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RESEARCH Update

News of the Progress and Impact of IWMI's Research • May 2002

Dealing with Drought

How can droughts be used as a catalyst for positive change? How can irrigation systems be made less vulnerable to drought?

When drought hits, the media is flooded with reports on starving communities, rioting farmers, and the outpouring of food aid from the international community. But very little is said about the positive steps farmers and water managers can take to cope with drought conditions.

"We need to learn how to deal with droughts, not just suffer through them," says Frank Rijsberman, Director General of IWMI. "Food aid is a temporary solution. Farmers and water managers need positive examples. They need tools and resources to protect their harvests and to reduce their vulnerability to drought. With global climate change and increasing water scarcity, drought mitigation will have an increasingly important role to play in ensuring food security and productive livelihoods in many parts of the world."

IWMI research in Turkey and Sri Lanka has documented responses by farmers and water managers to both multi-year and single-season drought in irrigated areas. These experiences offer insight into possible strategies for reducing drought's impact and improving the productive use of water—even in non-drought conditions.

EFFECTIVE STRATEGIES ADOPTED BY FARMERS

To cope with multi-year drought	To cope with short-term drought
Switching to crops with lower irrigation requirements Requires: Support from extension services, access to capital and to markets	**Reuse of drainage water** Requires: Awareness by farmers and minor investment in building bunds and digging diversion channels
Investment in groundwater development Requires: The availability of groundwater, appropriate pumps, and access to capital	**Mulching to retain soil moisture** Requires: Awareness by farmers and availability of plant material

Find more water or need less

When water becomes scarce, farmers have two options: find new sources of irrigation water or find ways of minimizing irrigation demand.

In Turkey's Gediz Basin, farmers coped with a five-year drought by tapping groundwater. The government had offered a subsidy to encourage groundwater development, but this process proved too slow for desperate farmers. There was an explosion in private tubewell development. In many cases, groups of neighbors purchased a pump to run as a joint venture.

Some Gediz farmers further reduced their need for canal irrigation by switching from cotton to grapes, which have a lower irrigation requirement. The Gediz basin had been one of the most important cotton growing areas in western Turkey, but as a result of the drought, approximately 40 percent of the area is now under grape cultivation.

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Research to combat soil erosion

How Can Southeast Asia Stop Losing Ground?

Every year when the monsoon rains scour Southeast Asia's hillsides, they carry away more of the fertile top soil and nutrients that the region's farmers depend on. Here in the steep uplands—the world's erosion hot spots—farmers struggle to feed their families and make a living from the poor soil.

Erosion reduces not only the soil's depth, but also its capacity to hold water and the amount of nutrients it contains. It also has serious consequences downstream—polluting drinking water, silting up rivers and irrigation systems, and degrading coastal ecosystems.

"Unless people make investments in soil conservation now," says Frits Penning de Vries, Leader of IWMI's research on smallholder water and land management, "there is little doubt that many countries will find themselves facing serious degradation of fragile upland areas as these are developed for agriculture. The long-term consequences are increasing poverty and loss of food security in these areas."

The Management of Soil Erosion Consortium (MSEC) was established through the Soil, Water and Nutrient Management initiative of the CGIAR to focus specifically on the growing problem of soil erosion in Asia. Catchment research began in 1998 with support from the Asian Development Bank. This research, coordinated by IWMI, brings together scientists from Indonesia, Laos, Nepal, the Philippines, Thailand and Vietnam with international experts in soil science, sociology, economics and hydrology. Its goals are to develop soil conservation practices that are economically acceptable to farmers, to promote better land management decisions at the field and basin level, and to encourage knowledge sharing across national and disciplinary boundaries.

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Dealing with Drought

The switch, although it involved a considerable initial investment, has paid off. Farmers' incomes have improved due to the higher value of grapes, and they are now less vulnerable to future droughts.

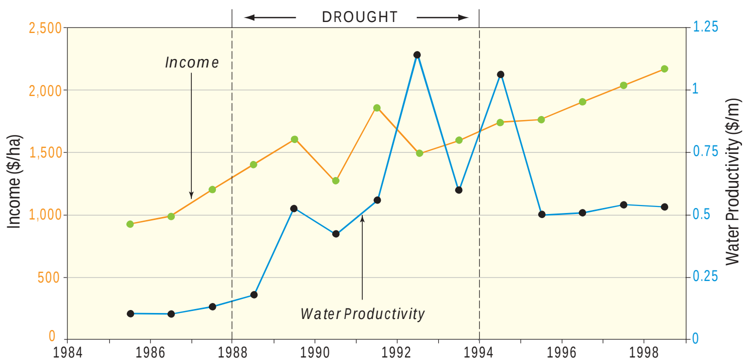
In Sri Lanka's Kirindi Oya Irrigation and Settlement Project, a key element of the farmers' strategy during a season-long drought was to recycle drainage water. To capture this water, which otherwise would have flowed out to sea, farmers created earthen bunds across drainage channels and diverted the water to their fields either by gravity or by pumping. Before the drought, farmers didn't believe drainage water was of high enough quality for reuse. Here the drought created a change in thinking, and recycling of drainage water has continued.

What makes systems vulnerable?

