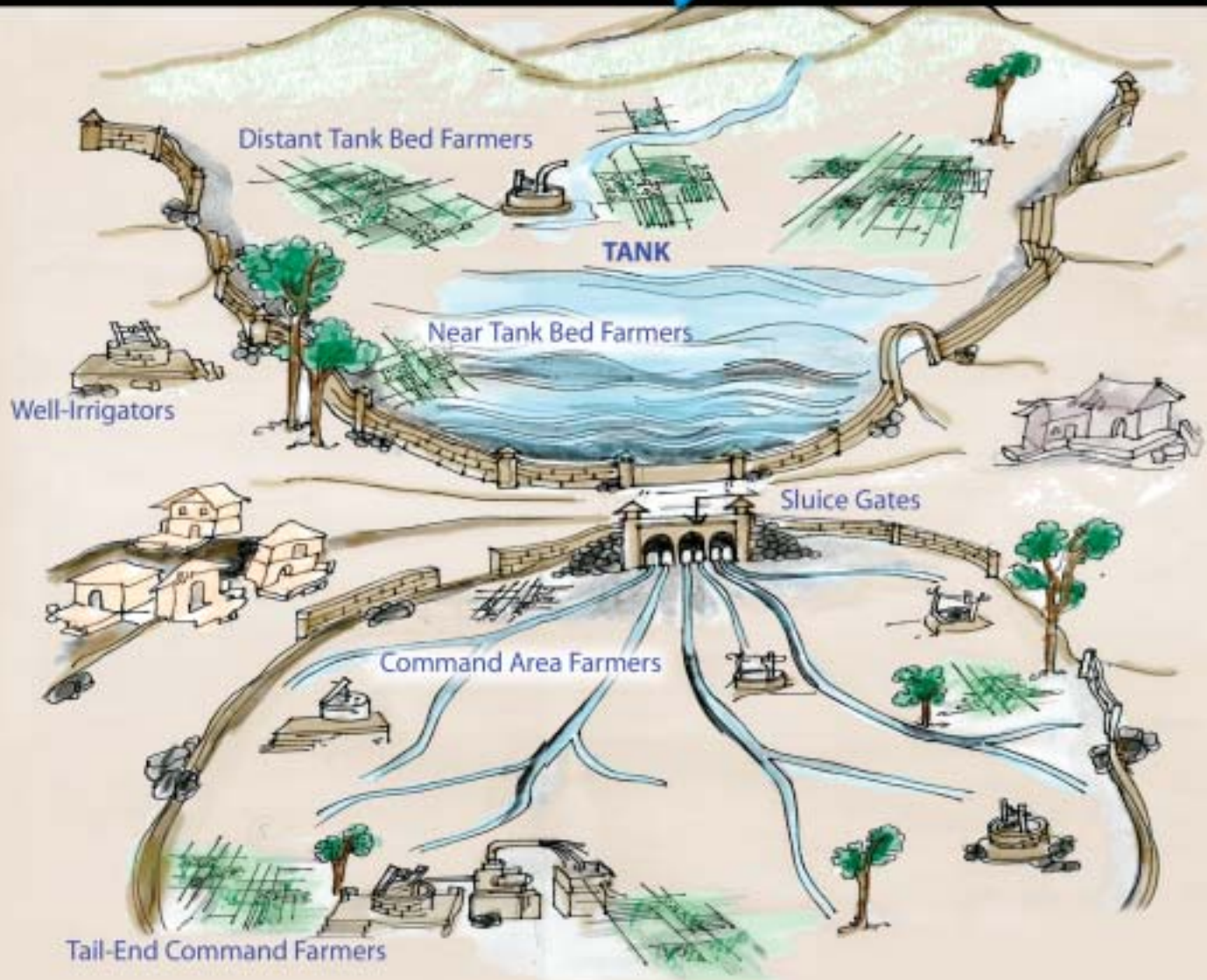


Water Policy Briefing

Issue 7

IWMI-Tata Water Policy Program

Putting research knowledge into action



Rethinking Tank Rehabilitation

Before renovating an old irrigation tank, take a closer look. You will see that in its current state of disrepair, it provides a valuable set of services to the community, which extend beyond irrigation. The only successful tank rehabilitation strategy is one that looks at all the current socio-ecological activities and their values. Not just irrigation.

Rethinking Tank Rehabilitation

Issues in restoring old tanks to their original state in irrigation structure

Approaching the rehabilitation of the 50-100 year-old irrigation tanks—spread across Rajasthan, South Bihar, Madhya Pradesh, Tamil Nadu, Karnataka, Andhra Pradesh, and other South Asian locations such as Sri Lanka—solely from an irrigation perspective, runs the risk of depriving communities of valuable socio-ecological services and functions that these structures provide today.

