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RESEARCH Update

News of the Progress and Impact of IWMI's Research • September 2001

The Groundwater Dilemma:

Danger Zones and Opportunities for Poor People

A cubic meter of groundwater creates several times more income than a cubic meter of water from large surface irrigation systems. How far is this resource protected and its potential understood?

Tapping and using groundwater in a sustainable way is a formidable challenge that few developing countries and local communities have been able to meet. The problem is a pressing one, with crises beginning to emerge in Asia and a serious risk to food security in India and China, where up to 25 percent of the harvest is at risk due to falling water tables, according to recent IWMI research.

Countries must put strategies in place that ensure equity of access for all members of society, and sustainable use of the groundwater resource. What action can be taken? What can we learn from the successful groundwater management experiences?

Developed countries like Australia and the US have successfully managed their groundwater resources. For example, in Australia's Murray-Darling River Basin, where high salinity in groundwater threatens the future of the country's agricultural economy, new river basin institutions provide for trade in 'salinity credits'; this means that one can no longer have free rides. In the western US, groundwater rights are closely monitored by groundwater district authorities. Water institutions here also arrange to import surface water from long distances to reduce groundwater pumping. They line the aquifer borders along the coast with high-capacity recharge wells to maintain a fresh water barrier to prevent sea water intrusion into coastal aquifers.

"These experiences provide good lessons, and advice," says Tushaar Shah, leader of the IWMI groundwater research theme. "But they cannot be directly applied to the Asian context. The scope is very different. There are hundreds of millions of people in these areas, many of them living in extreme poverty, as opposed to millions in developed countries; and the developing country institutions are not as adaptable."

Competition for Water

Competition for water between farmers, cities and industries often result in over use of groundwater. People draw more water than what is actually seeping in. This has many social and environmental dimensions and can adversely affect the major breadbaskets of the world. In China, 52 percent of the irrigated lands are served by tubewells. Research shows that in these areas, since 1967-2000, the water tables have been falling greatly–from 8 to 50 m–due to over exploitation of groundwater. In the Fuyang basin of North China, IWMI found out that surface water supplies to agriculture was drastically curtailed to meet the industrial needs and farmers have responded by resorting to groundwater irrigation. This has increased the number of tubewells tremendously resulting in the fall of water tables.

Groundwater, if tapped responsibly, offers immense opportunities for poverty reduction.

Continued on page 2 ➤

Dialogue on Food, Water and Environment:

Bridging the Gap between Water-for-Food and Water-for-Environment

IWMI participates in the international initiative that aims to close the 'water-food-nature' gap.

There is much debate–and to date little consensus–on how much water is needed to provide food security for the world's developing countries, and how much water is needed to sustain natural ecosystems.

Water-for-food proponents call for water use to be expanded to increase food security and improve people's livelihoods in rural areas paying less attention to nature conservation. Nature protection groups focus on biodiversity and preserving natural ecosystems, placing less emphasis on the development objective–food security.

"Both points are valid," says Hans Wolter, Director of the Secretariat of the Dialogue on Water, Food and Environment, an international policy and research coalition led by ten of the most influential players representing the irrigation, nature conservation and farmer groups. "The missing link is open communication between these interests and the understanding by each of the other's situation. This is precisely the goal of the Dialogue on Water, Food and Environment–to bring these two groups together to find common solutions," he explains.

The Dialogue's objective is to influence policy makers to encourage better investments in water development infrastructure that support countries' food security requirements and preserve natural ecosystems for future generations. It will do this by bringing to the debate a new body of science-based information that will help reach consensus on the water needs for food and nature.

Continued on page 4 ➤

Dialogue on Water, Food and Environment

Malaria & Agriculture (SIMA)

Assessment of Water in Agriculture

Link to these international research partnerships through www.iwmi.org

(Continued from cover)

Groundwater and Poverty Reduction

At the heart of the groundwater problem is population density; cities just do not have enough recharge area to support the needs of their inhabitants on a sustainable basis. Intense drawing of water results in the falling of water tables as in many parts of India, China and Western Turkey. Millions of people in India and Pakistan are already suffering from the consequences of over-exploitation of groundwater. In the two Punjabs, Haryana, and Rajasthan the growing salinity of groundwater has meant that people have been forced to switch to contaminated surface water for drinking and washing; in North Gujarat and Southern Rajasthan fluoride contamination in deep tubewells has caused major health hazards, especially to children; in hard rock Southern India, the poor farmers are finding their pumps left high and dry as water tables decline and pumping costs increase. In West Bengal and Western Bangladesh people are slowly poisoned by their drinking water–arsenic-contaminated groundwater.

Directly concerned by the current lack of solutions and the potential disastrous situation looming in many developing countries, IWMI has expanded its groundwater research. The goal is to produce ‘action research’ that brings policy makers and communities new insights and practical solutions to address their groundwater situation. The five-year target is to produce a range of practical groundwater management tools, change the thinking of policy makers, and encourage countries to create strategies to manage groundwater more effectively.