In some cases, managers haven't considered changes in climate or water use within the basin when planning. The result is an inflated estimate of water availability and a system that is frequently water-short. At Kirindi Oya, long-term data was used to estimate inflow into the reservoir, without taking into account the migration of settlers to the upper catchment. Says B. R. Ariyaratne, coordinator of the IWMI Benchmark Basin, Ruhuna, where the irrigation scheme is located, "At the time of the IWMI study there were some 2,000 private pumps taking water from the river before it reaches the reservoir, plus more than 150 small, traditional reservoirs in the upper catchment that had been rehabilitated in the past 15 years. These changes have had a significant impact on the amount of water flowing into the system's reservoir."

The system does not receive enough water to run at its designed capacity three years out of four. Consequently, it is particularly affected by lower than normal rainfall. The IWMI study found that the estimated inflow using up-to-date monthly data was 11 million m^3 less than one made only six years before, and was 36 million m^3 less than when the reservoir began operation in 1986.

Income/hectare and water productivity, Gediz Basin, Turkey



IWMI's Irrigation Performance Indicators showed that, due to the changes made by farmers and managers, irrigation performance and productivity of water were higher during the drought than ever before—with a corresponding rise in farmers' incomes.

The importance of flexibility

"Irrigation systems and farmers should be flexible enough to react to changing conditions," says Hammond Murray-Rust, author of the Turkey study and leader of IWMI's Integrated Water Management for Agriculture Theme. "This has implications for irrigation system design and operation. A system that's designed to work only under ideal conditions is not the kind of robust system that will weather drought well."

Systems need mechanisms to recognize and deal with change. One way of building responsiveness into a system is through an allocation policy that covers a range of water conditions. This allows water managers and farmers to react more quickly and effectively to changing water availability. "Different degrees of scarcity demand different allocation rules," says Murray-Rust. "Farmers need to understand and agree to these rules under both normal and drought conditions."

Early warning systems that monitor changing conditions and trigger contingency plans at the first sign of water shortage are another important way to help 'drought-proof' a system. "When the first signs of possible water shortage appear, when there's not the expected amount of inflow into the reservoir, the temptation for water managers is to wait and hope the rain will come," explains Murray-Rust. "By the time it's clear that there's not going to be enough water, managers have already lost their best chance at heading off crisis, and farmers are hit that much harder because they haven't been able to consider alternative strategies."

LESSONS IN DEALING WITH DROUGHT

Generic lessons, such as the ones here, offer a good starting point for building a drought strategy. But to be effective, strategies need to be tailored to an area's agricultural, hydrological and socioeconomic realities.

1. Irrigation agencies need a formal water allocation policy that includes contingency plans for different degrees of water shortage.
2. Allocation rules under both normal and drought conditions should be understood and accepted by farmers.
3. Under water-short conditions, allocation decisions should be made at basin and system levels rather than at local distribution system levels.
4. Up-to-date data should be used to capture development-related changes in the watershed and climate changes.
5. Early warning systems that monitor changing conditions and trigger contingency plans at the first sign of water shortage offer water managers and farmers the best chance of avoiding crop failure.
6. Water saving techniques, such as precision irrigation, zero tillage, raised bed planting and laser leveling of fields, can help farmers make the best use of scarce supplies and improve the productivity of water, even under normal conditions.
7. 'Carrying-over' stored water from the dry season to the wet-season ensures that planting can start on time, even if the monsoon is delayed.
8. Running irrigation systems at their maximum designed capacity reduces water stealing and simplifies operations.

Creating the right environment for cooperation

Without an existing foundation of open communication and trust between farmers and irrigation managers, it is difficult, if not impossible, to coordinate a successful response to drought conditions. Kirindi Oya officials attempted to prevent crisis after the 1991 monsoon failure by advising farmers to restrict the area planted with rice. The farmers didn't trust the officials' advice and so planted even more area with rice than was agreed on at the Project Management Committee meeting. This worsened the water-scarcity situation further–the result was complete crop failure in the 1992 dry season.

In 1999 farmers and water mangers found themselves confronting a similar situation. "1999 could easily have been a repeat of 1992," says IWMI research associate, Ronald Loeve. "But this time the Irrigation Department, Farmer Representatives and Farmers themselves cooperated to develop a new operational plan that would make the best use of the limited water available." As a result, farmers were able to bring their crops to harvest, despite the extreme water shortage.

In the case of a long-term drought, communication may not prevent crop failure, but it can prevent conflict. In the Gediz, the accurate information on water availability provided by the irrigation department and the formulation of a transparent water allocation policy helped to avoid conflict during the five-year drought.

The allocation policy has had benefits that have extended beyond the duration of the drought. Before the drought, the irrigation department was matching water releases to crop requirements, but the farmers didn't always know how much water was coming and when. With the switch to a simpler allocation policy, they now know exactly what to expect and can plan more effectively.

In the Gediz case, both managers and water users appreciated the benefits of the changes made during the drought and have continued them, even though water availability has now returned to normal. As a result, water productivity has remained high and incomes have continued to climb.

More sustainable water management

Droughts can serve as a catalyst for positive change–a move toward new and more sustainable approaches to managing water. During a long-term drought water managers and farmers are forced to change their behavior and manage water more carefully. "If changes are institutionalized, as they were in Turkey's Gediz Basin, you have a system that's less vulnerable to drought and generally more productive," says Murray-Rust. "If not, once there is plenty of water in the reservoir again, everyone goes back to business as usual until the next crisis hits."

