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RESEARCH Update

News of the Progress and Impact of IWMI's Research • July 2003

Fulfilling the Promise of Small-Scale Technologies

Small-scale irrigation and water-harvesting technologies can have a direct impact on some of the world's poorest people. But which technologies provide the greatest benefits? What factors encourage or impede their adoption? And what is the potential effect of widespread use on the environment and other water users in a basin? Part one of a two-part exploration.

In African countries, such as Zambia, Kenya, Niger, Malawi and Zimbabwe, the treadle pump is gaining recognition as a way to increase household food security and the availability of water for domestic use.

Nearly two-thirds of the rural population of developing countries–almost 1.8 billion people–live in marginal agricultural areas. It is here–where people suffer from low agricultural productivity and limited livelihood opportunities–that small-scale technologies could have the greatest impact on the poor.

Communities, often in partnership with NGOs, are developing and adapting new technologies or reviving old ones to meet their water management challenges. But while some of these spread quickly, many remain unknown outside their originating community. IWMI research in Africa and Asia is identifying promising small-scale technologies and analyzing both the technological and social constraints that impact adoption.

Technologies that can benefit the rural poor include low-cost pumps, local storage structures, soil and water conservation techniques, low-cost irrigation technologies (such as 'bucket and drip'), and rainwater harvesting.

"While trying to encourage the spread of suitable technologies, we need to keep in mind the bigger basin picture," says Dr. Frits Penning de Vries, leader of IWMI's research on smallholder technologies. "We need to be able to determine the impacts of large-scale adoption, something implementing NGOs are not currently equipped to do. Research has a very necessary role to play here."

Large numbers of technology adopters in a basin can affect the water balance. A river basin perspective and

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LEARNING LESSONS FROM RURAL COMMUNITIES

Through a grant from the Department for International Development (DfID), IWMI research assessed six traditional and innovative technologies that are helping poor communities in South Asia improve their livelihoods.

- Rainwater harvesting through *Paals* for groundwater recharge, Alwar, Rajasthan (India)
- 5% pit technology (on-farm rainwater harvesting and storage), Purulia, W. Bengal (India)
- Low-cost drip irrigation kits, Tanahun, Palpa and Dailekh Districts (Nepal)
- Integrated land and water management of degraded hillside watersheds, Udaipur Dist., Rajasthan (India)
- Wastewater irrigation, Ranga Reddy & Nalgonda Dist., Andhra Pradesh (India)
- Multiple uses of rejuvenated village tanks 'Ooranis', Ramanahapuram Dist., Tamilnadu (India)

Putting Water-Food-Environment Research on the Global Agenda: From Johannesburg to Evian

While the pressing issues of drinking water and sanitation have dominated the global agenda on water with good reason, other issues vital to sustainable development—how water can be better managed to provide food security and preserve the environment—are only now receiving attention in the international arena. A global water-food-environment agenda is beginning to take shape. IWMI is actively contributing to the formation of this agenda through a number of partnerships promoting research-based knowledge on water-food-environment issues.

The water-food-environment nexus is increasingly being recognized as inseparable from key development targets in the areas of poverty eradication, food security, and human health. This growing awareness is reflected in the action plans of the United Nations Secretary-General's WEHAB initiative, the World Summit on Sustainable Development, the 3rd World Water Forum and, most recently, the 2003 G8 Summit in Evian.

Executive Director of the United Nations Environmental Programme, Klaus Toepfer, in his comment on WSSD outcomes, states: "...the WSSD highlighted that water is not only the most basic of needs but is also at the centre of sustainable development and is essential for poverty eradication. Water is intimately linked to

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Fulfilling the Promise of Small-Scale Technologies

tools, such as IWMI's Water Accounting method, are needed to support sustainable implementation strategies.

Treadle pump success story

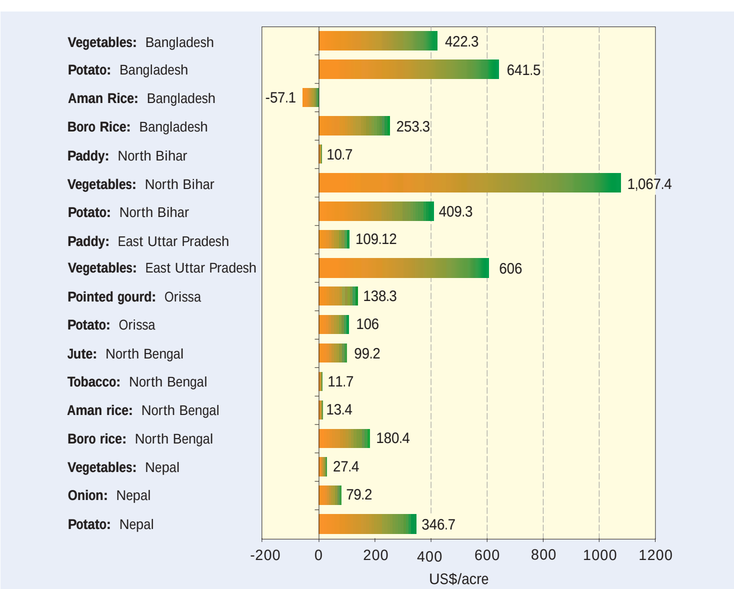
Treadle pumps are low-cost, pedal pumps that enable small farmers to tap groundwater–supplying irrigation to their crops when and where they need it. Treadle pump farmers are able to cultivate more land with less labor and, as a result of the more reliable water supply, increase their crop yields. According to an IWMI study in South Asia, in the long run, treadle pump-adopter households are likely to perform better in terms of savings and capital accumulation and investment in agriculture and education. The spread of pumps in a community also improves wage rates and employment opportunities for the landless.

