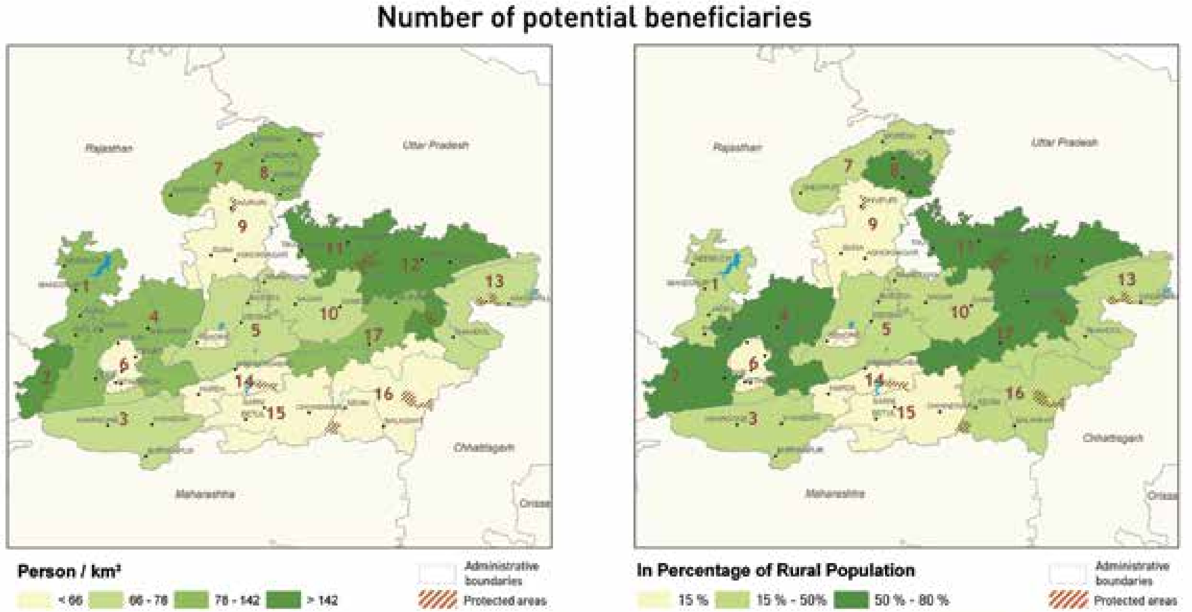
The Agwater Solutions Project mapped the potential for AWM to improve the livelihoods of smallholder farmers in Madhya Pradesh and found that just over 26 million people (just over half the rural population) could benefit from agricultural water management (Figure 1).

AWM Investment Options in Madhya Pradesh

The AgWater Solutions Project identified many existing AWM practices that could support the realization of this estimate that just over 26 million people could benefit from AWM in Madhya Pradesh. In Madhya Pradesh, the project initially considered technologies (e.g., rainwater harvesting, drip irrigation and water-lifting technologies) as well as supporting institutional structures (e.g., access to credit and market accessibility, synergies with poverty alleviation programs, and promotion of farmer and community organizations). After consultation with a variety of stakeholders, rainwater harvesting, drip irrigation and synergies with the MGNREGS were selected for research. A series of recommendations were made as to how to increase smallholder farmers' adoption and sustained use (Table 1).

FIGURE 1. Potential for AWM to improve livelihoods of smallholder farmers.





Livelihood zone		Water availability: IRWR/cp (m³/p/y)	Rural population			Perception of water as limiting factor for agricultural production	Potential beneficiaries	
No	Name		Total (,000)	Density (p/km²)	poverty rate		Person (,000)	in % of rural population
1	North Malwa-Chittor zone - Opium-silica production	3,062	2,476	188	22.3	Medium	1,238	50%
2	Western Malwa Hill Zone - Bhil tribe predominant	2,494	1,379	211	31.2	High	1,103	80%
3	Nimar Plains Zone - Hot dry Cotton Chilli Banana Sugarcane	3,148	3,797	163	67.1	Medium	1,899	50%
4	Malwa Plateau plain zone - Traditional agriculture (spices production)	3,098	5,764	187	23.7	High	4,611	80%
5	Eastern malwa extension zone - quality wheat and pigeonpea production	6,099	3,112	137	34.1	Medium	1,556	50%
6	Industrial/Urban Sub Zone of Malwa (Indore and Bhopal)	4,147	1,059	207	34.7	Low	159	15%
7	Northern Chambal Ravines Zone - Irrigated mustard predominant	2,602	2,787	186	20.8	Medium	1,393	50%
8	Gwalior Zone - Pastoral and dry degraded mining area	2,991	1,203	190	20.9	High	962	80%
9	South Chambal Zone - Progressive farming, wheat-soya	4,670	2,722	132	17.1	Low	408	15%
10	Lower Bundelkhand: low socioeconomic development, low productivity wasteland	5,390	2,560	152	53.5	Medium	1,280	50%
11	Upper Bundelkhand: low socioeconomic development, low productivity wasteland	3,882	2,493	193	23.1	High	1,994	80%
12	Western Baghelkhand - Forest, game reserve and energy production	3,784	4,640	199	28.9	High	3,712	80%
13	Eastern Baghelkhand - Forest, game reserve and energy production	5,713	2,820	145	34.9	Medium	1,410	50%
14	Central Narbada Sub Zone: Irrigated intensive agriculture production (horticulture)	7,032	1,273	136	39.7	Low	191	15%
15	Satpura Hills Mahakaushal: tribal forest gatherers and dry land farmers	6,205	2,793	133	48.4	Low	419	15%
16	Mahakaushal Maikal Hill: forest, water rich, subsistence (millet) tribal zone	7,187	4,137	134	47.4	Medium	2,069	50%
17	Upper Narbada: mixed commercial tribal farmers, industrial activities	5,068	2,651	190	35.7	High	2,121	80%

Source: FAO 2012a.