These tanks may have become ‘inefficient’ in their original function of providing flow irrigation, but as they have degraded over time, they have evolved into valuable systems that support people’s livelihoods in a number of ways. In addition to storing water for crop irrigation, tanks provide services such as recharge of groundwater used by adjacent communities, fertile silted soil that allows cultivation of additional crops, fishing and aquaculture, water for raising livestock, and sand and soil used by small industries.

So, to define tank rehabilitation as ‘*returning tanks to their original state as irrigation structures*’ runs the risk of increasing poverty and decreasing the livelihood opportunities of many stakeholders who depend on tanks in their current form for their livelihoods.

The research highlighted in this issue of *Water Policy Briefing* points to an alternative approach to rehabilitating tanks. It is one which aims to keep rehabilitation costs down and sustain the livelihoods of the many stakeholders who benefit from the tanks in their current state of disrepair.

Irrigation Departments favor ‘classical’ approaches to tank rehabilitation—renovating the

tanks (at high cost) by desilting the tank-beds or raising the bunds, repairing the outlets and lining the canals leading into them. This approach overlooks the gradual evolution of a tank’s role in the community and the new services that it provides. This classical rehabilitation will deprive a sizeable proportion of poor populations and return few advantages to farmers irrigating in the command areas. This was shown in a field study carried out in eastern Rajasthan.

This research suggests that rehabilitation of a tank should not be done before a profile of the current user base of the tank and its ecological functions is established. Key technical questions are: *What proportion of tank storage loss is due to evaporation and to groundwater recharge? What are the groundwater recharge coefficients respectively, in lined and unlined canal systems? What is the pattern of distribution of run-off capture and storage in various water harvesting and storage structures in a basin? How big are the underground recharge zones of different types and sizes of tanks? etc.*

A cost-benefit study is recommended, before rehabilitation begins. This analysis will help determine the balance of the financial or agricultural production advantages of returning the irrigation tanks to their initial condition versus



PHOTO: ICRISAT

The dry bed of a small water harvesting structure being cleared.

This issue of *Water Policy Briefing* is based on research presented in the paper *The Socio-Ecology of Tanks and Water Harvesting in Rajasthan* by Tushaar Shah and K.V. Raju. Readers interested in the details of this research can request a copy at the address given below. Questions and comments on this issue may be directed to Dr. Tushaar Shah c/o IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar 388 001, Gujarat, India or iwmi-tata@cgiar.org

the disadvantages and impoverishment which will be created among segments of the population who were not originally taken into account as stakeholders, when these tanks were built 50 or 100 years ago (and probably not since then).

Another important perspective in tank renovation is that the planners must look at the water resource beyond the scale of a particular tank. The river basin is the perspective that gives the most accurate overview of how much water is really available in a larger area or region. Looking at the tank question from this scale shows what the impact of tank rehabilitation in one location will have on neighboring and downstream communities. In a closed basin—where all water resources are used and little is flowing out to the sea—any significant modification in one part of the system will certainly adversely affect people in other parts.

Whatever their size and owner, water-harvesting structures all have the same primary purposes: gathering and storing as much rainwater as possible; preventing soil erosion and damaging floods caused by violent, unchecked water flows, and providing irrigation and domestic water to the local rural populations.

Potential benefits to local populations from “seasoned” multi-tank systems

1. The water table remains high thanks to widespread percolation, and irrigation water from wells becomes more available. It is favored by farmers for its flexibility.
2. Water becomes available in larger areas and to a larger number of farms, either as flow, tank, or as groundwater irrigation.
3. Land use improves as some tank beds are cultivated part of the year (*petta* cultivation) instead of remaining submerged.
4. Non-agricultural categories of the population gain access to water: for domestic use, but also for fisheries, livestock and industries.
5. Social customs and links are preserved or revived in building and maintaining traditional water-harvesting structures and in negotiating water use.



Planners assess the extent of rehabilitation required for this tank and its impact on downstream communities.

Rehabilitation of a tank should not be done before a profile of the current user base of the tank and its ecological functions is established.

However, Minor Irrigation (MI) tanks and smaller traditional tanks have been financed, built, managed and maintained by different authorities, and there have been some conflicts in the past. For a new system of water management to be implemented at the watershed level, integrating both large, older MI tanks and more recent but traditional water-harvesting structures, some new institutional developments may be required.

