

Water Policy Briefing

Issue 2

IWMI-Tata Water Policy Program

Putting research knowledge into action



Bringing pumps to people

Giving the poor better access to groundwater irrigation:
Sustainable approaches and options for eastern India.

What can States learn from the tube-well programs
created in eastern Uttar Pradesh and north Bihar?

Bringing pumps to people

Giving the poor better access to groundwater irrigation: Sustainable approaches and options for eastern India

What can States in eastern India learn from the tube-well programs created in eastern Uttar Pradesh and north Bihar?

The State government has a vital role to play in developing groundwater resources to help improve the lot of the poorest people in eastern India's rural communities. Many States have tried to achieve this over the past 50 years through centrally planned public tube-well programs. Recently published research says that most of these efforts have failed to bring irrigation—or improved livelihoods—to the poor.

This research shows how policy makers can have a significant positive impact on poverty reduction by removing pump subsidies and opening pump markets to international competition. Subsidies and import restrictions have kept pump prices in India artificially inflated, by more than 35–45%, over those of neighboring Pakistan and Bangladesh.

If a 'shock therapy' approach of removing restrictions is too drastic or politically difficult, the next best option is to use market mechanisms to manage pump subsidy and loan programs for the poor. A good example of this approach is the jointly managed subsidy programs that have helped usher in eastern India's belated Green Revolution. Here local pump dealers are active participants in the management of pump subsidy programs, alongside government and nationalized banks. The examples of eastern Uttar Pradesh and north Bihar provide working models of such approaches.

In much of eastern India, the development of groundwater for irrigation is confirmed as the key to improving the lives of poor people on a massive scale. Examples abound of how the introduction of small pumps has energized agrarian economies by allowing people to grow food and cash crops, creating new income streams for millions of households. If this is the case, then why have the public tube-well programs of eastern India—so enthusiastically supported by donors over five decades—been such resounding failures?

The answer lies in the gap in the perspective between institutional thinking and the reality of life at the village level. Most public tube-well initiatives in eastern India have been strangled by bureaucracy and the local political dynamic. In these programs, the government was responsible for centrally controlling activities that are best done by farmers in a decentralized mode—managing and operating irrigation wells.

In the 1930s, public tube-well programs played the useful role of introducing these technologies when

farmers resisted using it. Today, the situation is quite different. But public tube-well programs have failed to reinvent themselves and address the needs of the current market and society they serve. Small-scale, farmer-managed tube wells and decentralized pump irrigation markets, have made public tube wells largely irrelevant. It is no surprise, then, that governments in most economically dynamic states, such as Gujarat, have begun turning over government tube wells to farmer groups in a hurry.

Eastern India's poverty can be reduced by putting pumps in the hands of the small farmer. But the sheer numbers of people are



This issue of *Water Policy Briefing* presents insights distilled from the policy research of the IWMI-Tata Water Policy Research Program. Readers interested in the details of this research are invited to read the full text of the technical paper, *Wells and Welfare in the Ganga Basin: Public Policy and Private Initiative in Eastern Uttar Pradesh*, at www.iwmi.org/iwmi-tata or request a copy. Questions and comments on this issue may be directed to Dr. T. Shah c/o IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar 388 001, Gujarat, India or iwmi-tata@cgjar.org.

COVER PHOTO: Courtesy of Gene Hettel, International Rice Research Institute (IRRI).

such that a market push is needed to speed the process of transforming this region's vast groundwater irrigation potential into wealth and welfare for its poor population. Central and State government pump subsidy and loan programs were created to speed the process. But they are mired in bureaucratic procedure and compromised by political brinkmanship and rent seeking. The end result is that these initially well-intentioned efforts have failed to produce an impact.

The bright spot in this story is the successful programs of Uttar Pradesh (UP) and north Bihar. Here much of the practical organization of the pump subsidy and loan programs has been released from the stranglehold of the local bureaucracy. The private pump dealer plays a central coordinating role.

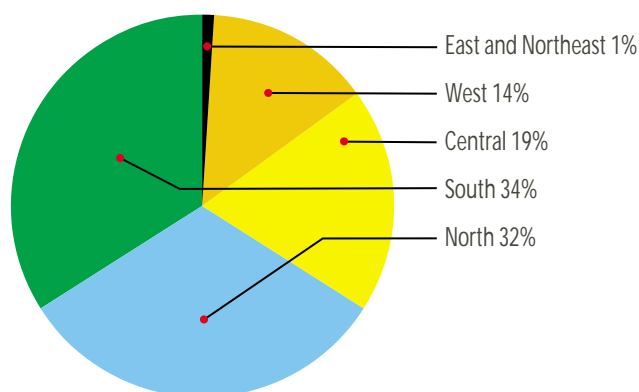
Motivated by the prospect of profits from the growing pump market, private dealers have proliferated in towns of eastern UP. Intense competition has induced these businesses to deliver small farmers a range of rapid and useful services that were never previously offered.

