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RESILIENCE Policy Brief

Upscaling micro-irrigation in the Indian states of Odisha and Assam: Recommendations based on field evidence

Food production in India is increasingly vulnerable to water scarcity risks, due to the growing demand for food, climate change and competition for scarce natural resources among competing sectors. Agriculture already accounts for more than 90% of the total freshwater withdrawals in India (FAO 2020). However, competing demands for water in the future may reduce the availability of freshwater for agriculture by up to 72% in 2025 and 65%–68% in 2050 (ADB 2013). Thus, there is an urgent need to enhance water resilience and adaptation to climate change to sustain Indian agriculture. The agriculture sector in India is marred by low irrigation efficiencies and low water productivity. Thus, improving water use efficiency in the agriculture sector is an essential step toward mitigating this crisis. To address this, the government has prioritized improving irrigation efficiency through micro-irrigation systems (MIS), with the goal of achieving 'more crop per drop'. The government is promoting micro-irrigation through a capital subsidy program under the scheme *Pradhan Mantri Krishi Sinchayee Yojana* (PMKSY). MIS coverage has steadily increased and currently 13.47 million hectares (48% drip and 52% sprinkler) are under MIS (Figure 1). However, the adoption of MIS has remained low when compared to its large potential (Nair and Thomas 2023).

Farmers installing laterals of a drip irrigation system in their sweet corn field in Cuttack district, Odisha, India (*photo*: IWMI, India).

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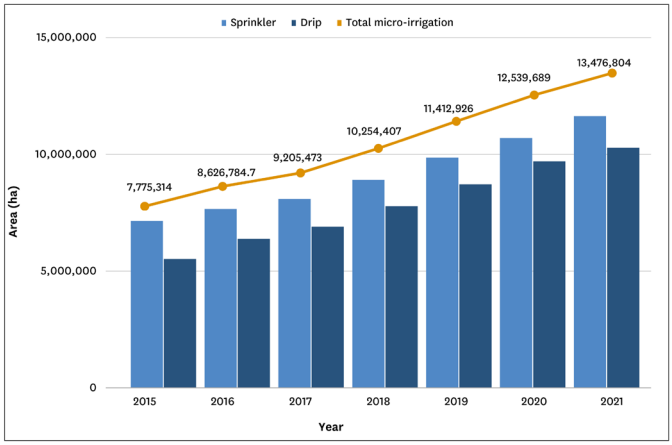

Figure 1. Status of micro-irrigation coverage in India. *Source*: Data compiled from GOI 2015, 2016, 2017, 2018, 2019, 2020, 2021.

Studies have identified various socioeconomic and institutional factors that affect the adoption of MIS among smallholder farmers (Nair and Thomas 2023). Among these, the key limiting factors were identified as the lack of technical knowledge to operate and maintain MIS, financial capacity and low awareness about the benefits of MIS. To address these issues and increase adoption, the RESILIENCE[1] project conducted field demonstrations of MIS among other water-saving irrigation practices, and capacity building and training programs in four districts in Odisha (Cuttack and Ganjam) and Assam (Golaghat and Sivasagar).

The pilot sites are indicated in Figure 2. This brief provides an overview of the project's findings and recommendations.

Micro-irrigation status in Odisha and Assam innovation scaling systems

Agriculture in the states of Odisha and Assam is at high risk because it depends heavily on monsoon rainfall. Less than a quarter of the area is under assured irrigation, making farming less productive and highly risky due to unpredictable and unseasonal heavy rains, floods and droughts. Even though there is plenty of water available from surface water and groundwater sources (annual average rainfall ≥ 1,400 mm), the lack of development of water resources and efficient use of irrigation potential leads to low crop yields and productivity in the *Rabi* and summer seasons. It is important to develop and utilize water resources to their full potential to improve crop yields, reduce risks and increase agricultural productivity in these states.