The research suggests that the treadle pump has the potential to put $1 billion of new revenue directly into the hands of some of Asia's poorest people. Originally introduced in Bangladesh in the early eighties by the NGO, International Development Enterprises (IDE), treadle pumps are slowly spreading throughout the subcontinent. To date, some one million units have been sold in Bangladesh, but sales have yet to break the half million mark in eastern India and Nepal terai–where IDE estimates there is a potential market of 9-10 million.

Based on the findings of the IWMI research, IDE reformulated its marketing strategy in India. The study, which found that first-time buyers are more motivated by cost considerations than quality, emphasized the importance of providing users with cheaper models as well as IDE's standard product. Encouraging competition in treadle pump manufacturing and marketing was another key recommendation. The result of these changes is that over a dozen treadle pump manufacturers have sprung up in eastern India and treadle pump sales have climbed.

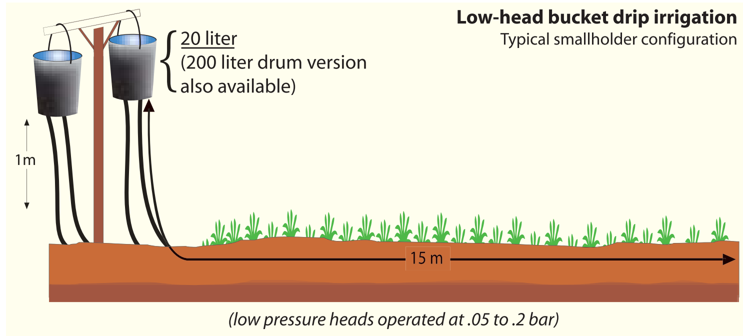
With the help of local NGOs, the treadle pump is now gaining acceptance in parts of Africa including Kenya, Niger, Malawi, Zambia, and Zimbabwe. IWMI supported research to create a new pump design that meets specific material supply, performance and market conditions in South Africa. Ms. Caryn Seago of the Institute for Agricultural Engineering who is leading the project says, "It's important that treadle pumps are easy to maintain and don't require expensive input costs. In our design we tried to use parts that are readily available in most villages so that it can be manufactured and repaired locally." Priced at around 600 Rand ($75)–15 percent of the cost of a diesel pump–the treadle pump brings pumping technology within range of the nation's poor farmers. The next step is to explore manufacturing strategies and credit options to enable purchasing on a large-scale.

Income Impact of the Treadle Pump in South Asia: Increased Value of Output/Acre (US$)



Treadle pump technology raised annual incomes of adopter households by $50–500, with the average value in the neighborhood of $100.

Source: IWMI Research Report 45, "Pedaling out of Poverty: Social Impact of a Manual Irrigation Technology in South Asia", Shah et al.



(low pressure heads operated at .05 to .2 bar)

Drip irrigation kits

Farmers in several Asian and African countries are already seeing the benefits of 'bucket and drip' irrigation kits. A simplified version of the more expensive drip irrigation technologies, the kits include a bucket or drum to hold water, a filter and rubber or plastic tubing with small holes or emmitters for supplying water to the plants. For as little as $5, this technology allows farmers to apply limited amounts of water to their crops in a way that makes the best use of scarce water while saving labor, and improving their yields.

As part of a DFID-supported study on small-scale technologies in South Asia, IWMI evaluated this successful innovation in Nepal, where IDE has designed a variety of drip kits to meet the needs of smallholders. The kits are easy to install and the systems are expandable–so farmers can start small and scale-up as their financial situation improves. According to the IWMI study, crops irrigated using this technology show water savings of up to 50 percent and yield increases of 30 to 50 percent.

The kits enable farmers to grow high-value crops, such as fruits and vegetables, even in areas that suffer from water scarcity. IWMI research has shown that the technology has raised incomes and as a secondary impact has improved in-house and off-farm employment opportunities. Improved household nutrition is another benefit documented by the study.

In Kenya, an IWMI study evaluated the most commonly available low-cost drip systems to address design constraints and develop practical recommendations for smallholders adopting the technology. Farmers interviewed offered ample testimony to the benefits of bucket and drip irrigation. Four months after installing a bucket and drip kit, Mrs. Mutai reported she had already sold enough vegetables to invest in more drip lines and make her garden bigger. After adopting bucket and drip irrigation, Anne Butia sold $200 worth of vegetables in three months from her home garden. Her neighbors used to walk 10 km into another district to buy vegetables but now they buy them from her. The extra income has helped pay school fees and buy clothes for her family.

The Paal revolution

In Rajasthan, the revival of a traditional community-managed technology, *paals*, has benefited farmers and the larger community. These simple structures built across seasonal watercourses help farmers overcome the constraints of erratic rainfall and dry season water shortages. The *paals* retain water on the fields and increase infiltration by spreading it over a larger area of the catchment. In combination with field bunds, *paals* increase soil moisture, reduce erosion, and contribute to groundwater recharge.