TABLE 1. Review of AWM options, recommendations and potential beneficiaries.

AWM option	AWM investment opportunity	Beneficiary households (% of rural households)*	Area in hectares (% of total agricultural land)*	Estimated investment costs (USD)
Rainwater harvesting (Rewa Sagar and field bunding)	*Benefits from decentralized rainwater harvesting (Rewa Sagar) include dry-season cultivation, agricultural diversification and groundwater recharge.* However, upfront investment costs limit investments by smallholder farmers and state subsidies are limited. New forms of financing, e.g., interest-free loans, could enhance the spread of this AWM solution.	270,000-1.2 million (up to 3%)	400,000-1.9 million (2-11%)	0.75/cubic meter (m^3) of water stored
		1.6-2.2 million (3-4%)	3.6-4.9 million (21-29%)	300/ha
MGNREGS	*MGNREGS funds thousands of AWM structures, including wells and ponds, every year.* However, to make use of the wells and ponds, farmers need pumps and water distribution systems. Soft loans or pump rental markets, and greater farmer involvement in the MGNREGS decision-making process, could enhance the benefits of the Scheme.	See above	See above	See above
Drip irrigation	*Drip irrigation makes efficient use of scarce water. It can achieve up to 95% water-use efficiency, enables fallow land to be cultivated and higher-value horticultural crops to be grown.* However, adoption of this AWM solution has been slow. The subsidy system is cumbersome, involves middlemen and farmers have limited choice. Replacing the subsidy with interest-free loans would be cheaper, gives the farmer flexibility and stimulates private sector innovation.	Not calculated	Not calculated	NA

Source: This study; all data: FAO 2012a.

Notes: * Figures assume that out of the total potential beneficiary households calculated, 50% adopt the AWM option; NA - Not available at the time of publication.

These findings are derived from an approach that combines primary and secondary data collection, stakeholder involvement and mapping. Details of the approach taken by the AgWater Solutions Project and the related studies are given in Box 1 and elaborated in subsequent chapters. Further information, including case studies and mapping data can be found on the project website (http://awm-solutions.iwmi.org).

Box 1. AgWater Solutions Project approach.

Situation analysis and selection of AWM options: An initial analysis was undertaken of the conditions in each country and the AWM practices already being undertaken. These were reviewed with stakeholders and some of the most promising practices were selected.

Field-scale and community-level case studies: Researchers used a participatory opportunity and constraint analysis and methodology to understand the complex interaction among social, economic and physical factors that influence the uptake and success of AWM options, and to identify technologies appropriate to different contexts in each of the project countries.

Watershed-level case studies: Researchers used a multi-disciplinary approach to look at how the natural resource base impacts on, and is impacted by, AWM in four watersheds in Tanzania, Burkina Faso, West Bengal (India) and Zambia. The analysis concentrated on the hydrological impact of current and potential AWM interventions; the current resource-based livelihoods and dependencies on sources of water and water management practices; an impact assessment of potential AWM scenarios; and a review of formal and informal institutional capacity to deal with AWM interventions and potential emerging externalities.

National AWM mapping: Maps were developed to help assess where AWM will have the greatest impact within a country or state, and where specific interventions will be most viable. The steps followed were to use a participatory process in which experts defined the main livelihood zones based on farming typologies and rural livelihood strategies, and the main water-related constraints and needs in the different rural livelihood contexts. Using this, the potential for investment in water to support rural populations could be mapped based on demand and availability of water. A further step was to map the suitability and demand for specific AWM interventions, such as motor pumps or small reservoirs, and to estimate the potential number of beneficiaries, application area and investment costs. These allow investors to choose entry points and prioritize investments in AWM that will have the most beneficial impacts on rural livelihoods.

Regional AWM analysis: Researchers used geographic information system (GIS)-analysis, crop mix optimization tools and predictive modeling techniques to assess the regional potential for the 'best-bet' AWM technologies in South Asia and sub-Saharan Africa in terms of: potential application area (in hectares), number of people reached, net revenue derived and water consumption. Scenarios were also developed to factor in climate change and potential changes in irrigation costs.

Stakeholder engagement and dialogue: An integral part of the entire project was the engagement of stakeholders from the initial assessment of AWM opportunities through to the identification of possible implementation pathways. The dialogue process was used to ensure that project results reflected stakeholder perceptions and addressed their concerns. National and sub-national consultations, dialogues, surveys and interviews were fed into all stages of the project.

AWM OPTIONS REVIEWED

Decentralized Rainwater Harvesting[2]

Encouraging smallholders to build their own tanks to conserve monsoon rainwater for irrigation has resulted in considerable benefits in parts of Madhya Pradesh.