By adopting efficient water management practices, especially through micro-irrigation in the post-monsoon season, farmers in these states can significantly reduce risks and increase crop production. However, the adoption of micro-irrigation has been low in both states. In Odisha, only 2.46% of the total net sown area is covered under micro-irrigation, while in Assam, it is only 0.72%.

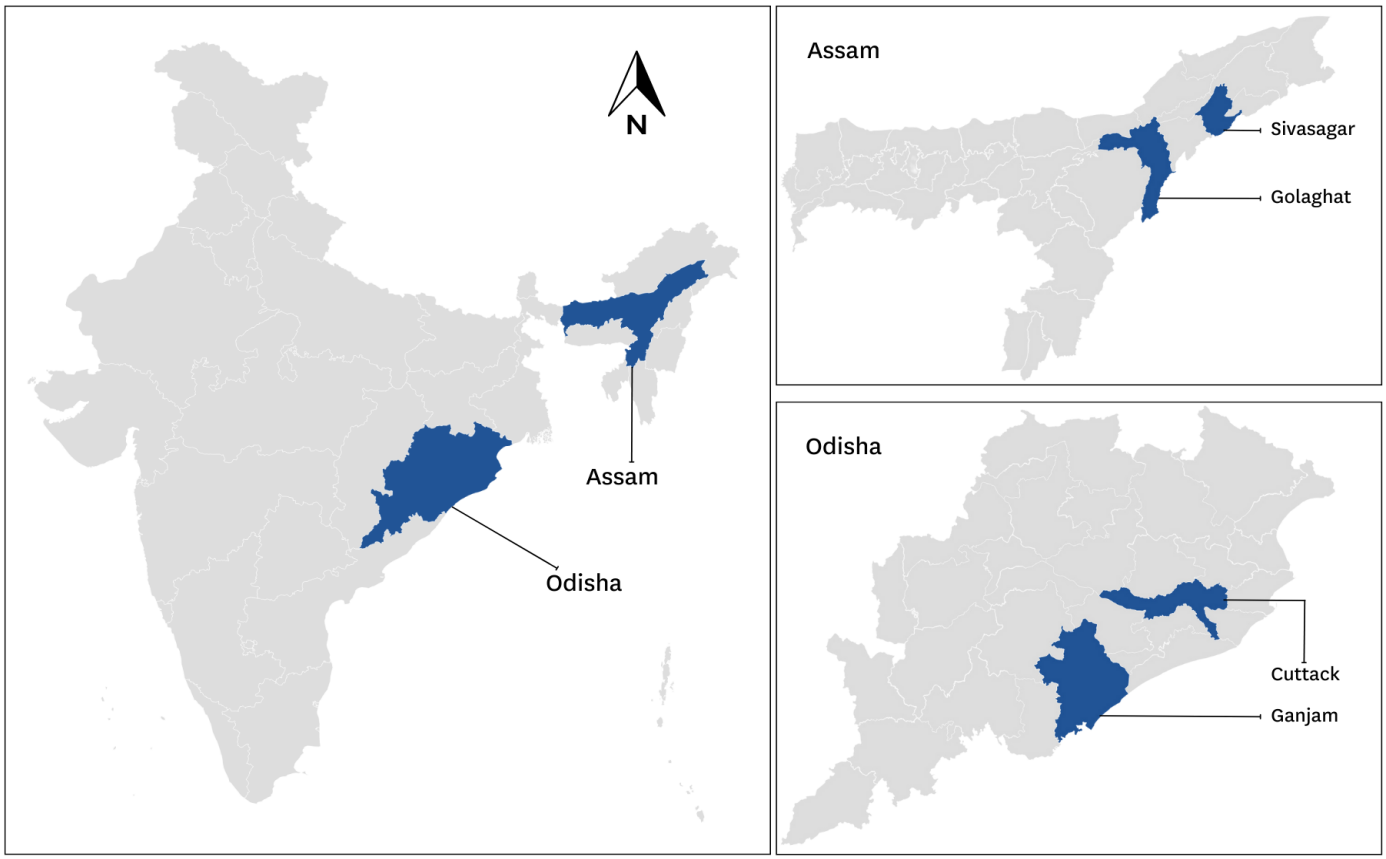

Figure 2. Pilot sites in the selected districts of Odisha and Assam in India. *Source*: Open Street Map (OSM).