These structures had fallen into disuse after many farmers migrated during the Indo-Pakistan partition in the late 1940s. In the early 1990s the NGO, Professional Asistance for Development Action (PRADAN), spearheaded the revival and improvement of *paals*.

IWMI research evaluated the *paal* project with support from DFID. "We've been able to substantiate a number of direct benefits from the use of this technology," reports IWMI-Postdoctoral scientist, Shrinivas Badiger who managed the study. "Farmers are now able to grow more than two crops a year where earlier only one was possible. Their productivity has gone up and pumping costs for groundwater have gone down as a result of the recharge provided by the *paals*. Communities where the paals were taken up also seem to be experiencing a general socio-economic uplift."

Mr. Handa Khan, a 48-year-old farmer, and his wife and five children are a few of the beneficiaries. Before the *paal* revival, they could only grow enough food for 4 to 6 months and had to work in others' fields to make ends meet–some years migrating as far as Haryana to find work. When asked about his life after the revival, Khan says, "Since the *paals* have been restored, we are not only self sufficient but also sell a significant portion of our produce to the local market. All my children now go to school. The moneylender now doesn't hesitate to lend me large amounts in case I have large expenses such as buying a pump or for a wedding. My wife can fetch water from a well nearby, while earlier she had to walk long distances just to fetch drinking water."

Paals, a traditional community-managed technology in Rajasthan benefits farmers by improving soil moisture and groundwater recharge.

According to the IWMI research, *paals* have the potential to benefit smallholders in areas where geology favors storage and extraction of water in soil and rock layers and where there are no problems with salinity, excessive flooding or waterlogging. IWMI is currently working with PRADAN and other NGOs to promote the spread of the technology in India.

In the next issue of Research Update: More on the potential of small-scale technologies to help farmers in rainfed areas of sub-Saharan Africa.

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Putting Water-Food-Environment Research on the Global Agenda

The WaterDome, organized by IWMI on behalf of the African Water Task Force as an official parallel event to the World Summit on Sustainable Development, advocated increased attention for water-food-environment issues on the international development agenda. Here Nelson Mandela, the HRH Prince of Orange and HE Salim A. Salim officially open the WaterDome.

health, agriculture, energy and biodiversity. Without progress on water, reaching other Millennium Development Goals (MDGs) will be difficult if not impossible."

Research has played a significant role in this shift in thinking–from a sectoral approach to water to looking at water in a much broader and more integrated context. And the responsibility of research in shaping future thinking has been acknowledged by the international development community. The WSSD Implementation Plan and G8 Summit Action Plan on Water both call for collaborative research to improve water resources management. The World Water Forum Statement highlights the important role of international programs such as the Dialogue on Water, Food and Environment and the CGIAR's Challenge Program on Water and Food "*to bridge the gap between the food and environment sectors and to develop mechanisms to increase the productivity of water for food and livelihoods in a manner that is environmentally sustainable and socially acceptable.*"

Contributing to global knowledge

IWMI, the Challenge Program on Water and Food, the Comprehensive Assessment of Water Management in Agriculture, and the Dialogue on Water, Food and Environment have joined together to ensure that research knowledge is used as a basis for better decision-making on water–from policy makers to river basin communities. Over the coming 5 years, these linked initiatives will produce a significant amount of new data, research findings and recommendations for ways to improve water management for food and environmental security. "The common goal of these activities is that they produce public goods–freely available tools and knowledge–aimed at improving livelihoods and protecting the environment," says Prof. Frank Rijsberman, IWMI Director General and Chair of the Challenge Program.

To ensure the maximum impact from their complementary research outputs, these programs are developing a strategy for effective two-way knowledge transfer between research and its intended beneficiaries. This strategy is based on the creation of strong partnerships, establishment of durable communication channels, and identification of effective tools for dialogue and knowledge delivery, including shared electronic platforms.

To follow the progress of these initiatives and track the publications and recommendations as they emerge, point your browser to www.waterfoodenvironment.org

International initiatives contributing to THE GLOBAL WATER-FOOD-ENVIRONMENT AGENDA

- **The Challenge Program on Water Food:** Finding ways of growing more food with less water—while improving rural livelihoods and protecting the environment.
- **The Dialogue on Water, Food and Environment:** Bringing together agricultural and environmental communities to find ways of managing water to meet the needs of both.
- **The Comprehensive Assessment of Water Management in Agriculture:** Assessing the past 50 years of water development for agriculture to support better-quality investments for food and environmental security in the future.

Ensuring Women Farmers Get the Water They Need

A practical new tool for more gender-appropriate irrigation management—developed through research supported by the Swedish International Development Agency (SIDA), the Ford Foundation and the Government of the Netherlands.

Irrigation agencies often operate on the premise that all farmers are men, leaving women farmers with unequal access to water and no recourse for addressing the imbalance. "If male farmers have taken the irrigation turn of a woman it is difficult for her to win the battle," reports one woman farmer from the West Gandak irrigation scheme in Nepal. "The other farmer may admit that he is wrong, but he will not change his practice."