Where the opportunity lies

Surface water sources are used on less than 20% of the net irrigated area of the state, but groundwater is not available in some areas and groundwater levels are declining in other areas due to over-abstraction and insufficient recharge. That leaves large areas where rainwater harvesting could make a good investment (Box 2).

> **Box 2. What is rainwater harvesting?**
>
> Rainwater harvesting is the collection and storage of rainwater for productive use and recharge. Rainwater harvesting structures can be built and owned by individuals or communities, and can be of any size and shape.
>
> Individual structures include small ponds, shallow wells and tanks taking up one-fifteenth to one-tenth of a farmer's land.

The research

A number of organizations are promoting rainwater harvesting in many places in India. This study focused on the Dewas District, where, in 2006, the District Collector launched a campaign to promote rainwater harvesting amongst farmers. The initiative quickly took hold and became the Rewa Sagar Bhagirath Farmers' Movement.

Researchers from the AgWater Solutions Project conducted interviews with government officials and a random sample of 90 farmers who practice rainwater harvesting for irrigation and 30 who do not.

How farmers benefit

- **Costs:** The cost of constructing rainwater harvesting structures varies with size. On average, farms are 2 ha, for which a typical water storage structure would have a surface area of 1,780 square meters (m^2) and a depth of 2.20 meters (m). The average cost of building a structure of this size is INR 135,580 (USD 2,600). More than 5,000 tanks have

[2] This section is based on Malik et al. 2011; and AgWater Solutions Project 2011a.

been constructed in Dewas District. The payback period is just three years and the cost-benefit ratio is 1.5-1.9.

- **Financial:** After accounting for the loss due to converting 1,780 m^2 of agricultural land into a rainwater harvesting structure, the net increase in income per household is approximately INR 33,144 (USD 637).
- **Water use:** Rainwater is stored for 6-7 months mainly for use in the dry season. The water can also be used for supplemental irrigation during the monsoon season.
- **Cultivation patterns:** The proportion of area cultivated during the dry season has increased from about 23% to 95% (Figure 2), and annual cropping intensity on the fields of farmers who have adopted the technology has increased from about 122% before construction to about 196% afterwards.
- **Livestock:** Numbers have increased and herd quality has improved, because more wheat straw and water are available and farmers are using profits to invest in improved breeds. Milk production has increased by 34% in Khategaon and 11% in Tonk Khurd.
- **Fish farming:** is possible, but not done for religious reasons in the study locations.
- **Irrigation costs:** less pumping translates into cost savings for farmers.
- **Groundwater:** Anecdotal evidence suggests that groundwater tables are rising.
- **Reduced conflict:** Rainwater harvesting structures on private land mean fewer conflicts over water sharing.

Where to invest

There are an estimated 58,000 smallholder landholdings (farm size of 1-3 ha) in Dewas District that are either entirely un-irrigated or partly irrigated and could benefit from rainwater harvesting (Table 2). If 10% (5,800) of these smallholders installed rainwater harvesting structures then the net increase in income would be INR 637 million (USD 12.25 million).

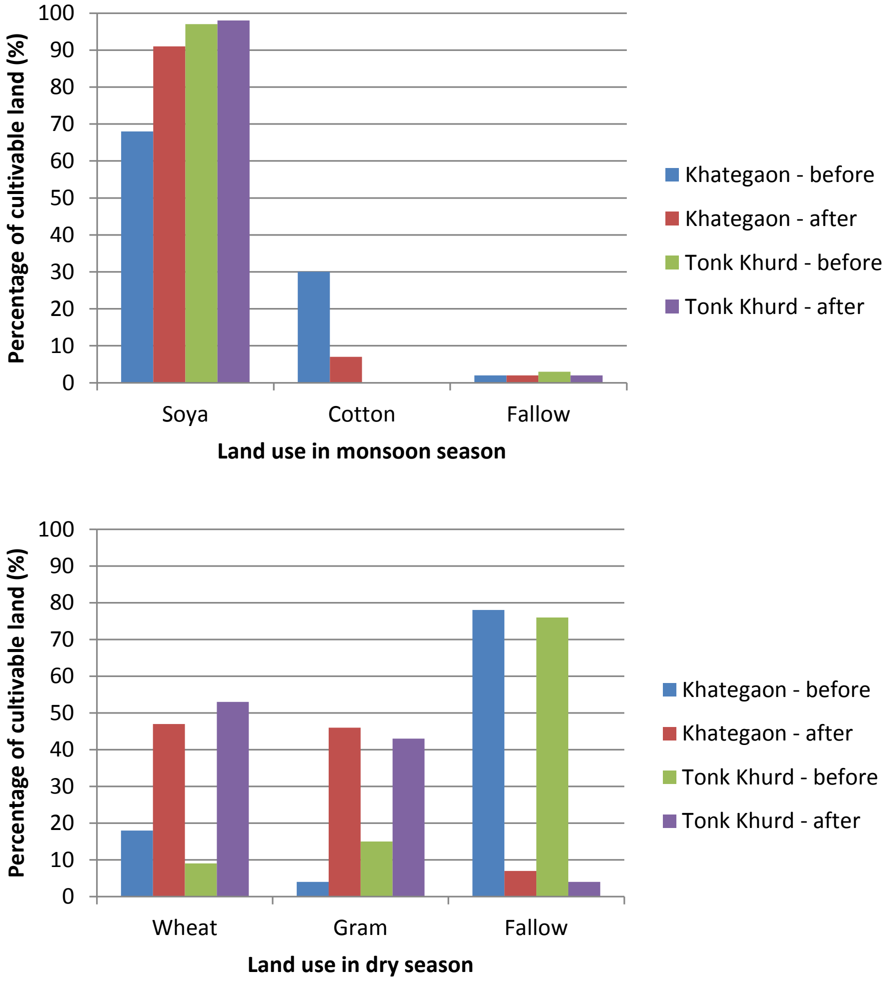
TABLE 2. Calculation of costs and benefits of on-farm rainwater harvesting.[3]