Asia and Africa: The two extremes

“There are two groundwater extreme scenarios,” explains Shah. “Crisis in Asia and opportunity in Africa. For both, research-based solutions are needed.” The root of the Asian groundwater crisis that threatens millions of poor rural communities is caused by the very fact that makes it a powerful poverty fighting tool–anyone has easy and free access. These aquifers have been open to anyone who can afford a pump. The exponential growth of pumps– estimates say 20 million in India today, and growing by 1 million every year– has caused water tables to fall at a rate 2-3 meters per year in many regions of this country. Pakistan is experiencing similar problems in its northern provinces of Baluchistan and North West Frontier Province (NWFP).

In Africa, millions of rural people live within a few meters of water that can easily be tapped to grow crops–and lift them out of poverty. “Here we need to learn from the Asian cases and provide research-based advice to ensure that these aquifers are used in a sustainable way,” Shah cautions.

IWMI’s groundwater research

IWMI’s Groundwater research theme has grown out of a series of groundwater research projects done over the past decade. We have created a focused groundwater research agenda because we know there are many practical ways to help. We also see massive development of groundwater resources for smallholder agriculture that are being planned as a part of countries’ food security policies, both in Asia and Africa.

Shah explains: “Our research target is to create a new understanding of the groundwater problem areas and opportunities. This knowledge will help governments formulate groundwater management strategies that are responsible and sustainable. It will also provide practical information for development partners and NGOs, to help them deliver groundwater to rural areas and avoid the tragedies caused by salinity, overdraft or arsenic and flouride poisioning,” says Shah.

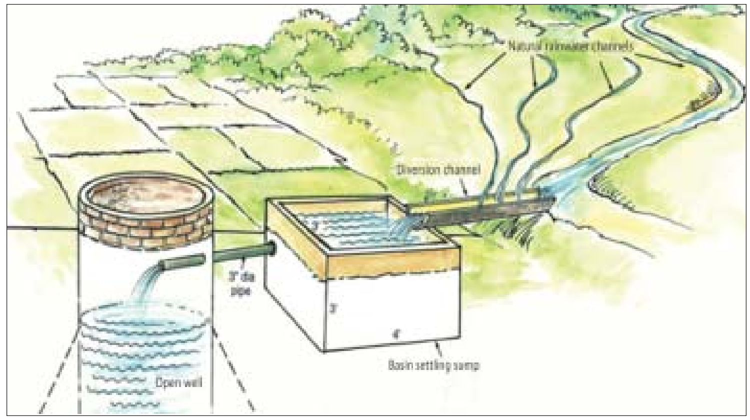
IWMI’s work has helped put the groundwater perspective of developing countries on the global water agenda. It led a special groundwater session and presented new research at the Second World Water Forum in 2000.

A recently completed research project looked at the potential for large canal irrigation systems in northern India’s Madhya Ganga plain to be used to recharge groundwater aquifers. This 10-year study confirms that by making slight modifications to drainage canals, groundwater can be effectively recharged. These results are being published in a special report to advise Indian ministers and policy makers of the options available to them to address the water crisis. Lessons learned here are relevant to canal irrigation systems in other developing countries.

Another study in western India looked at the socio-ecological value of groundwater and consequences of its unsustainable use. This research identified the potential of social and religious movements to encourage recharge groundwater in drought-prone locations by modifying wells into ‘recharge systems’ channeling water back into the ground. In Saurashtra, western India, a massive well-recharge movement converted some 300,000 wells for recharge. “It would be difficult to imagine achieving such an impact–a permanent change in a population’s thinking on a large scale–through the standard development project approach,” comments Shah.

Insight and practical solutions

A new initiative to address North Gujarat’s sustainable groundwater management is currently underway under the IWMI-TATA water policy program.



A typical open well recharge system used in Saurashtra, India to divert rainwater runoff to refill groundwater aquifers.

Major groundwater challenges for the developing world

- The potential for development of large, currently untapped groundwater aquifers in the world—including the Ganga-Meghana-Brahmaputra basin in South Asia and areas of Vietnam, Laos and South China.
- The most formidable challenge is to attain the sustainable use and management of groundwater in vast and growing regions where the resource is under threat.
- Thousands of rural communities in Africa live several meters from groundwater aquifers that can be tapped to grow new crops. This resource must be used in a sustainable and responsible way.

Examples of groundwater overexploitation

- In western and peninsular India water tables are falling. More drilling causes more pumping costs.
- In India’s Gujarat and Rajasthan States, groundwater over use is causing fluoride contamination of drinking water supplies—a major public health crisis.
- In Bangladesh and West Bengal, the groundwater is arsenic contaminated.
- In Pakistan’s Indus River Basin secondary salinization of water and land are brought on by inappropriate practices for the combined use of surface water and groundwater.

The ultimate goal of this initiative is to achieve sustainable management of water resources, drought preparedness and stability in agricultural livelihoods. The aim of this research program is to find practical solutions at the policy level. Local groundwater and surface water availability during periods of water stress will be ensured through water harvesting and groundwater recharge mechanisms. A new ethic of sustainable water and natural resource management through intensive education and awareness is also included. "The results and lessons of this initiative may offer a "show-case" for sustainable land and water management in water-stressed regions elsewhere in India and the world," says Shah.

IWMI researchers are perfecting groundwater mapping techniques, using satellite remote sensing and Geographical Information Systems in countries like Pakistan. Here, the emphasis is on developing low-cost technology tools that developing countries can use to improve the understanding of their water resources situation.