Related reading:

- IWMI Research Report 55, *Water Scarcity and Managing Seasonal Water Crises: Lessons from the Kirindi Oaya Project in Sri Lanka.*

www.iwmi.org/pubs

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How Can Southeast Asia Stop Losing Ground?

Hedgerow cropping is one of the promising erosion control practices being introduced by MSEC. In this system, rows of shrubs, grasses or perennial crops are planted at regular intervals across the slope of the field. Traditional crops are grown in the 'alleys' between the hedgerows.

A catchment approach

"Previous research has focused on the physical aspects of soil erosion at field level," says Amado Maglinao, IWMI coordinator for MSEC. "MSEC takes a wider catchment approach, looking at agricultural land management in the context of other land and water uses in the catchment. This includes analysis of the socioeconomic and institutional factors that impact, and are impacted by, soil erosion."

Soil conservation methods introduced in the region decades ago have failed to take hold, primarily because the technologies were too expensive for farmers to adopt and maintain. "Soil conservation projects are difficult to sell to farmers because the benefits are dispersed widely, while farmers must make the initial investments," explains Maglinao. "Also results from these projects often require a long time to be realized. Farmers are looking for a quick fix rather than a long-term investment, which often they can't afford. Social and institutional factors, such as land tenure, also affect farmers' willingness to invest." MSEC is addressing these concerns by identifying and testing the 'best bet' options, such as hedgerow cropping systems, with the active participation of the farmers.

"The challenge," says MSEC partner, Fahmuddin Agus of Indonesia's Center for Soil and Agroclimate Research and Development, "is to develop a model that land mangers can use to introduce appropriate technologies. In general the problem is that the farmers are skeptical of adopting these practices due to the lack of a direct effect on their income."

Investing in soil conservation

MSEC research traces the impact of soil erosion from the farmers' field to the sea. The idea is to present these impacts in economic terms. "In some cases, it may not be possible to find soil conservation practices that economically benefit farmers," says Maglinao. "In these cases, farmers need incentives to adopt conservation practices. We need to be able to convince policy makers that erosion control is a good investment."

MSEC has already generated useful information on benchmark catchments established in six countries. Future MSEC research will focus on scaling up erosion control technologies from these small test catchments to larger catchments and developing policy guidelines based on research results. This work has the potential to benefit the some 120 million small farmers cultivating sloping uplands who are affected by soil erosion worldwide.

Says Agus, "Without research support, it's difficult to imagine a breakthrough in management techniques that can rejuvenate the soil fertility as well as protect the surrounding environment. Continuing erosion research leading to better policy and land management systems is vital for Indonesia's future and that of our neighbors."

For more information on MSEC, see www.iwmi.org/MSEC

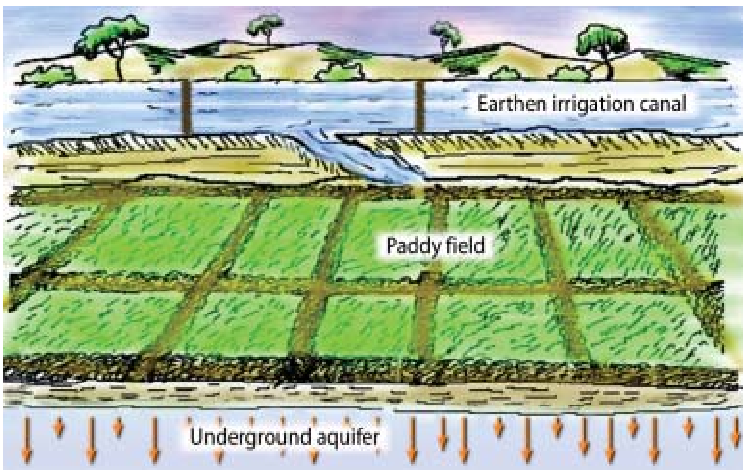
Partners

- Center for Soil and Agroclimate Research and Development, Indonesia
- Soil Survey and Land Classification Center, Lao PDR
- Nepal Agricultural Research Council
- Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
- Royal Forest Department, Thailand
- Land Development Department, Thailand
- National Institute for Soils and Fertilizers, Vietnam
- Asian Institute of Technology, Thailand
- Central Research Institute for Dryland Agriculture, India
- Institute of Research for Development, France
- International Center for Research in Agro-forestry, Indonesia
- International Crops Research Institute for the Semi-arid Tropics, India
- International Water Management Institute, Thailand
- University of Bayreuth, Germany

A Success Story in Reversing Groundwater Decline

The results of a ten-year study in Uttar Pradesh show that surplus monsoon water can be used to recharge underground aquifers and simultaneously provide farmers with better crop security.

Halting groundwater decline, improving farmers' incomes and saving energy–and all without large capital outlays? The government of Uttar Pradesh has managed to accomplish all three of these benefits through an innovative experiment in large-scale



For paddy rice, around 60% of the irrigation water applied is used by the plants; most of the remaining 40% filters through the soil to recharge the aquifer below. Combined with seepage from unlined canals, these 'losses' provide farmers with groundwater to irrigate dry season crops.

groundwater recharge. Here, they have transformed an earthen irrigation system into a highly productive groundwater recharge system–simply by switching from providing irrigation during the dry season to providing canal irrigation only during the monsoon.