[1] http://resilienceindia.org/node/119

Findings of MIS benefits from the farmers field demonstrations

The micro-irrigation techniques were demonstrated under the RESILIENCE project in 19 farmers' fields across all pilot districts for irrigating different vegetable crops that were cultivated during the three *Rabi* seasons of 2019-2022 (Figure 3). MIS resulted in significant water savings, a substantial increase in yield, irrigation water productivity and economic water productivity.

For example, for varying vegetable crops and locations, the MIS resulted in about 20-70% water saving and a 10-90% increase in yield (Figure 4). For all the pilot sites in both states, micro-irrigation resulted in a two- to four-fold increase in irrigation water productivity and economic water productivity as compared to the control plots. In addition, in the feedback survey, farmers indicated that micro-irrigation systems led to higher production with lower cost of cultivation, less labor and easy fertigation as compared to the traditional method of irrigation.

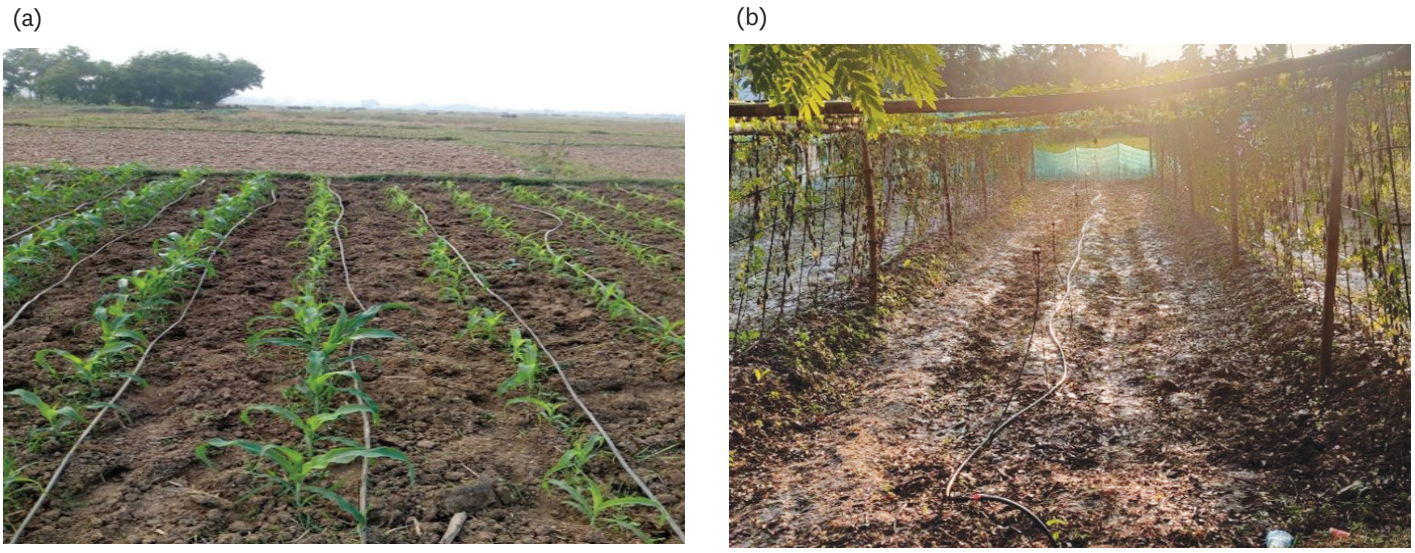

Figure 3. Demonstration of drip and sprinkler irrigation systems in the pilot sites situated in the Indian states of (a) Odisha, and (b) Assam (*photos*: IWMI, India).