To get the farmers' business, these pump dealers do the paper work and legwork, get the clearances and approvals needed. They organize bank loans, arrange the issuing of pipes, pumps and the drilling of boreholes—all in an unusually short time as compared with a centrally coordinated approach. The average delivery time for a working pump set under the government's Free Boring Scheme in eastern UP is one-to-two weeks. In other States, dealers extract a heavy 'service charge' from farmers for providing these services. But the intense competition in the UP region has reduced dealer margins to 7–10% from 15–18% elsewhere.

The government's role is to support this market-oriented approach by encouraging the creation of these types of public-private partnerships. The government's key role is to set market rules that allow suppliers to deliver fast service and pump equipment adapted to local farmers' needs.

The central lesson is that removing pump subsidies and opening up imports is the best strategy to create welfare for the poor in this region. If this approach is not possible, the research suggests a five-point strategy that water development planners can draw from when crafting their groundwater and poverty reduction policies in eastern India.

Groundwater overdevelopment in India by region



East and northeast India have a very small share of the country's 'dark blocks', where over 85% of the available groundwater is being developed. This points to an untapped potential for groundwater development in these rural areas.¹

Bringing pumps to people: A five-point strategy for poverty reduction in eastern India

The research summarized here analyzes factors that have influenced the success and failure of groundwater development schemes in India. Based on these studies, five points are recommended for policy action:

- **Discontinue government minor irrigation programs** and focus on private tube wells as the primary mode for bringing groundwater irrigation to poor communities.
- **Improve electricity supply for agriculture** by reintroducing metered charging, decentralized retailing of electricity, and prepaid electricity cards. A number of practical examples exist of ways to manageably meter electricity across rural areas.
- **Promote the modification of pump sets** to improve the energy efficiency of groundwater pumping, reduce pollution and lower the sale price of water to poor users.
- **Introduce small diesel pumps and manual irrigation technologies** for vegetable growers and marginal farmers.
- **Remove pump subsidies and open the market** to the import of smaller micro-diesel pumps, such as the Chinese equipment used in Pakistan and Bangladesh. If this is not practical, a useful alternative is to redesign pump-subsidy schemes along the lines of the Uttar Pradesh Free Boring Scheme.

¹A "block" consists roughly of 100 villages; and it is a basic geographic unit between a village and a district. The groundwater administration classifies blocks under three categories based on the extent of groundwater development. Blocks where groundwater draft is less than 65% of the available resources are categorized as "white;" those with 65%–85% development are classified as "gray;" and those with more than 85% development are classified as "dark." While new groundwater development is strongly discouraged in dark areas it is encouraged in "white" areas.

1. Cease Public and Community Tube-Well and Minor Irrigation Programs

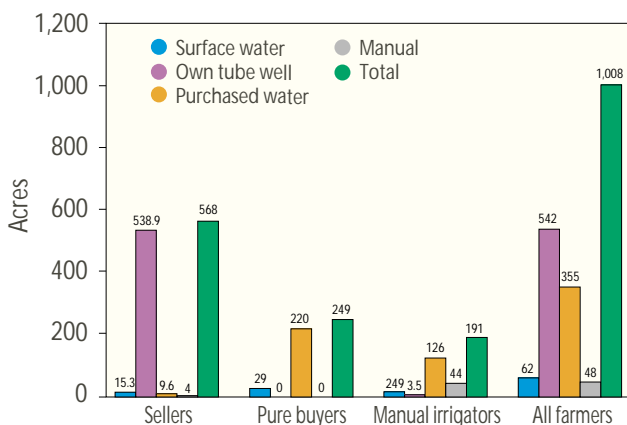
The critical challenge of minor irrigation development—and, indeed, of overall agrarian growth—in eastern India is to increase the region's current pump density of 1–3 pumps/100 hectares of net sown area to 25–40. This requires programs whose primary goal is to put the pump into the hands of the poor.

But rather than attacking this problem directly, much of eastern India is still busy building new public tube wells and big community-managed river lift irrigation schemes that the rest of India stopped doing 15 years ago. North Bengal—which does not need deep tube wells and buried pipeline technology—has continued to deploy them.