When the monsoon raises river flows, surplus water is diverted through the system to provide farmers with irrigation for wet crops such as rice. Seepage water from the canals and fields recharges the underlying aquifers. That stored water is then pumped back up for a second cropping season post-monsoon. The drawdown of the aquifers, caused by pumping, maximizes their storage potential for the next monsoon and prevents waterlogging.

Conjunctive use: A sustainable option

Roorkee University, the Water and Land Management Institute (WALMI) of Uttar Pradesh, the State's Irrigation Department and IWMI evaluated the impact of the project on groundwater levels, land use, cropping patterns, and the costs and benefits of agricultural production. The conclusion is that this conjunctive use of canal water and groundwater is both productive and sustainable. "This approach holds real promise for areas with good aquifers, surplus monsoon water and a problem with unsustainable groundwater use," says R. Sakthivadivel, the IWMI researcher leading the evaluation.

The research showed that the water table in the study area, which had been progressively declining, has been raised from an average of 12 m below ground level to an average of 6.5 m. A simulation of the groundwater system suggests that without the artificial recharge provided by the monsoon irrigation, the water table would have fallen to an average depth of 18.5 m. below the surface during the course of the ten-year study period.

Raising water tables and farmers' incomes

Farmers have benefited from the corresponding reduction in pumping costs and the improved cropping pattern. With the introduction of monsoon irrigation, average net income has increased by 26 percent. In addition, the project benefits other water users in the area–water demand for household and industrial use is also met from recharged groundwater.

"Any earthen irrigation system in an area where there are viable aquifers and surplus monsoon water is a good candidate for this approach," says Sakthivadivel. "Even in cases where canals are concrete-lined, there will still be beneficial recharge–although not as much as you would get in an unlined scheme."

From a State's point of view, one of the most attractive advantages of this approach is that the 'infrastructure'–earthen irrigation canals and groundwater aquifers–already exists, and can be modified at a very low economic and environmental cost, compared to planning and building dams, tanks or other water storage facilities.

Areas That Could Benefit from Recharge Approach

- Where geology favors storage and extraction of water in underlying soil and rock layers
- Riverine systems with high river flows during the monsoon that have not been harnessed for productive use
- Areas with no soil salinity problems, where the ground slope varies gradually, and where it is not subject to flooding and/or waterlogging.
- Locations where constructing a dam or building a surface storage structure is not environmentally or economically feasible.

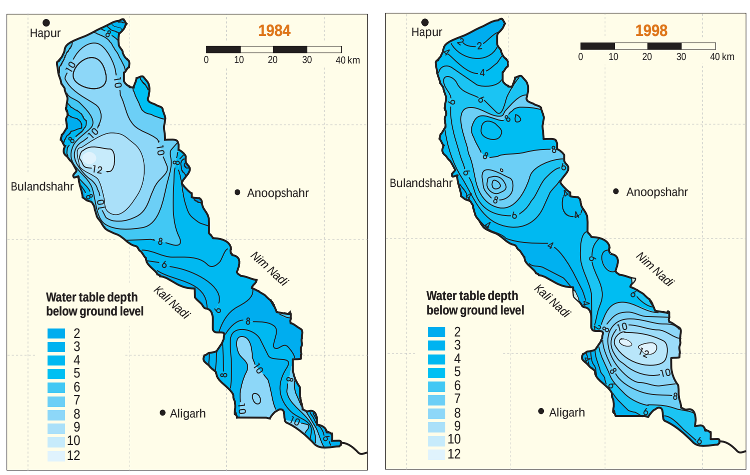
NEW SERIES FOR POLICY MAKERS

This research has been presented in the first issue of *Water Policy Briefing*, a new series that translates the findings of research in water resources management into useful information for Indian policy makers.

The Series is put out by IWMI in collaboration with national and state research organizations. It is made possible by a grant from the Sir Ratan Tata Trust.

Each Briefing is supported by detailed research documentation. The Briefings and supporting documentation are available on the IWMI-Tata Water Policy Program's web site (**www.iwmi.org/iwmi-tata**) or by direct request (iwmi-tata@ cgiar.org).

Comparison of water table depth below ground level before and after recharge



Maps of the Lakhaoti Branch Canal command area, Uttar Pradesh, showing post-monsoon depth to groundwater both in 1984, four years before the artificial recharge began, and in 1998, after the project had been in operation for 10 years. The level of the groundwater has risen almost uniformly, with the exception of a few small pockets in the tail reach where the water distribution infrastructure is incomplete.

Can Inland Wetlands Be Used Sustainably to Profit Southern Africa's Poor Farmers?

In developed countries the debate on use of wetlands is often framed as private interests versus public benefits. Private individuals want to develop the economic potential of wetlands, while the public interest demands conservation. Is there a middle ground? And do the stakes in this debate change when developing the economic potential could mean giving millions of poor farmers a chance to move from subsistence farming to profitable agriculture?

How Do Wetlands Benefit Small-scale Farmers?

- Reliable food supply
- Increased incomes
- Less vulnerability to drought

"Yes," says IWMI's researcher, Mutsa Masiyandima, who leads research on the issue. "In the context of poverty eradication, it's imperative that agricultural research find ways of enabling private individuals to profit from the resource–without sacrificing the long-term benefits of conservation."