	Approximate value per farm (USD)
Cost of one structure	2,465
Increase in net value of crop output per farm	557
Increase in net value of milk per year	104
Increase in net value of crop and milk output	661
Loss in annual crop production (for land use for rainwater harvesting)	58
Net increase in income	603

Source: Malik et al. 2011.

[3] Calculation based on a 2-ha farm with a rainwater harvesting structure covering 8.8% of the land and harvesting 3,920 m^3 of water per year.

FIGURE 2. Land use in monsoon and dry seasons before and after constructing rainwater harvesting structures.



Source: Malik et al. 2011.

To realize this potential, investments in financial arrangements and extension offer the most immediate and long-term benefits.

Extension services are required to raise interest in rainwater harvesting, to allay fears, for example, about the need to take land out of agricultural production, and to demonstrate the benefits. Actions should include the following:

- Identifying potential areas for rainwater harvesting with biophysical conditions similar to Dewas District.
- Showing farmers, through demonstrations and field visits, the benefits of building their own tanks and giving them information.
- Garnering the support of the district administrations. A responsive, understanding and supportive local-level bureaucracy is absolutely essential.
- Providing technical support, such as engineering expertize and construction advice.
- Providing extension support to increase outputs, for example, advice on which crops to grow, water requirements, and fisheries and livestock production.

Financial support is required because the capital cost of around USD 2,600 prevents many farmers from investing in rainwater harvesting. Training and raising awareness are needed to overcome certain concerns, such as the reluctance to take land out of production to build a pond.

Some of the financial options that could be pursued are as follows:

- Treat rainwater harvesting structures as part of the agricultural loan portfolio.
- Micro-credit, cooperative banks and the donor community could offer loan guarantees or revolving lines of credit.
- An appropriate subsidy could be offered to compensate farmers partially for the high cost of building rainwater harvesting structures. The existing government subsidy should be increased and made easily available.
- Financing could be provided under MGNREGS or other relevant programs. Civil society and *panchayats* (village-level institutions) need to be informed about how to obtain support.

The AgWater Solutions Project calculated that, if 5,800 farmers invested in decentralized rainwater harvesting, the increase in the annual gross value of crop and milk output in Madhya Pradesh would be INR 365 million (USD 7 million). This is a major incentive for the government and donor investment. The state government currently offers a subsidy, but it is not providing the desired result in terms of the number of farmers reached. Alternative models, including loans, could result in wider adoption of the AWM technology and lower costs to the government (Box 3).

Box 3. Financing through loans and subsidies.

Researchers from the AgWater Solutions Project proposed three models for financing 5,800 individual rainwater harvesting structures which cost INR 135,580 (~USD 2,600) each (Table 3). The total investment is INR 786 million (~USD 15 million).

Model 1: assumes that neither government subsidies nor loans from financial institutions would be forthcoming and the donors (private foundations, national or international development assistance agencies) would be willing to lend the money to bridge the financing gap.

Model 2: assumes that the government subsidy will continue to be made available, but loans from financial institutions will not be forthcoming.

Model 3: assumes that both government subsidies and loans, each subject to a financial ceiling of INR 50,000 per structure, will be available. Currently, India’s public sector banking system treats loans for rainwater harvesting structures as commercial loans, with a

(Continued)

Box 3. Financing through loans and subsidies (Continued).

higher interest rate than the concessionary rate offered for other types of agricultural loans such as crop loans. If the government can encourage financial institutions to treat lending for investment in rainwater harvesting structures as a priority and make smallholder farmers eligible for loans of INR 50,000 (< USD 1,000) then the financial gap is reduced substantially to INR 49 million.

TABLE 3. Model scenarios (values in INR millions unless stated otherwise).

	Model 1 No subsidy	Model 2 Subsidy	Model 3 Subsidy + loans
Total investment requirement	786	786	786
Farmer's contribution (20%)	157	157	157
Government subsidy (INR 50,000 per structure)	0	290	290
Loans from financial institutions (INR 50,000 per structure)	0	0	290
Financial requirements from donors	629	339	49
Equivalent (in USD millions)	12	6.5	0.9

Source: Malik et al. 2011; and AgWater Solutions Project 2012b.

Who benefits and where

Rainwater harvesting is a good investment in areas where there is high vulnerability to droughts and where groundwater resources are unavailable or are totally or partially depleted. It is appropriate where there is sufficient slope, vertisols and over 1,000 millimeters (mm) of rainfall each year (Figure 3). In general, the western part of the state and some central and southern areas are appropriate. Rainwater harvesting is not suitable in the northeast. Where soils are permeable, low-cost linings may be suitable.