Ensuring women farmers have access to resources and to decision-making forums, such as Water Users Organizations, is increasingly being recognized as vital not only for women's livelihoods but also for the health and productivity of many irrigation schemes. But the pace of reform has been slow and progress uneven. "There is still a big gap between good intentions and effective action," says IWMI gender and water expert, Dr. Barbara van Koppen. "Policy makers and change agents need tools to help diagnose concrete gender issues in irrigation schemes and design appropriate interventions."

To fulfill this need, IWMI researchers developed the Gender Performance Indicator for Irrigation (GPII). The Indicator has been successfully tested in nine case studies in Asia and Africa and is now being released for use worldwide.

Identifying agents for change

The GPII taps information that is typically available in intervention contexts to measure women's and men's relative access to irrigation at farm-level, and to decision-making processes at forum and leadership levels. It helps to direct action by identifying the primary shapers of inclusion/exclusion that need to be targeted in order to achieve change.

The first step in applying the indicator is to determine whether farmers in a system are predominantly female, male, or a more-or-less even mix (a dual system). This in turn determines the approach needed. An intervention successful in a female- or dual-farming system is unlikely to be effective in a male-dominated scheme and vice versa.

Van Koppen explains, "In male-dominated schemes, it is more the structure of agrarian society itself, than the policies of agencies that are responsible for the exclusion of women farmers. In these cases, to include the minority of women farmers, you have to challenge the gender-bias of the locally prevailing production and institutional arrangements–something irrigation agencies can't do alone."

In female and dual farming systems, research has shown that irrigation agencies themselves largely determine whether women farmers are excluded or included.

The GPII helps avoid this situation by distinguishing between women who are farm decision-makers and women who participate only in specific farming tasks. This difference is often overlooked in the formulation of 'gender-sensitive' projects and interventions–with the result that these fail to address the true needs of women farmers.

In South Africa's former homelands, an estimated 70 to 90% of farmers are women, but a much lower percentage have titles to the land they cultivate. In the National Water Act of 1998, the South African government helped open up Water Users Associations to these women farmers by removing landownership as a criterion for membership. Women are now able to demand the water they need.

The Gender Performance Indicator for Irrigation (GPII)
MEASURES INCLUSION/EXCLUSION AT THREE LEVELS

- Women's and men's access to water and irrigated land at farm level
- Inclusion in irrigator's network in which rules for infrastructure construction, operation and maintenance are set and enforced
- Eligibility and election for leadership positions and women's capacity to function well in these roles

Identifying women's needs

One of the primary reasons for the failure of previous efforts has been inappropriate targeting for gender inclusion. To successfully address exclusion of women, the intervention needs to take into account the role women already play in agriculture.

In some cases, aid organizations and NGOs have attempted to improve the situation of women by forcing blanket gender-inclusiveness onto farming systems where women do not traditionally participate, except in specific tasks such as weeding or harvesting. "Blanket measures seldom achieve anything beyond window dressing," asserts van Koppen. "Trying to ensure that all women participating in farming get equal access to irrigation water, without regard to the type or level of participation, is unrealistic and in the end fails to reach those women whose livelihoods depend on having equal access."

Related reading:

- Research Report 59: *A Gender Performance Indicator for Irrigation: Concepts, Tools and Applications*
- Contribution to World Water Vision for Food and Rural Development: *From Bucket to Basin: Poverty/ Gender*
- Working Paper 8: *An Assessment of Female Participation in Minor Irrigation Systems in Sri Lanka*
- Working Paper 10: *Gender and Irrigation in India: The Women's Irrigation Group of Jambar, South Gujarat*
- Working Paper 11: *Gender in Lift Irrigation Schemes in East Gujarat, India*
- Working Paper 15: *Women Irrigators and Leaders in the West Gandak Scheme, Nepal*

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Why is Integrated River Basin Management Reform Failing to Stick?

It's generally agreed that an approach to managing water that is integrated and basin-wide, rather than sectoral and territorial, makes good sense. So why are Integrated River Basin Management (IRBM) models failing to stick in so many developing-country basins?

IRBM models that have been successful in the USA, Europe and Australia are increasingly being imposed on river basins in Africa and Asia by well-intentioned governments and donors. But the experiences of many countries suggest that this reform has failed to bring basins any closer to achieving IRBM.

A recent IWMI report highlights the bad fit between the IRBM models promoted and the realities and priorities of developing-country river basins as a root cause of this failure. These models are not adapted to the very different hydrologic, demographic, socio-economic and organizational conditions that prevail in the developing world.

"It's an entirely different ball game from IRBM in western countries," explains Dr. Tushaar Shah, leader of India's IWMI-Tata Water Policy Program. "For reform to succeed in developing countries such as India, you have to find ways of influencing huge numbers of small-scale water users who depend on rain-fed agriculture and private or community water storage, without much mediation from public agencies or service providers."

Creating basin organizations is not enough

Research identifies a narrow focus on the formation of basin-level institutions as another factor in the failure of IRBM reform—particularly when this means simply changing the mandate of existing irrigation agencies.

The lesson: Creating institutions for river basin management does not guarantee IRBM. For example, China's Basin Management Committees were established in the 1950s with the aim of generating hydropower, mitigating flood damage and providing facilities for navigation. But in the end they have focused only on irrigation.

Says Shah: "We have so many examples of IRBM failures in Asia, but despite this, basin-level institutions are still held up by many influential organizations as the best, even the only model for water management—regardless of the context."