The fact is that in Southern and Eastern Africa, more and more people are dependent on wetlands for their livelihoods. Here small inland wetlands, usually less than 20 hectares, allow farmers to grow vegetables and other crops vital to household nutrition and incomes. The moisture-rich wetland environment means they can farm in both rainy and dry seasons–ensuring a reliable, year-round food supply and source of income. Without this natural resource, farmers would be limited to rainfed agriculture–a losing proposition for the poor who are left with the most marginal rainfed lands.

Balancing development with conservation

The potential of these wetlands in sub-Saharan Africa is estimated to be at least 135 million hectares, according to an FAO study on sustainable use of wetlands for agriculture–only 1.3 percent of which is actually being cropped. "Wetland areas have immense poverty-fighting potential," says Masiyandima. "But they also serve vital ecological and hydrological functions. To develop implementable guidelines for sustainable use, we have to understand how intensified wetlands-based agriculture impacts these functions."

Wetlands are sensitive environments. Modifications in soil moisture, groundwater and surface water levels, and the introduction of fertilizers and pesticides can have grave consequences for native plants and wildlife. The natural hydrological functions of wetlands, such as regulating water flows, recharging groundwater, and providing flood control, may be endangered by excessive water use for agriculture.

Small-scale farmers cultivating wetland area in Zambia. In wetlands like this, farmers take advantage of high water tables by digging small ponds to collect water for irrigation. They use raised beds to create an aerated root zone and ensure crops don't suffer from waterlogging.

A scientific basis for action

Research by IWMI, FAO, IUCN, the Southern Africa Development Community (SADC) and local partners, looks at ways of achieving a balance between protection of the natural resource and the needs of small-scale farmers. This requires the right combination of policies, public awareness, and appropriate farming methods. The Program will address the issue of sustainable use at both field and policy levels–giving farmers and policy makers the scientific knowledge they need to make the right decisions.

"A number of organizations have done pioneering work in this area–FAO, IUCN, Catholic Relief Services (CRS), and the agricultural research departments of Malawi, Zambia, and Zimbabwe" says Masiyandima. "Our aim is to add to that growing base of knowledge with more detailed studies, and to synthesize the results into practical tools and recommendations. This work will build on the research currently out there and the extensive knowledge of the farmers themselves."

The research addresses some current gaps in knowledge–answering key questions such as: How much water can be used for agriculture without negatively impacting the healthy functioning of wetlands? What affordable tools and methods can small-scale farmers use to make wetland-based farming more productive, without damaging the environment? What institutions and policies are needed to ensure that other vital wetland functions are protected?

The program is currently operating in eight countries in Southern Africa (Lesotho, Malawi, Mozambique, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe) and Rwanda in Central Africa. It will expand in later phases to cover other countries in Eastern Africa, and may in the future be linked to the Inland Valley Consortium in West Africa.

"Sustainable use is possible," asserts Masiyandima, "with the right combination of policies, public awareness, and appropriate farming methods. But for this we need a strong scientific base to build on."

For more information about this project and the issues surrounding wetlands and agriculture, see the on-line resource area at www.iwmi.org/environment

BENEFITS OF WETLANDS RESEARCH

- Guidelines for sustainable wetland management and development
- A classification of wetlands showing the degree to which they can be sustainably farmed
- Increased farmer awareness of the fragility of wetland ecosystems and the need for sustainable management
- Appropriate water application technologies
- Recommended cropping systems compatible with wetland environments
- Data on sustainable wetland management and development, including hydrology and available water, soils, actual and potential wetland use, and biodiversity
- Assessment of the social and economic values of the various types of wetlands, and alternative uses of wetlands

Irrigation Management—Boon or Burden for Africa's Smallholders?

Driven largely by financial pressures, governments throughout sub-Saharan Africa are in the process of transferring responsibility for irrigation management to farmers. Large-scale commercial farmers have welcomed this reform. But the result of government withdrawal from many of the smallholder schemes has been complete collapse. In South Africa, the latest country to initiate state withdrawal, this would mean virtually writing off as sunk costs over 2 billion Rand ($180 million) of past investments in the smallholder irrigation sector.

South Africa is attempting to avoid this fate for its smallholder schemes by taking an approach to Irrigation Management Transfer (IMT) that emphasizes capacity building. According to the Northern Province Department of Agriculture and Environment (NPDALE), the policy is "to create an enabling environment through which beneficiaries can, by means of a systematic take-over program, assume full responsibility and control of these schemes in a sustainable manner."

The smallholder dilemma

IWMI evaluated the management transfer program being piloted in 3 irrigation schemes in South Africa's Northern Province. The study found that the process has all the right ingredients based on international experience with Irrigation Management Transfer (IMT). "But," says principal researcher, Tushaar Shah, "it's unlikely to be successful."

"There are some important issues concerning the viability of smallholder irrigated farming itself that need to be addressed before adding the burden of irrigation scheme management," says Shah. "These schemes have been run almost like estates for decades, with the government providing the inputs and the markets. As it is, they are barely surviving on the oxygen of government subsidies and supports. If these are withdrawn, without first taking steps to improve the smallholder situation, these systems have very little chance of survival."