The AgWater Solutions Project estimated that, at a 50% adoption rate, rainwater harvesting could benefit 269,000 to 1,293,000 households. This equates to 0.5-2.6% of rural households. The potential application area is 404,000-1,939,000 ha, or 2.4 to 11% of the total agricultural land area.

Stakeholder recommendations.
When stakeholders in selected areas of Madhya Pradesh (Indore, Ujjain, Bhopal, Sagar and Jabalpur divisions) were consulted about rainwater harvesting, including Rewa Sagar decentralized ponds and bunding, the following feedback was given:

- Research carried out by the project found that farm ponds are most suited to Indore, Bhopal, Ujjain and Sagar divisions while field bunding and other rainwater harvesting

(Continued)

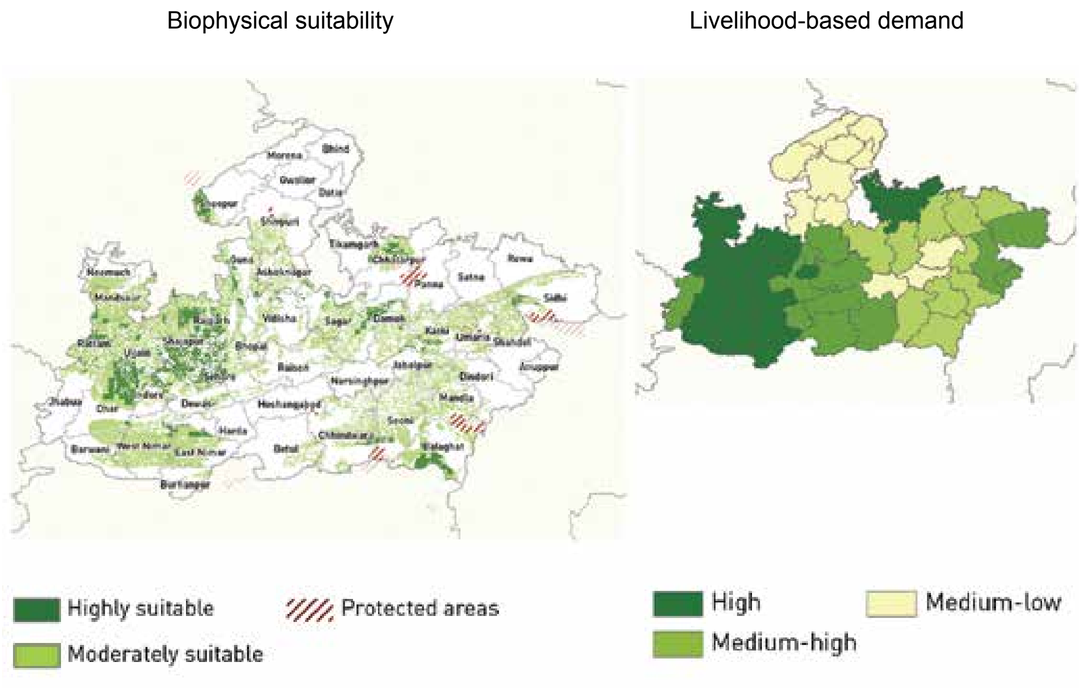
Stakeholder recommendations (Continued).

options are suitable for Jabalpur and the undulating regions of other divisions. However, not all district authorities or farmers share this opinion. Further investigation needs to be carried out to understand these concerns.

- Field bunding is best suited to areas where the slope gradient is low, e.g., Sagar, Khurai, Patera, Rahatgarh and Banda in the Sagar District, and Hatta and Patera in the Damoh District (under the Sagar Division). In the Indore Division, field bunding is practiced in the southern tribal region in Jhabua, Dhar and Alirajpur districts.
- Stakeholders felt that Rewa Sagar may not be suitable in areas of rugged terrain (e.g., Bundelkhand), and as a result are only suitable in one-third of the region.
- In other areas, highly permeable soils limit the use of farm ponds. In this case, low-cost options include lining ponds with black soil as a base layer and gradually building up a layer of clay, which results in an impermeable bottom over 2-3 years. Even if it takes longer to realize the benefits of rainwater harvesting ponds, this option is still competitive since alternatives are much more costly.
- Participants suggested that building rainwater harvesting ponds should be compulsory on farms larger than 5 ha, which depend exclusively on deep tube wells. This would decrease pressure on groundwater resources and enable recharge.

Source: FAO 2012b.

FIGURE 3. Suitable locations for rainwater harvesting.



Source: FAO 2012a.

Mahatma Gandhi National Rural Employment Guarantee Scheme[4]