This does not mean that basin-level institutions have no role to play in the developing world. But river basin organizations by themselves cannot be expected to address the more fundamental challenges that water sectors in developing countries must contend with.

Addressing developing-country priorities

The big success stories of IRBM, such as the USA's Tennessee Valley Authority and Australia's Murray-Darling Basin, have focused on rivers, lakes, and reservoirs ("blue water") and on improving the productivity of large publicly managed systems. This means they have not had to address many of the challenges central to the sustainable and productive use of water in developing countries. These include:

Challenge 1. Regulating the Informal Water Sector

How to regulate vast numbers of small-scale users who are not linked into public institutions? One possibility, suggests Shah, is to find ways of underpinning macro-level institutions with nested organizations of users at the grassroots.

Challenge 2. Improving the Productivity of "Green Water"

For countries such as India and China, where the population density is high both upstream and downstream, increasing the productivity of water diverted from rivers is less important than being able to capture rainfall and store water effectively in the soil profile ("green water").

Challenge 3. Managing Groundwater

In South Asia, Southeast Asia and Northern China, protecting groundwater from over-exploitation by millions of small unlicensed pumpers is an increasingly pressing issue. Community initiatives for groundwater recharge may offer the most immediate hope for reversing damage in areas where water tables are dropping as much as a meter per year.

Challenge 4. Water Scarcity

The heart of the problem in most water-scarce countries is too many people living off a limited natural resource base. Getting more crop, cash and jobs per drop is part of the answer; the other is generating off-farm livelihoods in rural areas.

Says Shah: "Answers to the developing world's most pressing water issues—lack of access to water, vulnerability to drought, shrinking aquifers—may fall largely outside of what are traditionally defined as 'institutions'. Communities tend to find their own solutions and will have to play a large role in any successful IRBM strategy."

DIFFERENT RIVER BASIN REALITIES DEMAND DIFFERENT SOLUTIONS

Developed country river basins—dominant characteristics	Developing country river basins—dominant characteristics
• Temperate climate, higher river-stream density (with Australia as a notable exception)	• Extreme climate, higher mean temperature, lower stream density
• Population concentrated downstream in valleys	• Population high both upstream in catchment areas and downstream in valleys
• Water rights clearly defined; based on riparian doctrine and prior appropriation	• Water rights often not clearly defined; based on land ownership
• Focus on water found in rivers and lakes	• Focus on water stored in soil profile or aquifers
• Small numbers of large-scale stakeholders	• Vast numbers of small-scale stakeholders
• Small percentage of population dependent on farming for livelihoods	• Large percentage of population dependent on farming for livelihoods (as well as subsistence)
• Water users get water from service providers, water provision is in the formal sector—making water resources governance feasible	• Water users get water without mediation from public agencies or organized service providers—making enforcing water legislation difficult
• Low transaction costs for monitoring water use and collecting water charges	• High transaction costs for monitoring water use and collecting water charges

Related reading:

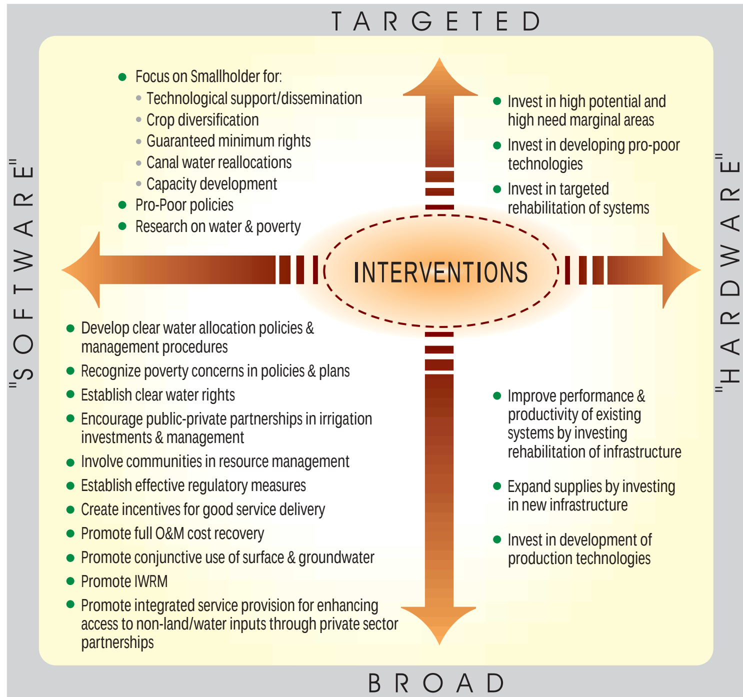
- *Limits to Leapfrogging: Issues in Transposing Successful River Basin Management Institutions in the Developing World*, by T. Shah, D. Molden and R. Sakthivadivel.
- IWMI–TATA Water Policy Briefing Issue 3: *The Challenge of Integrated River Basin Management in India.*

www.iwmi.org/iwmi-tata

Help for Farmers Left Behind in Asia's Green Revolution

In Asia, irrigation development has been a vital component of the 'Green Revolution,' which in the past three decades has helped improve rural incomes and lower food prices. Yet many of the continent's poor farmers—even those within established irrigation commands—have not benefited. An ADB-supported study uncovers the complex links between irrigation development and poverty reduction and identifies ways of targeting those left behind in the Green Revolution.