African Smallholder Challenges

- A history of dependency
- High cash costs due to mechanization
- Absence of credit, input and output markets
- Insecure land tenure
- Inability to depend on irrigated agriculture as their primary source of income

The experience of farmers in South Africa's Arabie-Olifants scheme is typical of the dilemma facing smallholder irrigators after government

withdrawal. Without state support services and management, the area being cropped declined to only 30 percent of total arable land within the first year. Plot holders couldn't pay for seeds, fertilizer, or tractor rental. They were unable to secure crop loans from the Land Bank, because without clear titles to their land, they had no way to guarantee repayment.

Conditions for success

The 'success stories' of IMT show that for transfer to work, the irrigation system must be central to a wealth-creating agriculture. In the typical African smallholder's case, it has been suggested that net income is negative when the full value of family labor is costed.

The IWMI analysis suggests that the first step for South Africa–and the rest of Africa–must be to enhance the income-creation potential of smallholder irrigated farming by strengthening access to markets and credit, promoting high-value crops and improving systems for extension and technical support. This approach will help create the right climate for IMT.

"The thinking needs to shift from institutional reform of smallholder irrigation management to institutional intervention designed to significantly enhance smallholder productivity and incomes," says Douglas Merrey, Director of IWMI's Africa Regional Office. "The institutions appropriate for this are probably not pure Water User Associations, but either farmer-controlled organizations with a much broader mandate and capacity, or with strong institutional links with agribusinesses."

Partnerships with agribusinesses

Collaboration with agribusiness may provide a window of opportunity for smallholder irrigators–particularly in South Africa with its dynamic agribusiness sector. These partnerships, if managed well, give small-holders the possibility of replacing some of the supports and services formerly provided by government agencies.

In South Africa, many agribusiness firms have made a special commitment to support smallholders. One such company, Capespan Group, has identified 27 smallholder projects from which they hope to export 700,000 cartons of citrus annually. In South Africa's Hereford Scheme, a group of smallholders, with the help of an NGO, Africare, developed a contract-farming arrangement with a vegetable wholesaler. By following a strict planting program provided by the company, the smallholders learned to grow quality vegetables, which were being exported to Hongkong and France, as well as supplying South Africa's national market. Although they could not maintain export sales, the experience enabled them to gain the skills needed to succeed in the local market. As a result, their farm incomes have increased significantly.

Lessons for Development Professionals

- IMT has to make good economic sense to farmers
- The larger the number of farmers involved, the higher the management costs
- For IMT to work, institutional reforms need to extend beyond the irrigation sector

There are many examples of contract farming that have failed–where companies or smallholders have not fulfilled their commitments. But if smallholders can make these partnerships work, they have a chance to make their plots profitable and irrigation management worthwhile. Governments need to explore issues such as: How to make contract farming sustainable by curtailing incentives for farmers as well as companies to default on their obligations? How to redesign farm equity schemes to enable smallholders to develop stable alliances with input suppliers and output marketers?

"Research has shown under what conditions IMT can be successful," says Merrey. "Now we need to address how those conditions can be developed in South Africa and the rest of sub-Saharan Africa."

Much of this research was carried out under a grant provided by the British Department for International Development (DFID) for Achieving Sustainable Local Management of Irrigation Water in Water-Short Basins: South Africa Case Study.

Related reading:

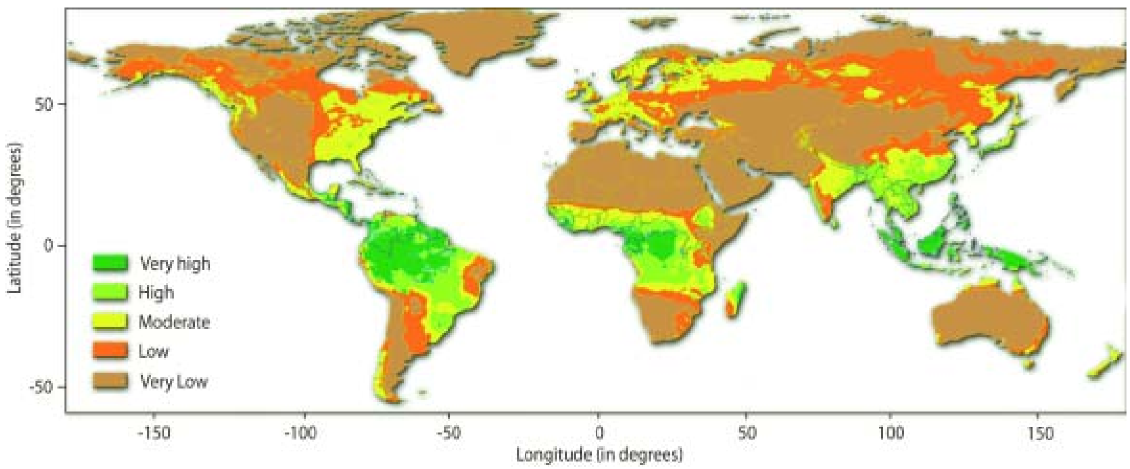
- IWMI Research Report 60, *Institutional Alternatives in African Smallholder Irrigation: Lessons from International Experience with Irrigation Management*
- IWMI Research Report 37, *Farmer-Based Financing of Operations in the Niger Valley Irrigation Schemes*
- IWMI Working Paper 18, *Policies, Legislation and Organizations Related to Water in South Africa*

www.iwmi.org/pubs

Mapping the Potential for Rain-fed Agriculture

Will meeting future food needs require large investments in irrigation systems or can expanding rain-fed agriculture and increasing its productivity satisfy at least a substantial part of the demand? A recent IWMI study on rain-fed potential takes the first step towards answering this question. The study is part of the Comprehensive Assessment of Water Management for Agriculture—a new CGIAR initiative to help improve future investments in water and agriculture.