Probably one of the most exciting results of IWMI groundwater research is the recent treadle pump study led by Tushaar Shah. This research concludes that the treadle pump—the manually operated water pump used to irrigate small plots of land—has the potential to put US$ 1billion directly into poor households in Northern India and Bangladesh—the 'poverty square' that is home to 500 million of the world's poorest people. The pump costs between US$12-25 and can be easily operated by anybody, including children.

Warning signals

Despite the warning signs and crisis situations surrounding groundwater use, Shah believes that this resource can be sustainably developed to the benefit of large numbers of rural communities. "The fact is, though freshwater supplies are decreasing and demands on the resource are increasing, there are still river basins in the world which offer huge opportunity for livelihood creation through poverty-focussed groundwater development; and the Ganga basin is one of these," he says.

The research now in progress at IWMI and the technical work of national research institutes in places like China and India is uncovering the best options that are practical and effective in the context of developing countries.

IWMI-TATA water policy program

The Sir Ratan Tata Trust of India has joined hands with IWMI to launch a water research and policy program that aims to help the country find viable solutions to its water crisis. The program, led by IWMI, taps into the talent and existing work of Indian research institutes and non-governmental organizations. It creates a policy dialogue that will encourage a change in thinking on water issues. The IWMI-Tata Water Policy Program pools the knowledge of Indian and International Institutes to identify possible solutions and relevant courses of action. The main objective is to give policy makers the scientific tools needed to avert India's impending water crisis. The Tata Trust has provided a grant of US$ 1 million over five years for this research.

The treadle pump, a manually operated water pump, allows poor farmers to access groundwater to irrigate small plots of land. IWMI's research shows that this simple technology has the potential to put US$ 1 billion of new revenue directly into the hands of some of the poorest people in the world.

IWMI Integrates IBSRAM's Land Management Expertise

A wealth of expertise on sustainable land management and soil science had been added to IWMI's water research portfolio, with the merging of the research activities of the International Board for Soil Research and Management into the IWMI research program.

The addition of the IBSRAM expertise strengthens IWMI's water resources expertise in several ways.

IBSRAM's research and the tools it has developed over the past 15 years strengthen IWMI's position as a natural resources research center and bring new skills and a network of new contacts—at the farm and NARS level—into the CGIAR. The sustainable land management research that integrates into IWMI's science program includes:

Catchment management network. A consortium for integrated research on catchment management, composed of different stakeholders in water catchments—in Indonesia, Laos, Malaysia, Nepal, Philippines, Thailand, Vietnam, together with 20 national partners, and three advanced research organizations.

Soil conservation on sloping lands. A seven-country network (China, Indonesia, Laos, Malaysia, Philippines, Thailand, Vietnam) developed with scientists and farmers. Findings are now being introduced on a large scale through demonstration and extension programs.

Acid and infertile soil management network that seeks ways to better manage acid and infertile soils, with particular attention to phosphorus management in Indonesia, Myanmar, Philippines and Vietnam. A capacity building for relevant soil analyses is being done in all eight ASEAN countries.

Research to determine nutrient balances of farms on marginal lands. Creation of land management information for farmers that brings together relevant information about land management from many sources, and makes it truly accessible to farmers and their children through the Internet. This work is implemented through partners in Indonesia, the Philippines, and Thailand.

Nutrient recycling in urban and peri-urban areas. Research and cooperation with many partners to set up a regional consortium for research and capacity building.

Training program for national research centers in land and water legislation to help these organizations review their legislation for water and land management, and to support the adoption of the best elements from other countries.

All past research produced under IBSRAM will be a part of the sustainable land management web page on the IWMI site www.iwmi.org/landmanagement

IBSRAM tools are being integrated into the IWMI tool kit and will be disseminated to partners and users across the developing world.

(Continued from front page)

Bridging the Gap between Water-for-Food and Water-for-Environment

Creating a knowledge base

Supporting the Dialogue is a Knowledge Base of authoritative new information and research that is being created by a number of independent international activities from the nature and irrigation communities. These include activities such as the UN World Water Assessment Program, International Commission on Irrigation and Drainage WATSAVE and Text Delivery Programs, UNESCO Hydrology for Environment, Life and Policy program, the WHO Fact Sheets on Water-Associated Diseases, IUCN Freshwater program, FAO Long-Term Forecasting Program, CBD/Ramsar River Basin Initiative, the CGIAR Comprehensive Assessment of Water Management in Agriculture and the Millennium Ecosystem Assessment.

The Knowledge Base is currently in its planning and design phase, and new participants are welcome, according to Frank Rijsberman, Chair of the Dialogue consortium and Director General of the International Water Management Institute (IWMI). He explains that, rather than create a single program or 'knowledge superstructure,' the Knowledge Base will tap existing development and research initiatives that are active at the international, national and regional levels. "It is about creating the linkages, more than about creating new activities," he says.

"There are many activities planned or now in progress that are looking at water resources from the biodiversity and agricultural perspectives. Over the coming five years, the Knowledge Base will tap this knowledge and attempt to synthesize it into useful data, best practices and tools credible to both the agriculture and environment communities."