Menu of productivity enhancing pro-poor interventions: ***The Way Forward***



Many farmers within established irrigation schemes still lack a sufficient and reliable supply of water, despite huge investments in irrigation development over the last 30 years. This is largely due to insecure water rights, unequal water distribution within schemes and poor management practices.

"Because these farmers can't count on receiving enough water for their crops, they do not invest in other green revolution inputs, such as fertilizers and higher-yielding crop varieties, that could improve their productivity and increase their incomes," says Dr. Intizar Hussain, the IWMI economist leading the study. "This situation leads to a low productivity rut that is difficult for farmers to escape from."

The IWMI study looks at the links between poverty and access to water for irrigation in six countries: Bangladesh, The People's Republic of China, India, Indonesia, Pakistan and Vietnam. The objective is to find ways of managing existing irrigation assets to improve productivity and returns to farmers and to identify pro-poor approaches to irrigation development for the future.

Redressing inequalities

"We are learning that development strategies focused exclusively on economic growth, or 'increasing the size of the pie,' do not necessarily contribute to poverty eradication unless they are accompanied by deliberate measures that ensure equity in access to, and control over, resources," says Hussain.

Research shows that decisions regarding access and control of water are in many cases still determined along caste, ethnic and gender lines (see "Ensuring Women Farmers...," page 4). In irrigation schemes, the wealthy elite tend to take the most advantageous plots, close to the canal head. They also have a greater voice in decision-making forums than poor farmers. "Governments have had a difficult time tackling the deep-rooted social issues that often lie at the heart of inequitable access," says Hussain. "It takes more than just clearly defined water rights, but awareness on the part of historically disadvantaged farmers of what those rights are and mechanisms to ensure they are enforced."

The study has identified a number of options to improve poor farmers' access to water. For example, legal and third party enforceable service contracts that define clear water rights and entitlements in irrigation systems can improve service levels for all farmers, including the poor. Measures such as developing and implementing water allocation rules for maximum and average, and minimum flows can ensure that farmers with plots at the tail-ends of canals get a share of water, even during shortages. Managing groundwater and surface water together can help to distribute water more evenly throughout the system.

Improving access to other resources

The research emphasized the importance of providing support measures (such as, access to inputs, technologies, credit and markets) in maximizing the poverty-fighting potential of access to water. Access to knowledge and decision-making forums is another important factor highlighted by the study. Reforming farmer organizations and water users associations to ensure that small farmers are included in decision-making helps these farmers assert their rights to water. Encouraging public-private partnerships and the creation of farmer networks for knowledge dissemination also have great potential.

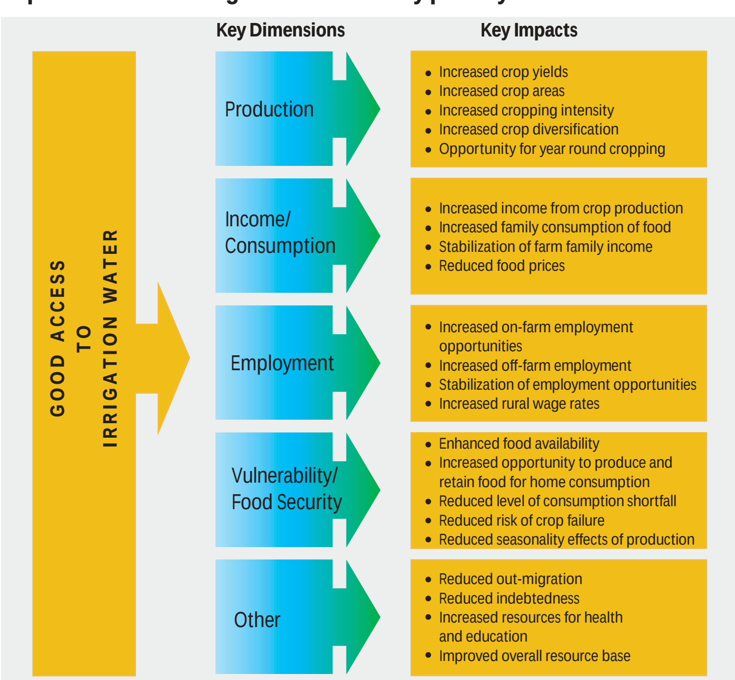
"Our goal is to provide governments with better knowledge of their options for reducing poverty and improving productivity in irrigation sysems—what works and what doesn't," says Hussain. "Our hope is that they will use this knowledge to create positive change."

Related reading:

- IWMI Working Paper 39, *Irrigation Impacts on Income Inequality and Poverty Alleviation*
- IWMI Proceedings, *Managing Water for the Poor*
- IWMI Proceedings, *Irrigation against Rural Poverty*

www.iwmi.org/pubs

Impact of access to irrigation water on key poverty dimensions



Addressing the Needs of Aquatic Ecosystems

A recent global assessment of environmental water requirements suggests that a significant proportion of the world's river flows may need to be allocated to maintain functioning freshwater ecosystems. According to the study, over 1.4 billion people already live in river basins where high water-use levels threaten the environment.

PARTNERS

- IWMI
- World Resources Institute (WRI)
- Center for Environmental Systems Research of Kassel University
- IUCN–the World Conservation Union

This research was supported by the Comprehensive Assessment of Water Management in Agriculture.