Potentials for rainfed agriculture on a global scale



"The major problem in determining the role of rain-fed agriculture in ensuring future food security has been the lack of accurate and specific agroclimatic data on a global basis," says Peter Droogers, a research hydrologist at IWMI. This problem was solved in large part with the creation of the World Water and Climate Atlas, a universal data set compiled by IWMI with the University of East Anglia, supported by USAID and Japan's Official Development Assistance.

The high resolution climate data provided by the Atlas, combined with a soil water storage capacity map and a dynamic water and crop model has made it possible to capture both the local and the global potential for rain-fed agriculture.

Meeting future food needs

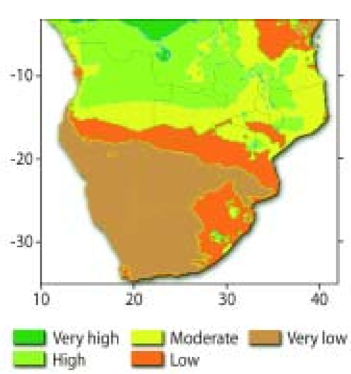
What is the maximum amount of food that can be produced from rain-fed agriculture? How much irrigation do we need to feed growing populations?

The map shows policy makers the theoretical maximum their country could produce from rain-fed agriculture. For some, expanding rain-fed agriculture is not possible. Policy makers in these countries can see where they will have to improve the productivity of existing rain-fed areas, expand irrigated agriculture or import food. "Many countries will have to make difficult choices," says Droogers. "Determining rain-fed potential can help clarify what their options are."

Investing in water development

Where is rain-fed agriculture a losing proposition for farmers? How can governments direct limited resources where they are most needed and in a way that will have a positive impact?

Potentials for rainfed agriculture in Southern Africa



There are extensive areas where potential yields from purely rain-fed agriculture are zero. The map clearly shows that some countries will need more irrigation to meet the food needs and reduce poverty in rural areas. Looking at Southern Africa, the rain-fed potential is classified as close to zero for almost all of Namibia and Botswana. Still many farmers are struggling to grow crops in these areas. In Namibia, only one percent of cropland is irrigated, and in Botswana it's less than one percent. Yet, for both countries, close to half the population is dependant on agriculture for a living. With few exceptions, the farmers in these marginal rain-fed areas suffer from extreme poverty, low agricultural productivity and vulnerability to drought.

Promoting appropriate technologies

Where can supplemental irrigation and rainwater harvesting technologies have a major impact on poverty and local food security?

Some of the greatest potentials to reduce poverty and improve household food security for small farmers lie in targeting the areas that are moderately or even poorly suited to rain-fed agriculture. The rain-fed map helps to pinpoint these marginal rain-fed areas where the use of small-scale rainwater harvesting systems that provide partial irrigation when water is most needed by crops, could greatly improve farmers' yields. Future refinements will allow farmers to determine the potential for rainwater harvesting in their area and to estimate the impact on yields.

Improving productivity

Why is rain-fed agriculture more productive in some areas than in others with similar climatic-hydrological situations? How can lessons learned from areas where farmers have managed to reach rain-fed potentials help farmers in low productivity areas?

"One of the most interesting future uses of the model is to compare the potential rain-fed yields estimated here with actual yields on the ground," says Droogers. "This kind of comparison will enable us to understand why some farmers are able to reach the potential rain-fed yields for their areas, while others fall far short. These findings may benefit farmers in low productivity areas of Asia and Africa."

For example, in the USA's cornbelt and parts of Western Europe, large-scale, well-capitalized farmers have been able to get much higher yields compared to farmers in areas of Africa and Asia with the same rain-fed potential. These farmers profit from fertilizer, improved crop varieties and appropriate water and land management, rather than from optimal climate conditions. "Finding ways of bringing these advantages to small-scale farmers in similar climatic areas is one of the challenges of agricultural research," says Droogers. "The mapping exercise is a starting point."

Related reading:

- IWMI Working Paper 20, *Estimating the Potential of Rain-fed Agriculture*

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Award Winners from IWMI's Africa Regional Office

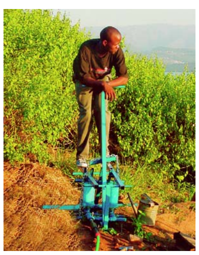
South Africa honors two IWMI researchers

Marna de Lange and **Tshepo Khumbane** received the prestigious 'Women in Water Award' from South Africa's Minister of Water Affairs and Forestry, Ronnie Kassrils. The Award, launched this year, was to recognize " women of stature, women who excelled in their field, and who have made a significant contribution to the management of water in South Africa."