With the deluge of studies and evaluations that testify to the failure of public tube-well programs in eastern Uttar Pradesh and elsewhere in India, the need to stop support for these types of programs should now be a well-accepted fact. Current practice shows that this has not yet happened. In many states today, new programs—mostly donor-supported—continue to fund group-owned and -managed minor irrigation or to rehabilitate the infrastructure.

One example is a study of government-managed lift irrigation schemes in Orissa. It reveals that these schemes irrigate an average of 18.2 acres and collect irrigation fees of Rs3,550. At a total cost of Rs200,000/

Contribution of water markets in eastern UP agriculture: Survey of 380 farmers



A survey done for this research reveals that surface water makes a surprisingly small contribution to smallholder irrigation in the area studied. After personally owned tube wells, the largest water provider to smallholders is water purchased from pump irrigators.

Source: Shah et al. 1997.

hectare to build, the economics of this approach seems destined to be perpetually unviable.

In many eastern Indian states, government departments are directly involved in tube-well programs at a level that is most logically the farmer's business. These administrations are installing small tube wells of the type that private farmers operate, using a bureaucratic structure that does not even cover operators' salaries.

This is not to say that centrally managed tube-well irrigation schemes are all bad. Systems with large group tube wells with buried pipelines are doing well in north Gujarat and Maharashtra where farmers have money and enterprise but not groundwater. In contrast, north Bengal's farmers have too much water but no pump capital, so collective management of lift irrigation systems is neither necessary nor worthwhile. What will help these farmers the most is rapid access to small pumps and a system that helps them finance their pump's installation. The correct minor irrigation strategy for Gujarat is clearly a wrong approach for areas such as North Bengal.

2. Take a Strategic Approach to Rural Electricity Supply and Pricing

The critical relationship between rural electricity supply and the development of eastern India's agricultural economy needs to be recognized. There are several determining factors. First, electricity is cheaper than diesel. Second, electric pump engines are cleaner. And third, as hydroelectric plants generate more than 50% of eastern UP's electricity, it makes good sense to promote electric power for the region's agricultural development.

High tariffs on electricity for agricultural use in eastern India have motivated millions of smallholder farmers, since the 1980s, to switch from electric pumps to the cheaper diesel-powered groundwater pumps.

The new investments needed to improve and extend power supply in rural areas—and ultimately attract the diesel pump users to switch back to electricity—are unlikely to come about without exploring radically new ways of pricing rural power. Current research and thinking offer little insight into how this can best be achieved. A standard solution advocated by most analysts and institutions such as the World Bank is to reintroduce metered electricity supply. But this proposal overlooks the huge transaction costs involved in metering power supply to the several million

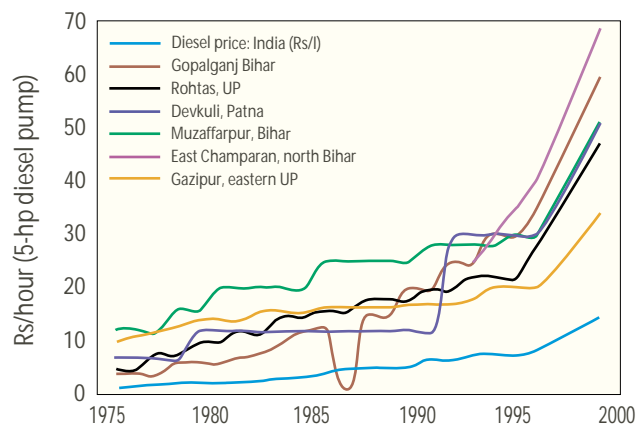
farmers who would turn to electric pumps if the power supply environment were to improve.

The central issue then is to reduce metering and collection costs by drastically reducing the number of power supply points that the State Electricity Board directly monitors and bills. Several options exist:

- One idea worth exploring is a variation on the concept of electricity cooperatives that saw widespread success in the rural United States in the early decades of the twentieth century. This approach has also worked in Maharashtra and Andhra Pradesh though not very successfully.
- A variation on this is currently being tested in Orissa as part of this state's power-sector reforms. A more distant alternative is inviting *Gram Panchayats* (Village Councils) to undertake the distribution of power within the village and collect electricity dues by offering an attractive commission on the fees collected. This should not be difficult as the State Electricity Board's (SEB) own transaction costs of metered power supply may be as high as 45–50% of overall operating costs including transmission and distribution losses. Efficient *Panchayats* can then transform electricity retailing into an income-generating proposition.
- Yet another alternative is to work with private power-distribution contractors—who will be charged based on consumption recorded in a central SEB meter and who can sell power to individual retail users.
- The prepaid electricity card might be another important mechanism for serving and 'metering' the consumption of a large number of small users over a vast geographical area. The South African electricity utility, Eskom, is using prepaid electricity cards to reduce the transaction costs of serving a dispersed rural customer base. And this is precisely the same challenge that Indian electricity distribution boards face.