The study, which provides initial estimates of the environmental water requirements for major river basins, enables policy makers and water users to see more clearly the trade-offs associated with their water-allocation decisions. "This analysis provides a better understanding of how much water countries can withdraw from their river systems for agriculture and other uses without causing irreversible harm to the natural resource base," says Dr. David Molden, leader of the Comprehensive Assessment of Water Management in Agriculture.

Presented at the third World Water Forum in Kyoto, the study is the first to consider the requirements of freshwater ecosystems in assessing water-scarcity on a global scale. It improves on existing global studies, which are most often based on a comparison of water withdrawals to water availability without considering environmental requirements.

"Freshwater species and habitats are highly threatened, more so than any other ecosystems on earth. Without sustaining the underlying freshwater ecosystem and its dependent species, we will lose many of the goods and services we take for granted, such as fisheries and flood control," says Ms. Carmen Revenga, Senior Associate at the World Resources Institute (WRI), who participated in the study

How much water do rivers need?

The study's estimates are based on the premise that river ecosystems where flows are relatively steady are more sensitive to human-induced flow reduction than those with a large variation in flow. The reasoning is that ecosystems where life is adapted to stable river flows throughout the year will need a higher proportion of natural runoff to maintain their functions.

In the study scenario, ecosystems located in the equatorial belt or in regions with a high proportion of lakes, where river flows do not vary much, have been allocated a larger proportion of the water flowing into the basin. Ecosystems in monsoon-driven river systems and rivers in arid areas, where river flows can vary greatly between wet and dry seasons, have been allocated a lower proportion of the water flowing into the basin. Under these assumptions, the estimates of environmental water requirements range globally from 20 to 50 percent of total water available per river basin.

A tool for dialogue

"We view these estimates as a plausible scenario of basin-scale environmental water requirements," says Dr. Vladimir Smakhtin, Principal Eco-Hydrologist at IWMI, who is leading the research. "Environmental water allocation is a very site- and basin-specific matter. At the same time, in many developing countries, environmental water requirements have never been assessed. We are attempting to help fill this gap with preliminary estimates based on existing knowledge, which can then be refined further through more research and dialogues with relevant stakeholders on the ground."

"We hope the environmental water estimates can become the basis on which to build basin-wide discussions. Stakeholders need this type of information to make informed choices regarding the usage of water," says Ms. Domitille Vallee of the Dialogue on Water, Food and Environment, an international initiative that brings together agricultural and environmental communities to find ways of managing water to meet the needs of both.

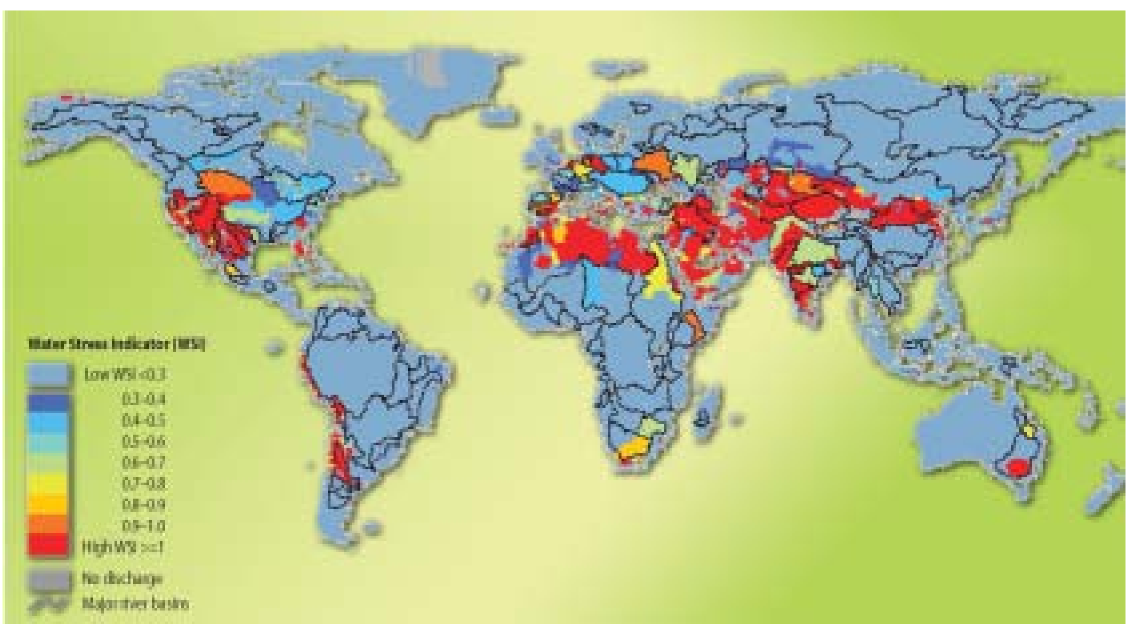
The inability to link environmental security with water and food security has been identified as a major stumbling block for sustainable development. IWMI is currently working to refine initial estimates of environmental water requirements for aquatic ecosystems and to develop new tools for incorporating environmental water needs into planning and decision-making processes.