Comprehensive Assessment fuses into Dialogue

The Future Harvest agricultural research centers will make a significant contribution to the Knowledge Base, through the Comprehensive Assessment of Water Management in Agriculture. This is a broad-based water resources and agricultural research initiative that will document the costs and benefits of irrigation over the past 50 years, look at the current situation, present data and tools that policymakers can use to make more informed decisions on water-food-nature development in the future. "Having a better knowledge of the costs and benefits of water development for agriculture–over the past 50 years and looking at innovative solutions created by the people in rural areas to address their water crises–will give insight into how food production and nature can coexist in the coming 50 years," says David Molden, Principal Researcher leading the Comprehensive Assessment.

The IWMI water and land resources research reveals only a part of the picture. It is completed by the work of partners in the other Future Harvest Centers. They are developing drought and salt-tolerant plant varieties; practical and low-cost methods to sustain soil fertility in poor areas; ways to manage forests to catch and distribute water; strategies where fisheries and irrigation work together; and other research-based solutions. "Water saving and novel approaches to fight water scarcity, and ensure food security and nature protection is a big and complex issue. The combined knowledge and coordinated work of the Future Harvest Centers on this problem will have a big impact on improving people's livelihoods," says Molden.

Dialogue on Water, Food and Environment

PLANNED OUTPUTS:

- **Irrigation-environment dialogues** in 20 countries (national, basin and community levels).
- **'Water options' scenarios for policy makers** (global, national and basin levels)
- **Best practices and innovations** created by communities and countries.
- **New and authoritative knowledge** for policy makers.
- **Exchange of practical experience** through a worldwide dissemination and education campaign.
- **Input to key meetings** (Rio + 10, 3rd+4th World Water Forum, ICID Montreal, UN Convention meetings).

THE PARTNERS:

- Food and Agriculture Organization (FAO)
- Global Water Partnership (GWP)
- International Commission on Irrigation and Drainage (ICID)
- The World Conservation Union (IUCN)
- International Water Management Institute(IWMI)
- United Nations Environmental Program (UNEP)
- World Health Organization (WHO)
- World Water Council (WWC)
- World Wide Fund for Nature (WWF)
- International Federation of Agricultural Producers (IFAP)

Comprehensive Assessment of Water Management in Agriculture

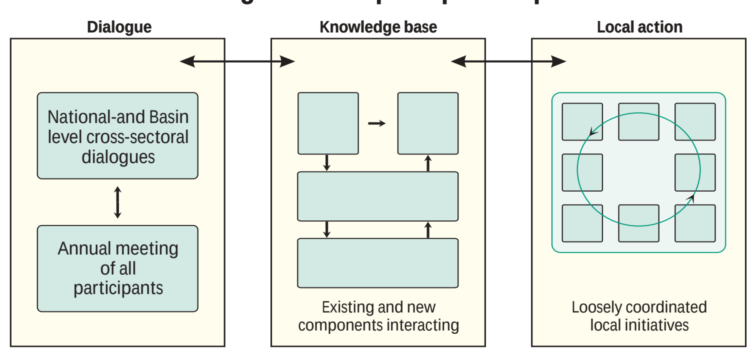
How the CGIAR's 'Future Harvest' centers help solve the water crisis

- Crop breeding (drought and salt-tolerant varieties)
- Soil nutrient management (sustaining fertility)
- Technologies (low-cost drip irrigation and water harvesting)
- Irrigation and basin-level management for water savings
- Policies and institutions (pricing, water user organizations, basin management)
- Integrated Natural Resource Management of water for fisheries/forests/crop cultivation
- Forest management for catchment protection, agro-forestry for income
- Irrigation effectiveness to protect forest reserves

Major outputs

- **A new information set on water use in agriculture.** Global assessment of irrigation benefits and costs; map of global irrigated agriculture and a wealth of new water use statistics; more precise data on groundwater use in agriculture and hotspots where its use is unsustainable; potential of rainfed agriculture to meet food production needs; and health impact assessments.
- **Tools to help water managers and policy makers** strengthen water-food-nature strategies.
- **Identification and dissemination of innovative solutions** created by poor communities, governments and international organizations.
- **Capacity building to help water stakeholders** apply tools to improve the situation in their areas (national and local levels).
- **Knowledge input and technical advice** into the Dialogue on Water, Food and Environment.

The Dialogue's three principal components.



Putting the Right Value on All Aspects of an Ecosystem

Tools and methods for valuing ecosystems need to be robust enough to provide good quality analysis in developing country situations where there is a chronic lack of data. IWMI and its partners are developing valuation tools that encourage priority setting between poor people, local authorities and others interested in using common water and land resources.

If something has value for you, or if you are informed of its value, you will treat it with far greater care. This is common sense and human nature. Yet billions of dollars have been spent on water resources and rural development projects in developing countries–ranging from the digging of wells, building of irrigation canals–based on a less-than-complete picture of the actual situation and consequences of the intervention.

This is not to say that decisions were hastily made. Implementing agencies– for the most part–planned responsibly and used the best data available to forecast costs and benefits of the projects. The missing link has been a lack of methods that clearly show the value of all aspects of an activity. And more importantly, a lack of agreement on how to assign value to the various aspects of a development activity that includes more than profit and financial returns.