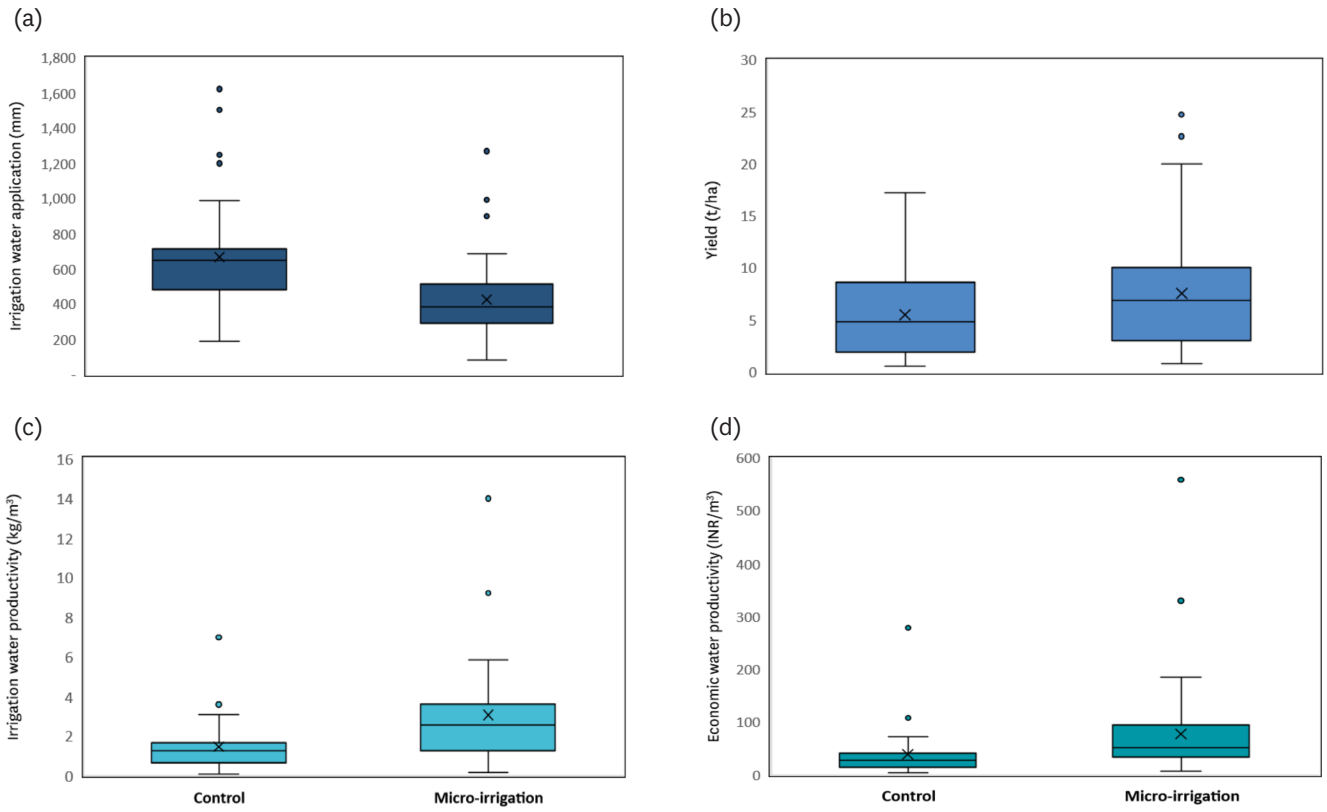

Figure 4. Comparison of (a) irrigation water application, (b) yield, (c) irrigation water productivity, and (d) economic water productivity in the control and 'micro-irrigation plots in the Indian states of Odisha and Assam.