Related reading:

- IWMI Working Paper No. 42: *Environmental water needs and impacts of irrigated agriculture in river basins: A framework for a new research program*

For more information on IWMI's research on water and environment, see www.iwmi.org/environment

Water stress in major basins taking into account environmental water requirements



Basins are shown as having a high degree of water stress if the amount of water withdrawn for human use is a large proportion of the amount available after environmental requirements are met. Basins with a water stress indicator above 0.4 are already considered as areas under some environmental stress. In many basins, particularly in North Africa, the Middle East, South Asia, Northern China and the Western United States, there is little or no scope to increase water withdrawals without causing irreversible damage to ecosystems.

Introduction to New Researchers

- **Dr. Boubacar Barry,** Regional Researcher, IWMI Subregional Office in Accra, Ghana (as of March 1). Dr. Barry holds a Ph.D. in Agricultural & Biological Engineering from the Purdue University, USA.
- **Mr. Marco Blixt,** Associate Expert, Dialogue on Water, Food and Environment Secretariat, Sri Lanka (as of February 5). Mr. Blixt has been seconded to IWMI by the Swedish Government. He holds a M.Sc. degree in Biology from the University of Göteborg, Sweden.
- **Dr. Mobin-ud Din Ahmad,** Post-Doctoral Scientist, IWMI Global Research Center, Sri Lanka (as of February 1). Dr. Ahmad started as a Water Resources Engineer with IWMI-Pakistan. Prior to joining IWMI's PostDoc program, he did his Ph.D. research in the Division of Water Resources & Environmental Studies at the International Institute for Geo-Information Science and Earth Observation (ITC), The Netherlands.
- **Mr. Naoya Fujimoto,** Principal Researcher/Deputy Coordinator Comprehensive Assessment, IWMI Global Research Center, Sri Lanka (as of June 2). Prior to joining, Mr. Fujimoto was the Head of the Laboratory of Agricultural Water Management Unit of the National Institute for Rural Engineering (NIRE), Japan.
- **Dr. Chu Thai Hoanh,** Senior Researcher, IWMI Global Research Division in Sri Lanka (as of May 1). Dr. Hoanh, an experienced hydrological modeler, holds a Ph.D. in Agriculture and Environmental Science from the International Institute for Aerospace Survey and Earth Sciences, Enschede, and Wageningen Agricultural University in the Netherlands.
- **Mr. Philippe Lemperiere,** Researcher, IWMI Subregional Office for Eastern Africa and Nile Basin (as of March 1). At IWMI, Mr. Lamperiere is leading the APPIA Project–improving the performance of small- and medium-scale irrigation schemes in Ethiopia and Kenya. He is an agricultural engineer who graduated from the Ecole Nationale d'Ingenieurs des Travaux Agricoles of Angers, France.
- **Dr. Prasad Thenkabail**, Senior Researcher, IWMI Global Research Division in Sri Lanka (as of March 24). Dr. Thenkabail comes to IWMI from the Center for Earth Observation, Yale University, USA. He holds a Ph.D. in Agricultural Engineering from the Ohio State University, USA.
- **Dr. Shinji Suzuki,** Post-Doctoral Scientist, IWMI Southeast Asia Regional Office, Thailand (as of April 21). Dr. Suzuki holds a Ph.D. in Soil Physics from Hokkaido University, Japan.
- **Dr. Bharat R. Sharma,** Liaison Officer, IWMI, New Delhi (as of April 24). Prior to joining IWMI, Dr. Sharma served as Assistant Director of the Indian Council of Agricultural Research. He holds a Ph.D. in Soil Science from the Punjab Agricultural University, India.

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Recent Water Policy Briefings

Issue 6: Pro-poor Irrigation Management Transfer *(IWMI-Tata Water Policy Program)* Research has revealed that many irrigation management transfer programs have aggravated–rather than reduced–rural poverty. Policy makers need to ensure that poor farmers participate equally in the decision-making process to avoid reinforcing existing inequalities or introducing new ones.

Issue 7: Rethinking Tank Rehabilitation *(IWMI-Tata Water Policy Program)* 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.

Issue 8: Improving water productivity: How do we get more crop per drop? *(Comprehensive Assessment of Water Management in Agriculture)* Agriculture consumes 70 % of the world's developed freshwater supplies. By improving the productivity of water used for agriculture, it is possible to reduce the amount of additional water withdrawals needed to feed the world's growing population. What steps can policy makers take now? And where should we invest in research for the future?

Recent Publications

For a complete list of recent publications and on-line access to IWMI Research Reports and Working Papers, see www.iwmi.org/pubs

Hussain, I.; Sakthivadivel, R.; Amarasinghe, U.; Mudasser, M.; Molden, D. 2003 *Land and Water Productivity of Wheat in the Western Indo-Ganjetic Plains of India and Pakistan: A Comparative Analysis*. (IWMI Research Report 65)

Kikuchi, M.; Weligamage, P.; Barker, R.; Samad, M.; Kono, H.; Somaratne, H. M. 2003. *Agro-well and Pump Irrigation Schemes in the Dry Zone of Sri Lanka: Past Diffusion, Present Status and Future Prospects* (IWMI Research Report 66)

Murray-Rust, H.; ul Hassan, M.; Horinkova, V. 2003. Water Productivity in the Syr-Darya River Basin (IWMI Research Report 67)

IWMI Papers in Internationally Refereed Journals

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