For the power supplier, prepaid cards drastically reduce the cost of metering and charge collection. For users, it offers a practical and transparent way to plan and track their electricity consumption. Prepaid card systems are expensive to put in place for small numbers of users. But for the large volumes that rural power consumers in India use, this approach is quite affordable. Broad user acceptance will be ensured if the SEBs transfer part of their savings to users and invest in improving the quality of power supply.

The impact of 35% diesel price hike on pump irrigation prices



Time series diesel pump irrigation prices (from data collected by researchers with grassroots NGOs) in selected locations of north Bihar and eastern Uttar Pradesh. The research projects cost increases from the current Rs25–40 to Rs40–65, depending on price increases and competition levels in local water markets.

3. Improve Energy Efficiency in Pump Irrigation

Some 30–35% of the energy actually used by irrigation pumping can be saved by modifying pump sets. Against the maximum achievable efficiency of 54% for electric pump sets and 20% for diesel pump sets, observed efficiencies are sometimes as low as 13% and 5%, respectively. There are two common reasons: the subsidized flat electricity tariff; and farmers' lack of knowledge of how to select the right pump for the job, to operate and maintain it.

S.M. Patel, an agricultural engineer based in Ahmedabad, has pioneered thousands of pump rectification experiments throughout India. His work shows that simply replacing a pump's foot valve and suction pipe increases the water output of diesel pumps by 30%. But full-scale pump rectification— involving appropriately matched foot-valve, suction pipe, delivery pipe, pump and engine— can increase the discharge of a diesel pump by 85% and cut diesel consumption/hour by 17%.

Some Netherlands-supported experiments in north Bengal registered significant gains in energy efficiency by removing the restrictor and attaching a 'thermo-syphon' cooling system, reducing the engine speed and removing the check valve (or foot-valve in case of dug wells). Tests showed that this type of rectification can cut diesel consumption by half and improve discharge improved by more than 15%. What's more, while the

Impact of modifications on fuel efficiency of diesel pumps: Test results in north Bengal Terai Development Project (static suction head in shallow tube wells: 3.5 m)

Modification	Discharge (l/s)	Diesel consumption (l/h)	Cumulative Improvement (%)
Unmodified	8.6	0.8	-
Raising cooling water temp. from 35 °C to 75 °C	8.6	0.78	13
Removing check valve	10.5	0.76	31
Reducing engine speed from 1,470 to 1,100 rpm	10.3	0.55	51

Source: NBTDP 1996:4.

full rectification program recommended by S.M. Patel may cost nearly Rs8,000 for diesel pumps, the modifications piloted in the north Bengal project cost all of Rs350.

Many agencies have promoted programs for pump rectification, with mixed results. One important reason for this is that farmers are unable to meet the exacting conditions of maintenance, repair and access to spare parts that are required to achieve high fuel efficiency.

The reasons to persist with the pump rectification programs are compelling. Existing programs are driven primarily by the goal of energy efficiency, but pollution reduction is a relevant secondary benefit. Owners of rectified pumps are more competitive, as

The social welfare power of manual irrigation technologies

The impressive response received in Bangladesh and parts of eastern India, by improved manual technologies like the treadle pump confirmed that small farmers' purchasing decisions are highly price-sensitive. The treadle pump is also a perfect example of how groundwater irrigation had improved the livelihoods of the extremely resource-poor.

The treadle pump has many advantages, including: low price; no cash outlays for fuel; ability to transform smallholder farmlands even into cultivations with high-yielding varieties of crops; easy operation by women, men or children; ability to irrigate ½ acre of vegetables or paddy.

The significant role played by this 'wonder pump' in improving the access of the extreme poor to groundwater irrigation, should never be overlooked. Bangladesh has been successful in promoting it among a significant proportion of its rural poor. Today's challenge for eastern India is to adapt pricing and distribution strategies that will encourage the maximum uptake of this low-risk investment to the poorest category of potential treadle pump users.

they can charge a lower price for water they sell to poor farmers, as pumps use less diesel per hour of operation.