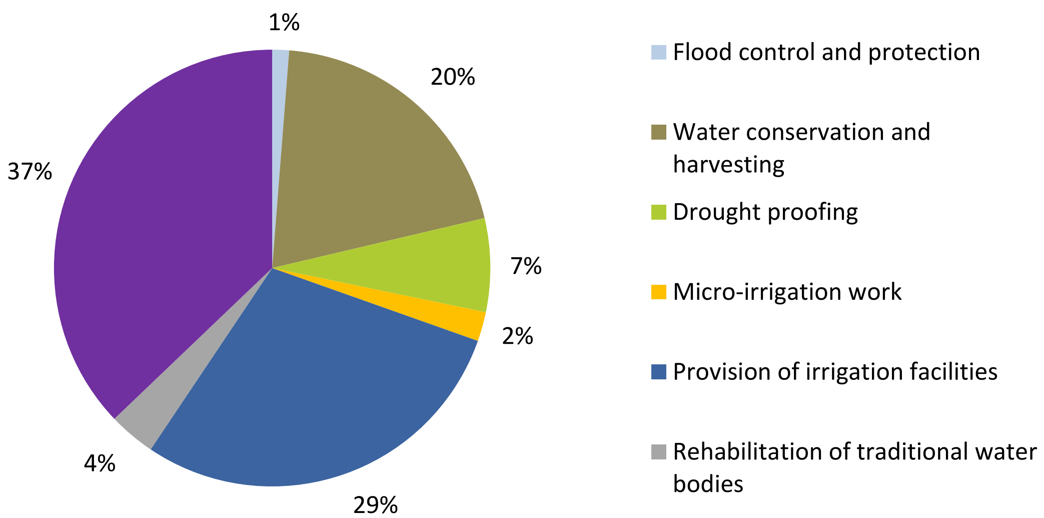
The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) seeks to address chronic rural poverty. The scheme has been effective in developing rainwater harvesting and storage structures. However, not all farmers in the scheme can make use of this water because they do not have pumps.

Where the opportunity lies

MGNREGS addresses the causes of chronic poverty and supports sustainable development of the agricultural economy by guaranteeing 100 days of employment to members of rural households in the construction of rural infrastructure.

It covers rural areas across the country and the majority of projects are water security-related infrastructure. The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) makes provision for water conservation and harvesting; drought proofing, including afforestation and tree plantation; irrigation canals, including micro-irrigation and minor irrigation works; provision of irrigation facilities to scheduled castes and scheduled tribes; rehabilitation of traditional water bodies, including de-silting of tanks; and flood control and protection works, including drainage in waterlogged areas (Figure 4). On average, USD 6 billion is spent on water projects each year. In Madhya Pradesh, the focus has been on the provision of on-farm irrigation facilities, such as ponds and wells, and water conservation and harvesting.

FIGURE 4. Distribution of MGNREGS expenditure on work in Madhya Pradesh during 2009-2010.



Source: Malik 2011.

[4] This section is based on Malik 2011; and AgWater Solutions Project 2011b.

Although many farmers have been provided with such infrastructure, some are still unable to benefit because they cannot afford the materials and equipment needed to get the water to their crops. Herein lies an opportunity to further enhance the benefits from MGNREGS. However, before MGNREGS contributions to water security and agricultural output can be maximized, it is necessary to know whether the infrastructure provided is appropriate, effective, of good quality and durable; few studies to date have assessed this.

The research

Researchers from the AgWater Solutions Project carried out studies in four blocks of two districts to answer the following questions:

- What was the process for selecting the type of infrastructure to be developed?
- Does the implementer's choice of infrastructure match the preferences of the beneficiaries?
- Can MGNREGS deliver structures that ensure sustainable water security?
- Have the water structures led to an increased or more reliable water supply?
- What changes have been made by the beneficiaries (e.g., crops) to optimize the benefits?
- What has been the impact on livelihoods?
- Have the MGNREGS investments encouraged private investment to enhance water security?

Since 2006, farmers in the sampled area have been provided with structures for on-farm water storage (wells and ponds) or improved water management (bunds) (Table 4).

TABLE 4. Water structures built under MGNREGS in the districts studied.

Block	Number of households	Number of water structures		
		Farm ponds	Bunds	Wells
Bijadandi	40	6	14	20
Ghughari	40	13	12	15
Petlawad	35	6	0	29
Thandla	40	0	8	32
Total	155	25 (16%)	34 (22%)	96 (62%)

Source: Malik 2011.

Main findings

- Of the farmers with water storage infrastructure (wells and ponds), 96% reported an increase in water availability.
- Of the farmers, 60% felt that the structure was the best option for providing irrigation water.
- Farmers receiving wells were most satisfied.

- More than 90% of the farmers reported that the structures were durable.
- Of the farmers, 80% are satisfied with the quality.
- The structures are as cost-effective as those made under any other program.
- Transparency of expenditures made under MGNREGS is lacking and farmers are not always given the structures that they most desire.

Positive impacts in the research site

- Over five years the irrigated area has risen from 13 to 52% in the monsoon season and from 4 to 22% in the dry season.
- Cropping intensity has increased 27%.
- Farmers' incomes from crop production have increased by 36-47%, which is about INR 400 to INR 800 per acre (INR 1,000 to INR 2,000 per hectare).
- Around 57% of the farmers also use the water for domestic purposes and livestock.
- Farm bunds have improved moisture retention and increased crop yield in the monsoon season, but have had no effect in the dry season.

Limitations

- Of the farmers, 44% were not able to make use of the water because they needed pumps.
- Those who bought pumps used their own money and most chose diesel pumps because electricity is not available in the area.
- Others could not afford pumps nor could they take out loans to purchase pumps.