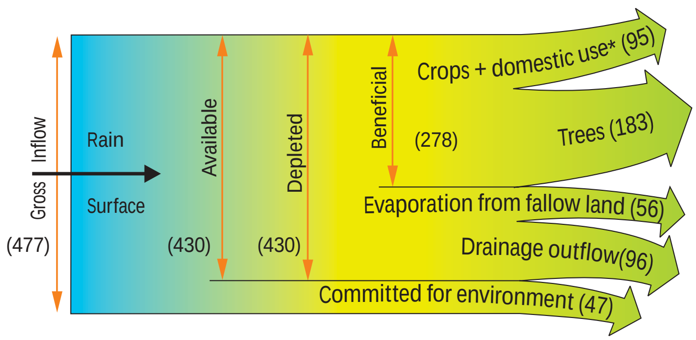
Water delivery options

A newly constructed irrigation canal will deliver water to rural communities more consistently and presumably, bringing improvements to crop yields and people's livelihoods. But what are the costs?

Or what is the choice of water delivery options available that can achieve the same results, with lower negative impacts on nature; respecting the social structures and cultural practices in villages? And with a higher impact in terms of giving the poorest members of the community better access to water and land resources.

Does saving water for wetlands keep certain populations below the poverty line? Are animals and biodiversity at risk due to irrigation?

Questions like these are at the heart of a debate, fuelled largely by emotion and anecdotal evidence, of what is good and bad about certain water development investments made in the past. The use of economic valuation techniques for natural resources puts facts on the table that allow users, developers and protectors of natural resources to assess the impacts of their decisions and reach common agreements that all can live with.



A water accounting view of Sri Lanka's Kirindi Oya shows all water users (figures in million m^3).

"It would be naive to think that all sides can achieve everything they want in a negotiation on the development of natural resources. But resource valuation techniques do ensure that interventions will not be planned blindly, without giving all stakeholders a clear understanding of the costs, benefits and other impacts of their actions," says Intizar Hussain, agricultural economist and senior researcher at IWMI.

Best evaluation techniques

Techniques for valuing ecosystems have been used for the past 20 years. But almost all the existing approaches are designed for use in developed countries. Parameters such as poverty, equity, gender, or allowances for a chronic lack of reliable data, are not taken into account.

"Through our research we are building a set of valuation tools that include parameters such as benefits to poor communities, poor people's ability to access natural resources, and other things that are specific to water and land development needs in poor countries," says Hussain. The goal of this research is to create simple and robust valuation tools that give an accurate picture of an agro-ecosystem even in situations when little data are available.

As a dispute resolution or negotiation tool, valuation builds a bridge and dialogue between various stakeholders in a project. It helps all parties assign and agree on values for different aspects of an ecosystem, to get the best solution for people, nature and food production.

IWMI tools and innovations

Looking at the bigger picture, from the river basin perspective, valuation techniques help communities reach equitable decisions on allocating water to different user sectors–including crops, domestic uses, trees and nature and the needs of nearby towns, cities and industry. IWMI's water management tools provide data input to the valuation process. Water Accounting and river basin modeling, show the amount of water available in a basin, who are the users, and how much water they are using. Other information on crop-water data available–at the country or regional level–can be seen with low-cost remote sensing tools developed by IWMI and tested with partners in five developing countries. All these tools are designed to produce accurate results in the data-poor situations that exist in most developing countries.

The valuation argument has been hijacked for political gain in some countries by people who say that it is used as a basis to impose taxes on the use of natural resources, or that it attaches value only to profit making activities in an ecosystem, pushing social aspects to the side as non-profitable activities. But this is a distortion, explains Hussain. The true application of economic ecosystem valuation is exactly the opposite.

Making the right decisions

"Using valuation, stakeholders in a community's natural resources agree on a monetary value for each important activity. This covers high monetary value for resource use in industry, hydropower generation, cash crops or even tourism. It also attaches a similarly high value to water allocated to the natural habitat (trees, wetlands, etc.) that sustain plant diversity and animal life. Social aspects such as reducing poverty and improving poor people's income, reducing land degradation, or improving the access to water in rural communities are also a key part of this new picture," he explains.

In areas where a substantial number of poor people live, valuing the priorities on a scale of 10 can place activities that are economically profitable for the community at the same level as poverty reduction activities, with nature a close second. Any decisions about developing water infrastructure or allocating water, then, will have to serve the needs of the priorities, as agreed in the valuation between all stakeholders. The priority setting gives all stakeholders a voice and a roadmap for making the best decision possible for all.

Examples abound of situations where the lack of a valuation consensus–and of proper tools to measure

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How Can Better Farming Practices Reduce Malaria?

The SIMA initiative on Malaria and Agriculture brings together agricultural and malaria research communities with planners in affected countries to look for preventative solutions to malaria.

The central component of national strategies for food security and rural development in most African countries revolves around the development of small-scale agriculture. It is expected that over the coming 20 years, smallholder farm will provide many poor areas with more stable access to daily food supplies and increased household incomes. Many of the areas where this new smallholder agriculture is expanding are the malaria hotspots of the world–Uganda, Tanzania, Mozambique, parts of Kenya and West Africa.

Why SIMA?

Unfortunately, agricultural development in spite of its many benefits also has the potential to negatively affect the health of human communities either directly or indirectly through various activities. Unintended side effects may include increased human exposure to agrochemicals and malaria mosquitoes. The Systemwide Initiative on Malaria and Agriculture (SIMA)–the malaria and agriculture initiative launched by the CGIAR was created to focus the thinking of the world's agricultural research community on how agricultural practices can reduce malaria in affected areas. Or more specifically, how can smallholder agriculture be expanded in developing countries' rural and peri-urban areas in a way that will not lead to a deterioration in the malaria situation.