Looking at a potential real-life situation in a local water market, a group of owners of rectified diesel pumps enjoys a powerful competitive advantage over owners of

unmodified equipment. The former will provide water to local buyers at a doubly reduced cost-per-unit of water. This situation will generate market pressure to encourage the other diesel pump owners to rectify their pump sets to remain competitive.



4. Promote Appropriately Sized Diesel Pumps

Different types of water sources—canal and river water, deep wells, and shallow dug wells—require different types of pumps to irrigate most optimally. But the current Indian pump market does not provide the entire spectrum of pumps required for all farmers' pumping needs.

Shallow tube wells and dug wells in the Ganga basin cannot use all the power of a 5-horsepower (hp) engine because the suction head is very low and because, at full revolutions per minute, it uses only some 2–2.5 hp. The Indian pump industry has not effectively promoted anything smaller than a 5-hp diesel engine to drive an irrigation pump.

Only two manufacturers—Greves Cotton and Sriram Honda offer a 1.98-hp diesel/kerosene pump, which is popular in parts of the Chhotanagpur plateau. It is difficult to find pumps of this size elsewhere in the region. The key reason, it seems, is that the small pumps neither offer a significant price advantage compared to the 5-hp pumps nor are particularly fuel-efficient, as are some of the small Chinese pumps used in Bangladesh.

If the barriers on the import of micro-diesel pumps of less than 5-hp are lifted, small farmers—especially those on the Indian side of the Ganga basin—would probably have taken to them in large numbers, as have the Bangladeshi farmers.

5. Reform Pump-Subsidy Schemes

India's eastern states need a drastic reform of their pump-subsidy and credit schemes if they are to succeed in their goal of giving needy farmers better access to groundwater for irrigation.

With more than 30% of India's rural poor and 30% of its groundwater resources, the region accessed only 7% of NABARD's minor irrigation refinance funds, due to bureaucratic formalities. This poor uptake of the schemes does not reflect a lack of need or demand for the subsidy, nor does it reflect NABARD's unwillingness to push credit for tube wells in eastern India. Above all, it reflects the difficulty, hassle and transaction costs of accessing pump subsidy and loan schemes as they are designed and operated by state governments.

In north Bengal, members of the ruling political class hold a monopoly on the subsidy and use it as patronage to command and strengthen allegiance and political support. As this objective does not fit those of nationalized banks and NABARD, these institutions have reduced their participation.

In Orissa, the subsidy scheme is effectively controlled by a monopoly, which has skimmed the bulk of the subsidy by over-costing. This has resulted in a weak 'demand pull' from farmers to participate in this loan-subsidy scheme.

Eastern Uttar Pradesh has diffused this monopoly structure by allowing open market competition between a number of dealers, creating a win-win situation for all players. Dealers increase their sales and market share and the Free Boring Scheme gives them a powerful instrument to do brisk business. Banks are happy because dealers share the responsibility of recovering the loans. Staff in relevant government and bank offices enjoy the fact that their total rents are large (though the piece rate is lower). And farmers are supremely happy because for a small *sewa-shulk* (service charge) dealers give them red carpet treatment and deliver their tube wells inside of 10 days.

Research that lies behind this Briefing and a number of related studies suggest that removing the pump subsidy altogether is the best way to deliver pumps to poor communities faster. These studies show that pump prices in India would fall by 30-40% if pump subsidies are removed and free import of Chinese pumps is allowed. In Pakistan, which meets both these conditions, pumps are sold for 35-40% less than in India.

How private tube-well markets bring better services to farmers: The case of eastern Uttar Pradesh

A study in 1984 by the Delhi-based Society for Promotion of Wastelands Development concluded that even with all the paperwork of a small farmer in perfect order, the decision on his application under the Free Boring Scheme took 11 months.

Accessing the subsidy also required visits to various government offices, including the Block Development Office; Minor Irrigation Department; and the bank and District Rural Development Agency. Once the application was approved, another round of visits began, this time to have pipes and valves issued from the Minor Irrigation Department, diesel pumps issued from the designated dealers, and the bank loan released from the lead Bank for that district.

Other administrative hurdles were that only members of the field staff of the Minor Irrigation Department were allowed to drill the bore using the department's rig; and only one or two pre-designated brands of diesel pumps were available to the farmer. And finally, the farmer had to offer 'speed money' at every office visited, which meant that by the time the tube well was commissioned, 35-40% of the subsidy had gone as these service payments.