The thinking and perceptions of policy makers and development specialists—of what tank rehabilitation is (and is not)—is perhaps the biggest change that needs to happen to drive a more holistic approach to rehabilitation of tanks as common practice. This concept is not necessarily a new one, but it has yet to be taken up as a serious option by donor and policy makers in India. See this 1998 conclusion of an FAO-sponsored conference on irrigation systems modernization:¹

¹Kalu, Indra Lal. (1998) 'Modernization of Irrigation System Operation: Institutional Development and Physical Improvement', in D. Renault (eds) *Modernisation of Irrigation System Operations*, Proceedings of the Fifth International IT IS Network Meeting in Aurangabad, India, 28-30 October 1998.

The best strategy for both irrigation authorities and donor agencies involved in rehabilitation is to view tanks as complex socio-ecological systems with multiple stakeholder groups.

'Modernization is a process of upgrading (as opposed to mere rehabilitation) of irrigation schemes, combined with institutional reforms if required, with the objective to improve resource utilisation (labour, water, economic, environment) and water delivery service to farms.' The approach is sound, but to date little has been done to apply this knowledge more broadly or communicate the importance of rethinking tank rehabilitation to irrigation or development circles .

For each rehabilitation option, policy makers would of course have to consider the expected output, the financial investment required, and also the possibility of unrest in excluded parts of the population, and compare the appeal of the various solutions to motivate the farmers and other stakeholders, as members of Water Users' Associations, to participate in tank maintenance and water management.



Tanks provide services to the community that go beyond irrigation.

NGO strategies for small tanks

Small water-harvesting and storage structures, with a water spread area of a few acres, are known all over the country under various local names. They usually consist of a bund built along a contour, like a miniature version of an irrigation tank but without sluice gates and canals. NGOs have placed much emphasis on the variety of roles these small tanks play in their socio-ecologies.

As an example, PRADAN operates a rainwater conservation project in the Alwar district, Rajasthan, that aims at reviving the traditional *paal* (bund) system of rainwater harvesting. It has helped village groups build over 110 *paals* in several micro watersheds. PRADAN discovered early, the value of working on a system (or cascade) of *paals* covering an entire micro-watershed. A series of *paals* built in a zigzag manner in a micro-watershed capture and impound the floods flowing downstream, prevent massive soil erosion and greatly reduce flood pressure on the dams constructed downstream. At the same time, they produce dramatic impacts on both farm economies and the hydrology of these areas, mainly by improving groundwater recharge.

Tarun Bharat Sangh (TBS) works with *johads* in roughly 550 villages in the Ruparel river basin, Alwar district. Their water-harvesting work covers approximately 6500 square kilometers. This large range makes its impact more visible, and serves as an example for other villages who request for similar work. With a core staff of less than 100, TBS had several hundred volunteers chosen in the villages where they work, and they have evolved into small grassroots organisations.

Over the years, they developed a set of norms and rules that are generally accepted: for example, people who benefit have to contribute the labor required. They also contribute some material and cash. TBS tops this up with financial support for the hire of tractors and cement. TBS's own 'home-grown' engineers also provide crucial help in community organization, finding out the needs and concerns of participating members, and designing a structure that addresses these needs. Each *johad* then is differently designed to meet the unique needs of each site and group.

TBS's works are low-cost compared to government structures. A couple of middle-sized *pucca bandhs* (dams) in the village of Bikhampur cost only around Rs 30000 (US \$ 700) each, besides farmers' contributions. The same *bandhs* would have cost around US \$ 10000-15000 had they been built by the Irrigation Department.

This research strongly suggests that the best strategy for both irrigation authorities and donor agencies involved in rehabilitation is to view tanks as complex socio-ecological systems with multiple stakeholder groups. Instead of restoring at great cost the flow irrigation system to its former condition,

the focus should rather be on a wider, river basin or macro-watershed development and management approach. Socio-ecological systems, like living beings, subsist on complex and delicate balances between nature and various parts of the population living in the same territory. These complex socio-ecological systems have become integrated into the community in many ways, and should not be disturbed by sudden change or reversals, without proper planning and analysis.

Ecosystem functions of minor irrigation tanks

In addition to capturing rainfall and reducing soil erosion and flash floods, other, highly valuable functions can develop in partially degraded but “integrated” socio-ecological systems:

Better land-use

Degraded tanks compensate their lesser irrigation efficiency with improved land-use, unlike some large reservoirs and tanks in South India which take land in the submerged areas away from other uses. Many silted MI tanks are not full all year long, but can be used both for water-

Financial pros and cons: An “official” rehabilitation project in Rajasthan

The official strategy, it is claimed, would bring an additional command area of 64,000 ha under irrigation. Partly as a result of expanded storage and improved distribution systems. And partly because it closes the gap between the designed intensity of irrigation of 59% and the actual intensity of irrigation, estimated at 51%. This would enhance the net annual agricultural production in the command by an estimated value of US \$ 30 M against an investment of \$10.3 M. Of this, over 95% is assigned to engineering works including repairs on head-works, canals, farm channels, and other OFD works.