The use of agro-ecosystem management techniques to reduce malaria vector mosquitoes is not a new concept. For instance, rice farmers in southern Europe were at the turn of the last century already regulating the flow of water in their irrigation systems to kill mosquito larvae. Some of this knowledge was lost through 50 years of DDT use, which stopped the need for these techniques, and the transmission of this knowledge from generation to generation.

Malaria and agriculture—the close links

According to Dr. Clifford Mutero, IWMI senior researcher and coordinator for the SIMA, the initiative, aims to bring together the agricultural research and malaria research communities to see how best they can work to reduce malaria. "Some agricultural and water management practices do exist today to reduce malaria in farming areas. But they have not been systematically documented or scientifically validated and made available for others to use," he explains. The goal of SIMA is to study a broad number of water and land management practices, and other aspects such as the use of livestock or cultivation of medicinal plants to deter malaria carrier mosquitoes.

The current SIMA action plan specifies a US$20 million action research program to be implemented over five years. Its goal is to produce a new body of knowledge, and a series of practical tools and methods that can help farming communities, developing country policy makers, agricultural planners and development professionals manage agricultural expansion and encourage a decrease of malaria related to these activities.

The highlight of the SIMA program will be the practical demonstration of best practices in agro-ecosystem management for malaria control, to be implemented with diverse stakeholders at selected "SIMA sites" in malaria-endemic areas of the world. The evolution of SIMA sites is already underway in Kenya (Mwea), Sri Lanka (Uda Walawe), and Ghana (Kumasi). Other countries where the establishment of SIMA sites is potentially feasible in the near future include Ethiopia, Zimbabwe, Rwanda and Peru.

The central point for malaria and agriculture information is the SIMA website. This space currently contains reports of the consultation between partners, and the research program they have elaborated. A complete list of resources and references to past agro-ecosystem management techniques is being compiled here. As research develops this will evolve into a resource center for the exchange of best practices, access to data and other useful information on agricultural interventions to malaria reduction.

To read the action plan and other resources point your browser to *www.imwi.org/sima*

THE PARTNERS: SIMA

- International Service for National Agricultural Research (ISNAR)
- International Institute of Tropical Agriculture (IITA)
- International Plant Genetic Resources Institute (IPGRI)
- International Water Management Institute (IWMI)
- International Livestock Research Institute (ILRI)
- International Food Policy Research Institute (IFPRI)
- West Africa Rice Research Association (WARDA)
- International Development Research Centre (IDRC)
- The International Center of Insect Physiology and Ecology (ICIPE)
- USAID Environmental Health Program (EHP)
- The Danish Bilharziasis Laboratory (DBL)
- WHO/FAO/UNEP/UNCHS Panel of Experts on Environmental Management for Vector Control (PEEM).

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Putting the Right Value on All Aspects of an Ecosystem

the ecosystem–have a significant negative impact on poor communities. A common situation in South Asia is that the conflict between cities and agriculture, both sides placing a demand on the scarce resource. "When done as a dialogue between stakeholders, valuation gives poor communities a say, and brings their voice into the debate for the first time," says Hussain.

Through several research projects, IWMI researchers are working to create and test ecosystem valuation techniques that help IWMI achieve the underlying goal of its work with developing countries to ensure access to water for the poorest members of rural communities.

Economic valuation alone will not solve the world's problems. And every water resources development situation may not be win-win-win for people, nature and irrigated agriculture. "But applying these techniques methodically before assessments or investment decisions are taken will ensure that choices are made based on the best available information from all stakeholders' points of view," concludes Hussain.

To put it differently, had poverty-focused valuation been available in the 1960s, some of the great failed development projects may not have been attempted.

Related reading:

Mary E. Renwick. 2001. *Valuing water in irrigated agriculture and reservoir fisheries: A multiple use irrigation system in Sri Lanka*. Research Report 51.

Making Irrigation Water a Safer Source of Drinking Water

In many parts of the world, irrigation water is the only source of drinking and other domestic uses. What are the positive and negative consequences of this practice?

Developing countries' efforts to supply drinking water to their rural communities have focused primarily on digging deep tube wells and installing hand-pumps to exploit bacteriologically safe groundwater. But in large areas of South Asia, the Middle East and East Africa, groundwater is not an option because of high arsenic, fluoride, iron, or salt levels. Here irrigation water is often the only water available for drinking, bathing, and washing. "Options for improving drinking water quality in areas where groundwater cannot be used have received very little attention," says Dr. Wim van der Hoek, leader of IWMI's health and environment research. "We are trying to put this issue on the map by looking at the ways irrigation water can be made safer for human consumption."

Measuring health risks

IWMI is conducting a series of studies in Pakistan, Sri Lanka and Morocco that examine the links between irrigation management, domestic use of irrigation water and human health. This research has highlighted the need to bridge the gap between the irrigation and drinking water supply sectors. "The potential for exploiting the health benefits of irrigation water is hindered by the lack of cooperation between drinking water providers and irrigation planners and managers. Drinking water programs are so focused on groundwater, they rarely consider irrigation water as an option. Irrigation managers base water allocation decisions on crop demands–ignoring the needs of domestic water users. A more coordinated effort could have a huge impact on child mortality and general community health," says van der Hoek.