Where to invest

Farmers need pumps to make use of most rainwater harvesting structures. At present, this is not within the scope of the MGNREGS which pays for unskilled, manual labor. Some options on how to overcome this barrier and ensure that farmers can use the water they receive are to:

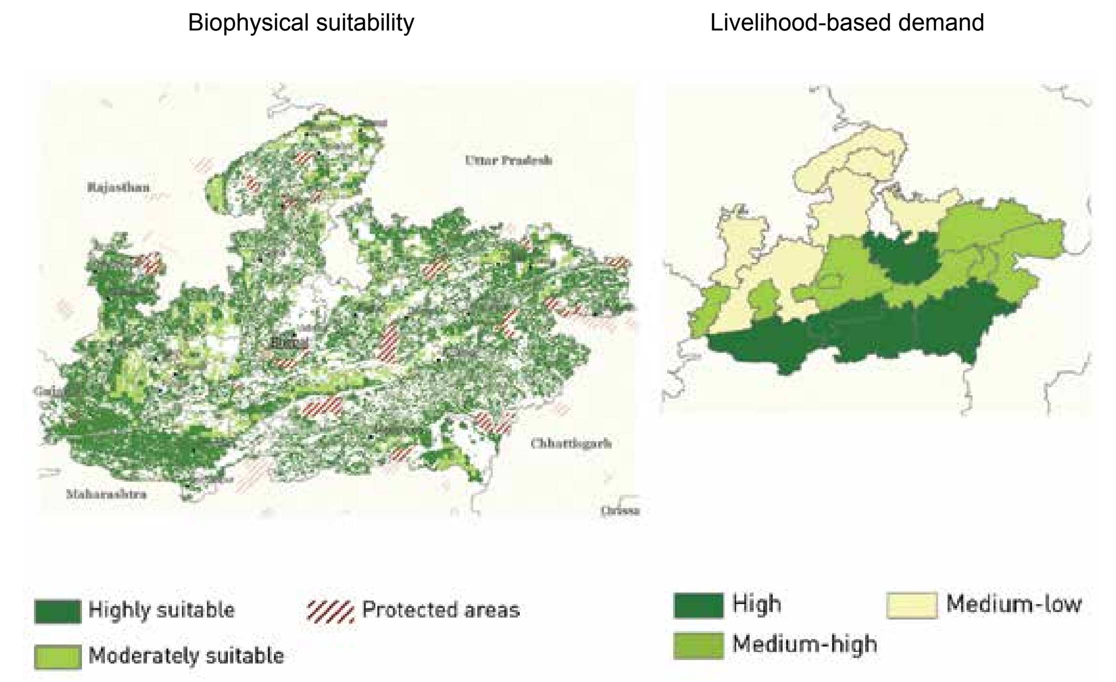
- provide soft loans with long repayment periods that are available to all farmers, including farmers with existing debt;
- offer concessionary (agricultural) rates for pump equipment; and
- consider providing pumps free of charge to the poorest farmers. This requires convergence or collaboration between MGNREGS and other schemes or NGOs and donor programmes.

Another issue is that farmers do not have much involvement in the decision making over which structures are built. This can be overcome with improved communication and better understanding of farmers' needs. The organizations that need to improve their understanding of what is possible under MGNREGS and how it can be implemented are various civil society organizations and *panchayat* authorities. The implementing organizations need to discuss proposed work with beneficiary farmers to ensure appropriate construction takes place.

Who benefits and where

It is difficult to map an intervention such as MGNREGS, but its infrastructure benefits can be mapped. In addition to rainwater harvesting (see previous section), MGNREGS pays for field bunding for soil and water conservation. This is most suitable on land with a slope greater than 5% and where there are high rates of poverty. The AgWater Solutions Project estimated that, at a 50% adoption rate, field bunding could benefit around 1.6-2.2 million households. This equates to 3-4% of rural households. The potential application area is between 3.5 and 4.9 Mha, or 21-29% of the total agricultural land area (Figure 5).

FIGURE 5. Potential area where farmers could benefit from bunding.



Source: FAO 2012a.

Stakeholder recommendations.

When discussing opportunities to make better use of MGNREGS financial assistance, participants considered that it can be most applicable in areas where farmers are also laborers and in tribal areas such as Jhabua, Dhar, Mandla and Dindori. They recommended not to limit MGNREGS investments to public and common lands, but to extend it to private land and to include other forms of infrastructure on individual plots (e.g., Rewa Sagar and field bunding). This would overcome community management issues and increase farmers' interest. Ultimately, it would enhance the effectiveness of the scheme in terms of water provision.

Source: FAO 2012b.

Drip Irrigation[5]

Drip irrigation saves water, increases yields, reduces the cost of pumping and requires less labor. However, there are difficulties and the spread of drip irrigation has been slow. Understanding the benefits and limitations of drip irrigation and factors that hinder uptake could result in its spread in appropriate areas as a way to conserve water and improve agricultural incomes.

Where the opportunity lies

Drip irrigation methods range from simple bucket kit systems for small farms to automated systems linking release of water to soil moisture conditions. Drip methods make it possible for farmers to achieve up to 95% water-use efficiency, cultivate fallow land and grow higher-value horticulture crops. Drip can also help reduce salinization and waterlogging. Of the 69 Mha of irrigated land in India, only half a million hectares have been brought under drip irrigation. The government has set a target to bring 17 Mha under micro-irrigation, including drip irrigation.

The research

Researchers from the AgWater Solutions Project looked for reasons to explain the slow adoption of drip irrigation, with particular emphasis on the role of subsidies. The study was based on interviews with manufacturers, retailers and promoters of drip technologies, as well as farmers in Sagar, Dhar and Indore districts. Researchers also interviewed officials of the State Horticulture Department responsible for administering the subsidy program.