This official plan is expensive. The cost of new irrigation potential at nearly US \$1600/ha is high compared with the average cost of \$1280 incurred in constructing new small-scale systems during the 1992-6 period. It is several times higher than costs incurred by NGO programs with people's participation in construction.



Tanks are complex socio-ecological systems that also serve nature.

Degraded tanks compensate their lesser irrigation efficiency with improved land-use, unlike some large reservoirs and tanks in South India which take land in the submerged areas away from other uses.

storage and for ‘petta’ or ‘tank bed’ cultivation. A practice called ‘inundation irrigation’ has come into vogue over the years which involves emptying the entire tank in just one long spell of irrigation, soaking the ground downstream. It serves to help recharge the aquifers; it also helps top soils downstream retain enough moisture to see the *rabi* (winter) crop through. As silt and minerals contained in rain-water run-off concentrate in tank beds and improve the fertility of the soil, *petta* farmers are able to grow winter—and, sometimes, summer—crops. *Petta* land farmers and downstream farmers have learned, through a process of negotiation, to agree on a date on which the sluice gates will be open, to give both groups enough time to soak, then drain their lands and get ready for *rabi* cropping.

Aquifer recharging

In a cascade of seven *paals* in Kishan Garh, one of the clusters of villages where PRADAN work has matured, the static pre-monsoon water table in open wells has risen to 8 meters from an earlier level of 25-27 meters. Before, wells could not be pumped for long periods, and had to be left to recoup for days before they could be pumped again for an hour or so. Now these wells can be pumped for hours on end without causing a significant drop in water levels. A number of abandoned wells have been revived. Many farmers with electric pumps had previously disconnected their motors, but have now begun pumping again. Pump irrigation markets have sprung up; and a good deal of irrigation is done on the basis of 1/4th crop share.

The improved productivity of wells due to groundwater recharge is by far the most valuable benefit to farmers associated with the tanks. In Govindgarh tank in the Ajmer district, farmers asserted that rising land value after the construction of a new tank is by no means limited to tank bund and command areas but extends to the entire domain influenced by groundwater recharge due to the tank.

Groundwater recharge

Through porous tank and canal beds, and leaks in dams and canals, water permanently percolates into the ground and recharges groundwater, providing a reliable and flexible source of irrigation and domestic water supply in areas out of reach of the main irrigation tanks. Both in the command area of minor irrigation tanks and at the periphery, the water level in the wells remains high, and as pumps are getting more numerous, farmers prefer using that water on demand, rather than depending on a fixed irrigation calendar. Even poorer farmers without wells know the easiest way to access water for irrigation is to buy it from a neighboring well owner. Meanwhile, low-cost flow irrigation in the command areas remains available, although in smaller quantities.

More stakeholders

Farmers in the original command areas were the main stakeholders taken into account when most large irrigation tanks were built. But a multi-use system is valuable—free of cost—not only to them,

but also to more farmers at the periphery or upstream, relying on groundwater or on other water-harvesting structures, and to those *petta* farmers who cultivate the tank beds. It can also be used by fishing communities, for raising livestock and by small industries.

These complex socio-ecological systems have become integrated into the community in many ways, and should not be disturbed by sudden change or reversals, without proper planning and analysis.

The value of small rainwater-harvesting structures

The Center for Science and Environment has found evidence to show that diverting rainwater in a large number of small water harvesting structures in a catchment captures and stores more of the scarce rainfall closer to communities in arid parts of the world than a large reservoir downstream.²

Evidence from the Negev desert in Israel shows that 3000 micro-catchments of 0.1 ha capture 5 times more water than a single catchment of 300 ha, even more in a drought period. Michael Evanari, an Israeli scientist, shows that “While a 1 ha watershed in the Negev yielded as much as 95 cubic meters of water/ha/ year, a 345 ha watershed yielded only 24 cubic meters/year, i.e. as much as 75% of the water that could be collected was lost. This loss was even higher in a drought year.” Agarwal cites Evanari: “... during drought years with less than 50 mm of rainfall, watersheds larger than 50 ha will not produce any appreciable water yield while small natural watersheds will yield 20-40 cubic meters per hectare and micro-catchments (smaller than 0.1 ha) as much as 80-100 cubic meters per hectare. This is because water collected over larger watersheds will have to run over a larger area before it is collected and a large part will get lost in small puddles and depressions, as soil moisture and evaporation.”