The most recent study explored the links between the quantity and quality of water available and the incidence of diarrhoeal disease–a major contributor to childhood mortality in Africa and Asia. The research was conducted in Pakistan's Southern Punjab where brackish groundwater and very low rainfall force people to depend entirely on irrigation water to meet their basic needs.

Pakistan: Irrigation water is often the only water

In the large areas of Pakistan where groundwater is too saline for human use, villagers divert canal irrigation water into small community reservoirs–called *diggi*s–to meet their domestic needs. This water is either carried home by hand or is supplied to the household by means of PVC pipes and hand and motor pumps, for those who can afford the required equipment.

In addition to using water directly from these reservoirs, people tap small pockets of potable groundwater formed by seepage from unlined irrigation canals and fields. In this case, the sandy soils act as a filter–removing fecal contaminants.

Villagers tapping small community reservoirs *(diggis)*—the water is either hand carried or supplied through PVC pipes to the households.

Availability of this cleaner water depends on how much and how often irrigation water is released into the canals. For a period of 4-8 weeks, during the annual canal closure, people must rely on water stored in the local *diggi* or in household storage tanks.

Several villages in the study area have piped water supply schemes, but the sand filters that the schemes rely on for water treatment are completely dysfunctional due to lack of funds for maintenance, and, in effect, villagers are being supplied with untreated irrigation water.

The year-long IWMI study followed the drinking water quality, hygiene behavior and health of 200 families with different levels of water availability. The study found that access to a large amount of water in the home had a greater effect on the incidence rate of diarrhoea than the quality of the water used. Among families without an in-house water connection and storage tank, the use of seepage water over surface water for drinking made no appreciable difference in the number of diarrhoea episodes suffered–even though seepage water contained fewer pathogens.

E. coli counts per 100 ml of different drinking water sources in Hakara 6R irrigation system, Pakistan.

	No. of samples	*E. coli* count
Seepage water	2528	1.98
Water supply scheme	111	33.08
Well connected to water tank	274	96.24
Direct from village water tank	333	128.56
Direct from canal	30	865.34
Total	3273	5.70

The use of seepage water resulted in a significantly lower incidence of diarrhoea *only* in situations where people had a private water connection, a large storage facility and a toilet. In these more fortunate households, those who used seepage water had less diarhoea than those who used water directly from the *diggi* or canals.

The results support the idea that the quantity of water available for drinking and domestic hygiene is more important than the quality of water.

The optimal solution: Improving both quantity and quality

Says van der Hoek: "Making it possible for people to pump irrigation seepage water into large storage tanks in their houses–thereby ensuring a continuous supply of water for drinking, sanitation and hygiene–would greatly reduce the incidence of diarrhoea. Combine this with a campaign to promote better hygiene and you have a recipe for healthier children."

As a second phase to this research, several pilot projects have been started to develop and test possible interventions–including chlorination of irrigation water, low-cost water storage containers and a sewerage scheme. The focus is on activities that can be implemented by the communities themselves.

Incidence rate of diarrhoea by age group and source of drinking water in 200 households in Hakara 6R irrigation system, Pakistan.

Age in years	Seepage water Incidence rate[1]	Surface water Incidence rate[1]
<1	6.54	5.91
1	5.31	5.93
2	5.20	5.93
3	2.26	1.51
4	1.83	1.02
5–14	0.79	0.53
>=15	0.58	0.61

[1]Diarrhoea episodes per person year.

The First IWMI Benchmark Basin

The Benchmark Basins are the 'laboratories' where IWMI and its partners (governments, the national research community, NGOs and universities) validate and test water management research concepts and tools and collect data over a 20-year period. The Benchmark Basin concept is an integral part of IWMI' s water research program currently running in some 21 countries. Ruhuna is the first IWMI Benchmark site comprising the Menik Ganga, Kirindi Oya and Uda Walawe rivers located in the Ruhuna basin. Over the coming five years some 8-10 such basins will be launched in Asia and Africa.

The first IWMI benchmark basin in Sri Lanka–the Ruhunu River Basin promises to improve the understanding and management of water resources in Sri Lanka. The goal of this effort is to improve the understanding of the water use interactions in this basin and to encourage improved management of water resources in southern Sri Lanka.

Welcome to More Post Docs

- **Dr. Katsuyuki Shimizu, Post Doctoral Scientist / irrigation engineer (Japan)** is based at IWMI's office in Lahore, Pakistan , he holds a Ph.D. in Irrigation Water Management from Osaka Perfecture University, Japan.
- **Dr. Robert Simmons, Post Doctoral Scientist (UK)** s based at the IWMI South East Asia Regional Office in Thailand , he holds a Ph.D. in Geography/Soil Science from the University of Kent, UK.
- **Dr. Eric Biltonen, Post Doctoral Scientist / economist (USA)** will be based at IWMI-South East Asia Regional Office in Thailand. , he holds a Ph.D. in Agricultural and Resource Economics from Colorado State University, USA.
- **Dr. Stephanie Buechler, Post Doctoral Scientist / sociologist (USA)** will be based in India at ICRISAT HQ in Hyderabad . She holds her Ph.D. in Sociology from Binghamton University, USA.
- **Mr. Nitish Jha, Post Doctoral Scientist / anthropologist (India)** will be based at IWMI Regional Office in Pretoria, South Africa. Before joining IWMI, he will finalize his Ph.D. in Anthropology from Brandeis University, USA.