Khumbane, who has been making valuable contributions to IWMI work since 2000, was recognized for her work on training women in crop production and business management. Her methods of teaching water and soil conservation practices have inspired both the women farmers she has worked with and professionals from different fields of agriculture.

De Lange received the award for her promotion of social justice in water policy and her dedication to improving the livelihoods of poor and marginalized people through better access to water. Currently she is coordinating the policy and strategy drafting team on revitalization of the small-scale irrigation sector in South Africa. She has been working with IWMI since 1998.

Treadle pump design wins World Bank prize



Caryn Kedge, an M.Sc. student working with IWMI's Africa Regional office, won second prize in the World Bank's first Contest for Innovative Ideas and Technologies. "Let's all stop talking about poverty and food security issues and actually get out there with practical ways of eliminating them such as the technologies presented here," the prize winner commented at the event.

Supported by IWMI as part of the Irrigation Technologies Project introduced in February 2000, Kedge designed a treadle pump specifically to meet the needs of South Africa's small-scale farmers–one that is easy-to-use, affordable and that can be manufactured and repaired using local materials. This month research begins on developing a new pump to supply water to households.

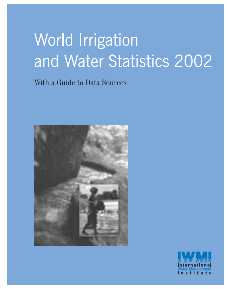
Groundwater presentation awarded Waternet prize

Mutsa Masiyandima gave a prize-winning presentation on groundwater management strategies at the Waternet/Warfsa Symposium held in October of 2001. She received one of the four awards given for best presentation at the Symposium. Masiyandima is currently leading IWMI's research on sustainable use of small inland wetlands in Southern Africa (see page 6).

Gender research awarded anthropology prize

Nitish Jha won the Harold K. 2002 Schneider Prize by the Society for Economic Anthropology for his research at Brandeis University on gender and decision-making in Balinese agriculture. Says Jha, "My argument simply put is that a non-physical, intellectual activity like decision-making about agricultural activities has certain definite impacts on individual household welfare, and so must be taken into account when considering how agricultural activities are gendered." Jha, who recently joined IWMI as a postdoctoral scientist, is now conducting research on water tenure in South Africa's Olifants Basin.

New resource for water statistics



The first issue of *World Irrigation and Water Statistics* is now available. "Our goal is for this publication to become a dynamic, 'living' resource, that responds to the needs of the international community of irrigation and water resources professionals," says Director General, Frank Rijsberman. The book features an overview of the global status of irrigation and water resources, national level data for 89 countries, and data by province/state for China, India and Pakistan on key irrigation and water variables.

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Recent Publications

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Research Report Series

Shah, T.; van Koppen, B.; Merrey, D.; de Lange, M.; Samad, Madar. 2002. *Institutional alternatives in African smallholder irrigation: Lessons from international experience with irrigation management transfer.* (IWMI Research Report 60).

Van Koppen, B. 2002. *A gender performance indicator for irrigation: Concepts, tools and applications.* (IWMI Research Report 59).

Albinson, B.; Perry, C.J. 2002. *Fundamentals of smallholder irrigation: The structured system concept* (IWMI Research Report 58).

Amerasinghe, F. P.; Konradsen, F.; van der Hoek, W.; Amerasinghe, P. H.; Gunawardena, J. P. W.; Fonseka, K. T.; Jayasinghe, G. 2001. *Small irrigation tanks as a source of malaria mosquito vectors: A study in north-central Sri Lanka.* (IWMI Research Report 57).

Molden, D. J.; Sakthivadivel, R.; Keller, J. 2001. *Hydronomic zones for developing basin water conservation strategies.* Colombo, Sri Lanka: IWMI. v, 30p. (IWMI Research Report 56).

Sakthivadivel, R.; Loeve, R.; Amarasinghe, U. A.; Hemakumara, M. 2001. *Water scarcity and managing seasonal water crisis: Lessons from the Kirindi Oya Project in Sri Lanka.* Colombo, Sri Lanka: IWMI. v, 29p. (IWMI Research Report 55).

IWMI papers in Internationally Refereed Journals

Bakker, M.; Matsuno, Y. 2001. A framework for valuing ecological services of irrigation water. *Irrigation and Drainage Systems*, 15(2):99-115.

Bandaragoda, D. J. 2001. Pakistan efforts in institutional reforms for participatory water resources management. *Journal of Applied Irrigation Science*, 36(1): 57-71.

Bastiaanssen, W. G. M.; Bandara, K. M. P. S. 2001. Evaporative depletion assessments for irrigated watersheds in Sri Lanka. *Irrigation Science*, 21(1): 1-15.

Bhattarai, M.; Hammig, M. 2001. Institutions and the environmental kuznets curve for deforestation: A crosscountry analysis for Latin America, Africa and Asia. *World Development*, 29(6):995-1010.

Duran, L. S.; Batac, J. H.; Drechsel, P. 2001. Planning in a changing environment: The case of Marilao in the Philippines. *Urban Agriculture Magazine*, 4:40-42.

Jensen, P. K.; Matsuno, Y.; Van der Hoek, W.; Cairncross, S. 2001. Limitations of irrigation water quality guidelines from a multiple use perspective. *Irrigation and Drainage Systems*, 15(2:117-128.