Capacity building and training programs

Under the RESILIENCE project, more than ten training and capacity building sessions on water-saving irrigation practices were organized in the pilot districts. This was done through on-farm field visits for increasing technical knowledge, awareness about benefits and access to subsidy programs (Figure 5). These activities were carried out in collaboration with RESILIENCE project partners, and government agencies and departments including *Krishi Vigyan Kendras* (KVKs) and officials from the state horticulture and agriculture departments.

The training and capacity building programs resulted in creating awareness in the pilot villages, motivating more farmers to adopt the technology. Currently, more than 30 smallholder farmers in the pilot and nearby villages of Odisha and Assam have shown interest in adopting MIS after the training and capacity building programs conducted under this project. The RESILIENCE project assisted farmers in submitting applications to avail subsidies under the PMKSY scheme in both states.

Issues and challenges with the adoption of MIS

Despite significant advantages associated with the use of MIS, its wider adoption has remained limited and slow. Some of the key reasons behind the limited adoption of MIS, which were experienced during the pilot demonstration and also from the farmers' feedback from both states are listed below.

• Lack of irrigation and energy sources

The lack of reliable sources of irrigation water in the post-monsoon season limits the potential for MIS adoption. In both states, irrigation coverage is low with only 11.2% and 26.7% of gross cropped area irrigated[2] in Odisha and Assam, respectively.

Similarly, groundwater resources are not developed with only 44% and 12.3% of available resources developed in Odisha and Assam, respectively. Additionally, low irrigation coverage is also compounded by the lack of a reliable electricity supply for operating MIS. The consumption of electricity for agricultural purposes is abysmally low for both Odisha (2.8%) and Assam (0.52%) compared to 23% in Punjab and Haryana (GOI 2021). Thus, farmers have to depend on diesel or petrol to run the pumps, which is very costly. Power intensity in these states needs to be improved to enable farmers to energize the pump sets and utilize the available irrigation sources.

• Financial and institutional factors

The project findings indicate that despite the availability of subsidies for MIS (up to 80%), accessing and affording the subsidy remains a challenge. This is particularly true for small and marginal farmers with limited financial capacity and fragmented landholdings who struggle to meet their share of the capital cost. In addition, low awareness about the benefits of adopting MIS compounds to this challenge. The process of accessing subsidies for MIS is complex and involves multiple levels, which further hampers small and marginal farmers' ability to access institutional mechanisms. In both Odisha and Assam, MIS is installed under the PMKSY scheme, with a multistep process for subsidy approval (Figure 6). Farmers can apply through the agriculture/horticulture department or directly through MIS distributors, who submit designs and cost estimates for installation. After pre-sanction approval, farmers must deposit the estimated cost (full or subsidized) to the distributor company before receiving MIS materials and installation. The subsidy amount is released after the installation is verified. In some cases, farmers must deposit the full cost upfront, which can take up to six months for approval. Simplifying the subsidy application process, providing technical assistance, increasing awareness and ensuring timely disbursement of subsidies can help overcome these challenges and encourage wider adoption of MIS.

(a)

(b)

Figure 5. (a) Farmers field exposure visit, and (b) village-level awareness meeting conducted in the Indian state of Odisha under the RESILIENCE project (*photos*: IWMI, India).

[2] Directorate of Economics and Statistics, Ministry of Agriculture. http://aps.dac.gov.in/LUS/Public/Reports.aspx