²Agarwal, Anil. (2000). *Drought? Try Capturing The Rain*. Delhi: Center for Science and Environment.

How a collection of old irrigation tanks in Rajasthan turned into “a socio-ecological and economic marvel”

A century-old, rather decrepit collection of minor irrigation tanks, earmarked for rehabilitation by the Rajasthan Irrigation Department (ID), has grown together with a more diverse informally created water sector that includes a number of smaller, traditional tanks built by the villagers with the help of NGOs. At the watershed level, these structures are useful for an even larger number of users than before, including categories that were not formerly considered as stakeholders by the ID. It provides—at no cost to public funds—an effective recharge of the aquifers and improved land-use. This was shown in a detailed field study, commissioned in 1998 to assess the strategy of an official irrigation tank rehabilitation project in Eastern Rajasthan, by researchers of the Institute of Social and Economic Change in Bangalore with the International Water Management Institute.³

The state of Rajasthan receives an average of 550mm of rainfall, mostly in the span of a few hours in torrential showers. To capture and retain this water, a large number of water-harvesting structures have been built. Small traditional check dams called *johads* or *paals*, spanning several acres, were traditionally used in Rajasthan over centuries but had fallen into disuse. Their use was revitalised by government programs and NGOs such as Tarun Bharat Sangh (TBS) and PRADAN in the last 20 years. These informal structures now supplement a collection of ‘minor irrigation’ (MI) tanks with command areas of 1000 ha or more. Together, they are the mainstay of the state’s rural communities, especially in the eastern and southern parts. In many river basins, an ecological equilibrium has prevailed that represents years of mutual adaptation by many water users.

Minor irrigation tanks were mainly built in the 19th and 20th centuries by the *Rajahs* and *Jagirdaars*, at a time when the population density was lower. They were traditionally managed for multiple uses by local communities through an intricate web of customs, traditions and community sanctions.

During the 1950s, MI tanks were brought under the management of the State Irrigation Department which lacked the resources to invest much in maintenance and repair. Today, the 4600 MI tanks with their sluices and canals are in an advanced state of disrepair and the rehabilitation of 1200 of them is being considered.

At first sight, their situation looks disastrous. The tank beds have been silted up, particularly near the dam, reducing their storage capacity. Siltation near the sluice gates often blocks the gates partially and/or raises the silt level. Because of siltation, the carrying capacity of canals has also been reduced. Most tanks have only unlined earthen canals and seepage rates during conveyance are high. A lack of maintenance and repairs has created breaches in the tank bunds. On many old canals, there are no outlets; so farmers themselves make breaches and divert the flow to their fields, and frequent breaching has made the canal walls weak. Water leaks continuously and percolates to the aquifers. The numerous smaller water-collecting structures built by villagers with the help of NGOs in the catchment area further decrease the amount of water gathering in the tanks. Distribution problems also arise: tail-end farmers face difficulty in receiving water at all, particularly in years of low rainfall when the tank is only half-full and the need for irrigation is acute. Commonly, tail-enders hardly manage to get one irrigation round when head-reach farmers get three.

A closer look at the situation, however, greatly brightens this somber picture. As the socio-economic context gradually changed over the last 50 years—with population increase, farm implantation in formerly uninhabited zones, and a growing tendency among the farmers to resort to individual groundwater irrigation instead of communal flow irrigation—the irrigation system has adapted itself to new needs. Paradoxically, in this new context, Rajasthan’s tanks in their present decrepit state fulfil a complex set of useful functions for a larger and more diverse group of stakeholders.

³Rethinking Rehabilitation: Socio-ecology of Tanks and Water Harvesting in Rajasthan, North-West India, by Tushaar Shah (Research Leader, International Water Management Institute, Colombo) and K Vengama Raju (Senior Fellow, Institute of Social and Economic Change, Bangalore) 2001.

Of course, the requirements and interests of all these groups do not necessarily coincide. For example, farmers in the command area may rather see the tanks desilted and their capacity augmented, while *petta* farmers are eager to keep cultivating the silted tank beds. However, good will and the legacy of local customs and traditions should make it easier to negotiate, so that none of the stakeholders feels thoroughly excluded from the benefits of the water, as would be the case if large MI tanks were

“rehabilitated” to their initial designation, i.e. serving only the needs of the farmers in the command area.

Capturing more water

Figures on rainwater capture by small tanks taken from studies in the Negev desert (Israel), add weight to the beneficial role of many small water-harvesting structures in a catchment.

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*.

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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.

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- 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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