Researchers Awarded in Sri Lanka

Four IWMI researchers were awarded the Presidential Research Award by Her Excellency Chandrika Bandaranaike Kumaratunga, President of Sri Lanka. These research awards have been initiated to reward research achievements and their weight in favor of research carried out in Sri Lankan laboratories.

- The researchers are Manju Hemakumara, Felix Amarasinghe, Wim van Der Hoek and Flemming Konradsen. The awards were granted for their respective contributions in internationally refereed journals.
- Manju Hemakumara . *Sensitivity of irrigation off takes.* Journal of Irrigation and Drainage Engineering in American Society of Civil Engineers.
- F.P. Amerasinghe, F. Konradsen, K.T. Fonseka and R.A. Wirtz. 1999. *Malaria vectors in a traditional dry zone village in Sri Lanka*. American Journal of Tropical Medicine & Hygiene 60: 421-429.
- F. Konradsen, P. Steele, D. Perera, W. van der Hoek, P.H. Amerasinghe and F.P. Amerasinghe. 1999. *Cost of malaria control in Sri Lanka.* Bulletin of the World Health Organization 77: 301-309.

IWMI joins the World Conservation Union, IUCN

IWMI's joining the IUCN brings the research communities focusing on water in agriculture and water in environment into a new partnership. This will strengthen the environmental dimension of the Institute's research on sustainable water management in developing countries. "The goal of IWMI research is to find ways of balancing the needs of water for agriculture and water for nature. This is the unique perspective that this partnership brings to the work of environmental conservation," says Felix Amerasinghe, the Principal Researcher leading this work for IWMI.

Recent Publications

Geoff Kite; and Peter Droogers, 2000. *Comparison of actual evapotranspiration from satellites, hydrological models and field data.* Research Report 42.

Geoff Kite; and Peter Droogers. 2000. *Integrated basin modelin.* Research Report 43.

Intizar Hussain; Fuard Marikar; and Waqar Jehangir. 2000. *Productivity and performance of irrigated wheat farms across canal commands in the lower Indus basin.* Research Report 44.

Tushaar Shah; M. Alam; M. Dinesh Kumar; R. K. Nagar; and Mahendra Singh. 2000. *Pedaling out of poverty: Social impact of a manual irrigation technology in South Asia.* Research Report 45.

R. Sakthivadivel; Upali A. Amarasinghe; and S. Thiruvengadachari. 2000. *Using remote sensing techniques to evaluate lining efficacy of watercourses.* Research Report 46.

Wim van der Hoek; R. Sakthivadivel; Melanie Renshaw; John B. Silver; Martin H. Birley; and Flemming Konradsen. 2000. *Alternate wet/dry irrigation in rice cultivation: Saving water and controlling malaria and Japanese encephalitis?* Research Report 47.

C. J. Jayatilaka; R. Sakthivadivel; Y. Shinogi; I. W. Makin; and P. Witharana; 2000. *Predicting water availability in irrigation tank cascade systems: The CASCADE water balance model.* Research Report 48.

David Molden; R. Sakthivadivel; and Zaigham Habib. 2000. *Basin-level use and productivity of water: Examples from South Asia.* Research Report 49.

Geoff Kite; Peter Droogers; Hammond Murray-Rust; and Koos de Voogt. 2001. *Modeling scenarios for water allocation in the Gediz Basin, Turkey.* Research Report 50.

Mary E. Renwick. 2001. Valuing water in irrigated agriculture and reservoir fisheries: *A multiple use irrigation system in Sri Lanka.* Research Report 51.

C. J. Perry. 2001. *Charging for irrigation water: The issues and options, with a case study from Iran.*. Research Report 52.

Peter Droogers; and Geoff Kite. 2001. *Estimating productivity of water at different spatial scales using simulation modeling.* Research Report 53.

Tushaar Shah. 2001. *Wells and welfare in the Ganga Basin: Public policy and private initiative in Eastern Uttar Pradesh, India.* Research Report 54.

IWMI Papers in Internationally Refereed Journals

Abernethy, C. L.; Sally, M. H. 1999; 2001. Experiences of some government-sponsored organisations of irrigators in Niger and Burkina Faso, West Africa. [Erfahrungen mit einigen staatlich geforderten Selbst-verwaltungs organisationen von Bewasserungs landwirten in Niger und Burkina-Faso, West Afrika]. *Journal of Applied Irrigation Science* 35(2):177-205.

Barker, R.; Scott, C. A.; De Fraiture, C.; Amarasinghe, U. 2000. Global water shortages and the challenge facing Mexico. *International Journal of Water Resources Development* 16(4):525-542.

Bastiaanssen, W. G. M. 2000. Satellite observations of international river basins for all. *International Archives of Photogrammetry and Remote Sensing,* 33(B6):319-331.

Bastiaanssen, W. G. M.; Bos, M. G. 1999. Irrigation performance indicators based on remotely sensed data: A review of literature. *Irrigation and Drainage Systems* 13(4):291-311.

Bastiaanssen, W. G. M.; Molden, D. J.; Makin, I. W. 2000. Remote sensing for irrigated agriculture: Examples from research and possible applications. *Agricultural Water Management* 46(2):137-155.

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