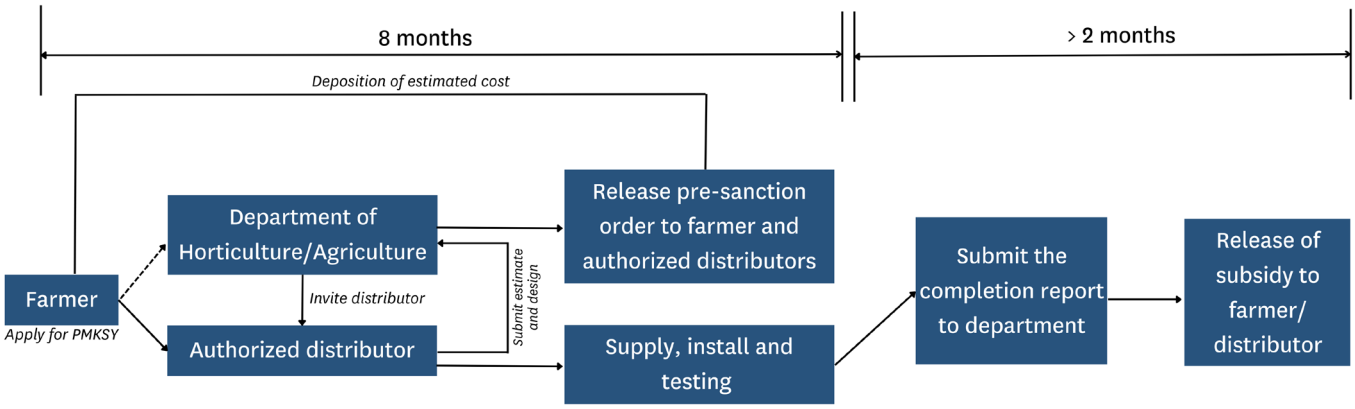

Figure 6. Process of obtaining a subsidy through the PMKSY scheme (the general procedure followed at the project sites and experienced by IWMI during project implementation).

• Lack of awareness and technical knowledge

In areas where the project was conducted, farmers generally lack the technical knowledge such as selection of micro-irrigation systems, designs and layouts, suitable cultivation practices, and proper irrigation-fertigation scheduling and maintenance. This is exacerbated by the improper irrigation scheduling linked with intermittent electricity supply, lack of post-installation services leading to clogging of the drippers, and the lack of regular monitoring and training provided to farmers who have adopted the technology. In many cases, there is a limited presence of suppliers/dealers in villages and farmers are dependent on the local vendors for troubleshooting. Poor quality materials and designs in some cases have also led to the failure of MIS, causing farmers to lose faith in the technology. In addition, there is a general lack of awareness among farmers about the available schemes and procedures for accessing subsidies from the Central and State governments. Moreover, small and fragmented landholdings, as well as sharecropping arrangements, have contributed to low levels of interest in MIS adoption due to land size constraints.

Recommendations for increasing MIS adoption in Odisha and Assam

Though the State and Central governments are trying to popularize MIS through capital subsidy programs, issues related to access to subsidies and affordability, lack of knowledge and capacity, and low awareness are hindering adoption. Thus, to accelerate adoption, a multipronged strategy is required. We summarize some of the key recommendations below:

• Convergence of resources

Water resources have inter-sectoral impacts and many schemes are operational at the Central and State government levels under different ministries/departments. However, the lack of integrated planning and inter-sectoral convergence of resources often results in multiple government and nongovernmental organizations working without interdepartmental and interorganizational coordination, even for the same scheme.

Therefore, a convergence of resources from ongoing government schemes can multiply the benefits and enhance social capital. For instance, the convergence of multiple irrigation and water-related schemes (e.g., farm ponds and groundwater development), energy-related schemes (e.g., solar irrigation) and capacity building-related schemes can encourage the wider adoption of MIS in potential areas of the states. This is important because the lack of irrigation resources and reliable power supply limits the adoption of MIS. One example, as demonstrated by the project, is the convergence of resources from the Odisha Minor Irrigation Development Scheme — *Biju Krushak Vikash Yojana* (BKVY) — with underground pipelines and MIS. Under this convergence model, borewells installed in farmers' lands were connected to underground pipelines with outlets and MIS through the PMKSY scheme to expand the cultivated land in the non-monsoon season. Similarly, other schemes such as those targeting farm pond development, solar irrigation and MIS can be converged to multiply the benefits of the developed irrigation resources.