Farmers reported a number of reasons for not adopting drip irrigation.

Technology

Lack of awareness about the technology and difficulties associated with its use (e.g., the laying of pipelines, storage when not in use and cleaning of emitters) discourage farmers, who say that they lack knowledge of operation and maintenance, and access to technical support. In addition, the equipment supplied is not always of good quality, spare parts can be difficult to find and the technology can be unreliable, for example, emitters get blocked.

Crop and farm size

Landholdings are small but drip systems are often designed for large areas, so there is a mismatch between the size needed and the size offered. Drip systems work well with horticultural crops and are not ideally suited to the types of crops being cultivated by smallholders.

Cost, subsidies and financing

It is difficult to obtain government subsidies or other forms of financing, without which the initial investment costs to the farmer are too high.

[5] Based on Malik and Rathore 2011; and AgWater Solutions Project 2012.

Water quantity, quality and pricing
Although drip systems are water-efficient, an adequate water source is still required but not always available. Some farmers do not have enough water and, therefore, see no opportunity to invest in drip irrigation. For other farmers, who have plenty of water or benefit from government subsidies for water or electricity, investing in water saving technologies is unnecessary.

Markets and power supplies
In some areas, drip systems are not available through local supply chains. Where they are available, the cost of fuel or electricity to pump water through the drip system may be a limiting factor, unless the system works on gravity flow.

Where to invest

Improve the subsidy scheme for drip irrigation
In almost all areas, the high initial cost of a system has been a major limiting factor. The state government offers a generous subsidy covering 70-80% of the cost of a drip system. Manufacturer and market estimates suggest that more than 95% of drip sales are through subsidies. The AgWater Solutions Project team suggests an alternative to the current subsidy scheme, which would be based on interest-free loans (Table 5).

TABLE 5. A comparison of the existing subsidy scheme for drip irrigation and a proposed loan scheme.

The current subsidy system	The proposed system
• Total subsidy: 70-80% of the drip system. • Farmers pay the unsubsidized portion of the equipment cost, usually as an upfront payment with no financial support. • The approval process is complicated and requires middlemen who charge farmers for their service. • Many farmers wait for a subsidy instead of investing their own money. • Farmers have to purchase a kit rather than individual components. There is no choice. This stifles technology innovation.	• The government would give interest-free loans, repayable after five years, for 100% of a drip system. • Loans would be administered through existing financial institutions in rural areas. • Each farmer is free to buy a drip system from any dealer or manufacturer, choose any desired configuration, and negotiate a price and after-sales service conditions. • The farmer does not need to visit government offices to complete the paperwork. • The government plays a facilitating role, ensuring that farmers are treated fairly by manufacturers and retailers.

Source: Malik and Rathore 2011.

Who benefits and where

The government
If the current subsidy regime were modified, the capital outlay to bring the same number of farmers and land area under drip irrigation would be substantially reduced because competition would lead to a reduction in market price and the government would only pay the interest forgone on their investment. The government has set a target to bring 17 Mha under micro-irrigation, including drip irrigation. An alternative to a subsidy regime, such as the one suggested by the AgWater Solutions Project, would help the government achieve this target.

Farmers
The proposed loan scheme would cover the entire cost of the drip system, so there is no upfront cost to the farmer.

CONCLUSIONS[6]

Changes to programs and funding could have a dramatic impact on farmers' interest in investing in AWM options. Involving farmers in decisions about state-funded AWM and providing loans so that they can choose the technologies that suit them could be highly beneficial. The AgWater Solutions Project estimates that support in the areas of decentralized rainwater harvesting could benefit hundreds of thousands of farming households. These interventions could be supported by loans and MGNREGS. Drip irrigation could also be expended through a careful loans procedure rather than the current subsidy system:

Rainwater harvesting could benefit up to 1.2 million households. For rainwater harvesting to reach this number of people and to have the desired benefits it should be implemented in suitable areas, where the biophysical conditions are similar to the Dewas District. Demonstrations and field visits could be used to illustrate the benefits of building tanks and create support among farmers and district administrators. Technical support, such as engineering expertize and construction advice, will be required as will agricultural extension services. To enable farmers to invest in rainwater harvesting it should be treated as part of the agricultural loan portfolio, and loans should be offered with guarantees or revolving lines of credit. The existing government subsidy should be revised so that funds are more readily available.

MGNREGS will only benefit smallholder farmers if they receive the water structures that they require, and have access to pumps and other irrigation equipment. The government could facilitate this by providing soft loans with long repayment periods that are available to all farmers, including farmers with existing debt. They could also offer concessionary (agricultural) rates for pump equipment and could consider providing pumps free of charge to the poorest farmers. This requires convergence or collaboration between MGNREGS and other schemes or NGOs and donor programs.

Drip irrigation would be beneficial in areas where farmers have access to water but need to use it more judiciously. Uptake of drip systems has been slow but could possibly be encouraged if the subsidy scheme was revised and replaced with a loan scheme. This would save the government money and give farmers easier access to funds as well as allowing them the flexibility to choose systems that meet their needs.

[6] All figures provided in this section assume that 50% of the total potential users adopt the AWM option. All figures are taken from FAO 2012a.

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