This situation still exists in north Bengal, Orissa and to a lesser extent in north Bihar. Eastern Uttar Pradesh broke free of this administrative stranglehold to transform its diesel-pump subsidy scheme into a powerful instrument of smallholder irrigation. The core of this was that private diesel-pump dealers replaced the government services as the central coordinating mechanism for the scheme. The diesel-pump dealer became the one-stop-shop for farmers wanting to set up a tube well under the Free Boring Scheme.

Interviews with some 200 small farmers in the Gorakhpur, Maharajganj and Deoria districts of eastern Uttar Pradesh confirmed that the emergence of the diesel-pump dealer was one of the best things to happen to the small farmers in the region. It was the dealer—or more precisely market forces that transformed the much-berated Free Boring Scheme into a powerful groundwater development tool.

Today, in eastern Uttar Pradesh, an eligible small farmer provides his photograph and land documents to the dealer of the brand of diesel pump he prefers. The dealer completes the entire process of getting approvals and clearances from the government departments involved and the bank. The pump and pipes are issued to the farmer on the same day. He is free to hire local rig operators to get his boring done, and within a week of applying, his tube well is commissioned.

Most of the farmers polled agreed that the cost of the pump without the subsidy would be lower by 8-10% but considered this a small service fee to pay for the red carpet treatment the dealer rolled out for them.

An estimated 800,000 small diesel-pump-operated tube wells have been installed in eastern Uttar Pradesh under the scheme after 1985. These wells irrigate an estimated 2.4-3.2 million hectares of their owners' and water buyers' lands, and provide the much-needed vertical drainage to the region.

Today, this market and service dynamic is largely missing in north Bengal, coastal Orissa and north and central Bihar.

Water Policy Briefing Series

The Water Policy Briefing Series translates the findings of research in water resources management into useful information for Indian policy makers. The Series is put out by the International Water Management Institute (IWMI) in collaboration with national and state research organizations. It is made possible by a grant from the Sir Ratan Tata Trust.

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IWMI-Tata Water Policy Program

The IWMI-Tata Water Policy Program was launched in 2000. This is a new initiative supported by the Sir Ratan Tata Trust. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resources management. Its objective is to help policy makers at the central, state and local levels address their water challenges—in areas such as sustainable groundwater management, water scarcity, and rural poverty—by translating research findings into practical policy recommendations.

Through this program, IWMI collaborates with a range of partners across India to identify, analyze and document relevant water management approaches and current practices. These practices are assessed and synthesized for maximum policy impact in the *Water Policy Briefing Series*.

The Policy Program's website (www.iwmi.org/iwmi-tata) promotes the exchange of knowledge on water resources management, within the research community and between researchers and policy makers in India.

IWMI in India

Over the past decade, researchers from IWMI have been collaborating with Indian scientists and development organizations in the areas of: irrigation performance; satellite remote sensing; irrigation management transfer; analysis of gender, water and poverty; and malaria control.

In January 2001, a field office was established in Anand, Gujarat to work with Indian partners on groundwater management and governance. In October 2001, IWMI established its India Regional Office in Patancheru, Hyderabad, Andhra Pradesh. IWMI's research and cooperation in India focus on three key areas: river basin water productivity, water and land management in watersheds, and groundwater management.

IWMI's principal partners and collaborators for its work in India are the Indian Council of Agricultural Research (ICAR), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and a host of state irrigation departments, agricultural universities, and nongovernmental organizations.

For further information, see www.iwmi.org/india or write to iwmi-india@cgiar.org

About IWMI

IWMI is one of the 16 Future Harvest Centers supported by the Consultative Group on International Agricultural Research (CGIAR).

The research program of IWMI centers around five core themes:

- Integrated Water Resources Management for Agriculture
- Sustainable Smallholder Water & Land Management Systems
- Sustainable Groundwater Management
- Water, Health and Environment
- Water Resources Institutions and Policy

The Institute fields a team of some 50 senior researchers with significant international experience, supported by national research staff and a corps of some 20 postdoctoral scientists, mostly from developing countries. IWMI is headquartered in Sri Lanka with regional offices in India, South Africa and Thailand.

All IWMI research is done with local partners (universities, government agencies, NGOs, research centers, etc.). The Institute's outputs are public goods that are freely available for use by all actors in water management and development. The IWMI Research Reports, data and other publications can be downloaded from the IWMI website or received free of charge from the IWMI publications office. A series of tools for improved water management is also available.

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