• Financial and institutional mechanisms

Small, marginal and economically weaker families with small and fragmented landholdings are facing difficulties in meeting their share of the capital cost, resulting in a lack of willingness to adopt MIS. To overcome this financial barrier, alternate financial mechanisms such as low-cost interest or moratorium loans could be provided to reduce the capital cost and cover the unsubsidized cost. In this direction, forming microfinance-based cooperatives for the MIS-adopting farmers could be one way to encourage more farmers to adopt MIS and overcome some of the financial barriers. To encourage more farmers to adopt MIS, it is important to simplify the application process to avail the subsidy, especially for small and marginal farmers. This could be done by providing technical assistance for applying, increasing awareness about the scheme and the process, and ensuring timely disbursement of the subsidies. Further, a cluster-based demonstration and implementation approach should be adopted for the effective and widespread adoption of MIS.

A farmer received sprinklers to irrigate his crops in Assam, India (*photo*: Tanmoy Bhaduri/IWMI).

• Alternate and small-scale MIS

As majority of farmers in Odisha and Assam are small and marginal, they may be interested in adopting MIS for irrigation, but face challenges due to small and fragmented landholdings. Additionally, energy access remains a barrier to the adoption of MIS. To address these challenges, nonconventional MIS systems such as gravity-based drip kits with overhead tank systems could be encouraged for small farms and home gardens. The RESILIENCE project piloted these systems in a few locations in Odisha (Figure 7), which showed positive results. Thus, subsidizing and promoting such systems for marginal farmers and sharecroppers can encourage wider adoption of MIS.

• Capacity building and awareness raising

To increase the adoption of MIS, it is important to build farmers' confidence in their ability to operate and maintain the technology as well as raise awareness of its benefits. This can be achieved through on- and off-farm capacity building programs in the form of more widespread field trials, village-level trainings, and exposure visits. Project experiences showed that involving pilot farmers, government agencies and KVK scientists can instill interest and trust in those who have not adopted MIS. Efforts should be made to organize regular training/capacity building programs focusing on operation and maintenance, post-installation services and easy accessibility of replacement parts to boost farmers' confidence.

Figure 7. Demonstration of micro-irrigation through a drip kit system along with an overhead tank in a cowpea field in Cuttack district of Odisha, India (*photo:* IWMI, India).

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Project

The RESILIENCE project promotes innovations through agroecology-based climate-smart agriculture (CSA) farming systems, tools and strategies to support smallholders. The overall goal of the project is to improve agricultural productivity and the adaptive capacity and livelihoods of smallholders to climate and economic changes, by building resilience and strengthening market value chains. The project is being implemented in the two states of Odisha and Assam located in the east and northeast of India, respectively. For more information, visit http://www.resilienceindia.org

Contacts

Alok Sikka, Country Representative – India, IWMI, New Delhi, India (a.sikka@cgiar.org)

Mohammad Faiz Alam, Researcher – Water Resources/Agricultural Water Management, IWMI, New Delhi, India (m.alam@cgiar.org)

Smaranika Mahapatra, Research Officer – Water Resources Management, IWMI, New Delhi, India (s.mahapatra@cgiar.org)

IWMI India

Delhi office
2nd Floor, CG Block C, NASC Complex, DPS Marg,
Pusa, Opp Todapur, New Delhi, 110 012
Tel: +91 11 25840811
Email: iwmi-delhi@cgiar.org

Anand office
Jal Tarang, Near Smruti Apartment, Behind IRMA Gate,
Mangalpura, Anand, Gujarat, 388001
Tel/Fax: +91 2692 263816/817
Email: iwmi-anand@cgiar.org

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International Water Management Institute (IWMI)

Headquarters
127 Sunil Mawatha, Pelawatte,
Battaramulla, Sri Lanka

Mailing address:
P. O. Box 2075, Colombo, Sri Lanka
Tel: +94 11 2880000
Fax: +94 11 2786854
Email: iwmi@cgiar.org
www.iwmi.org

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