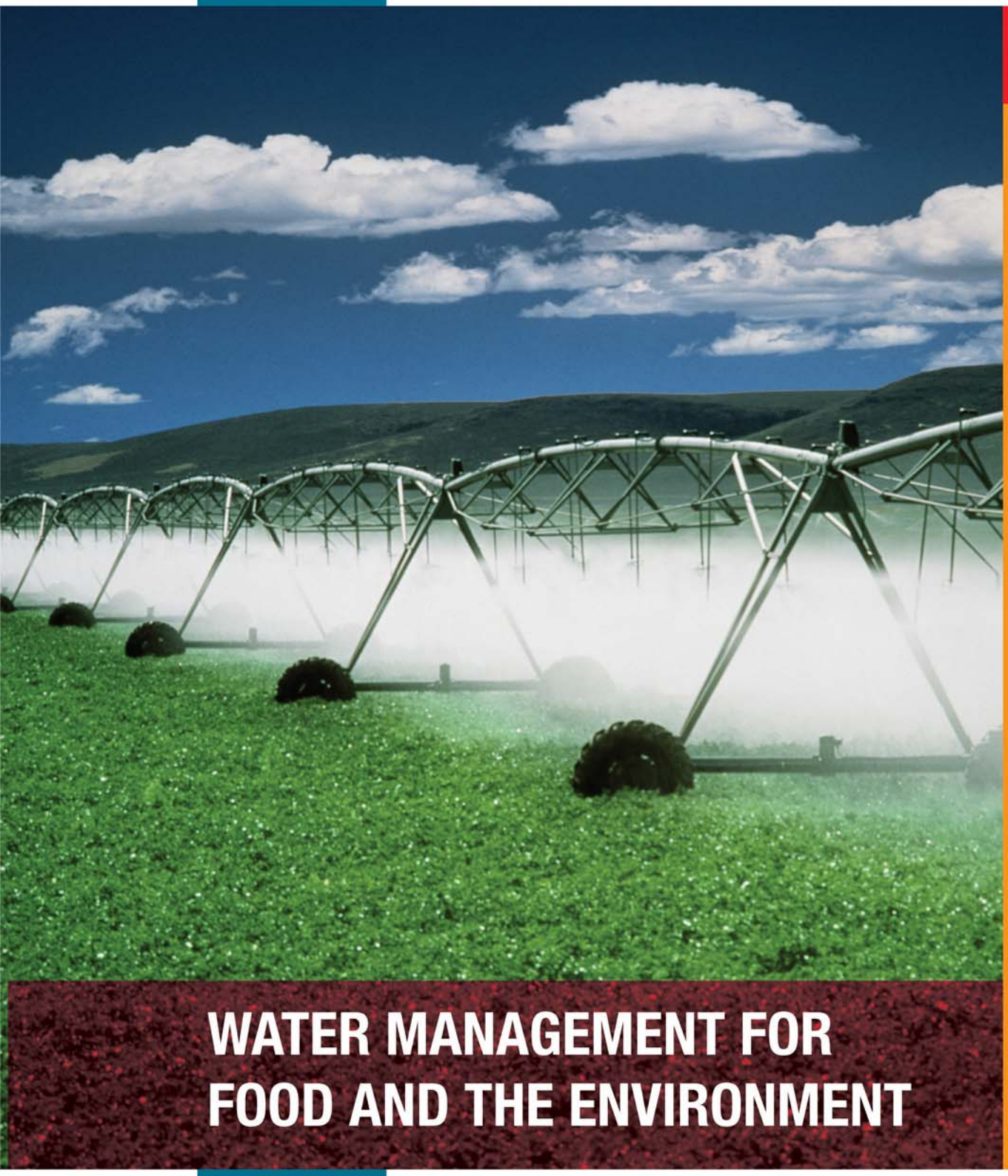
Mexico 2006
4th World
Water Forum



Local
Actions
for a
Global
Challenge

WATER MANAGEMENT FOR FOOD AND THE ENVIRONMENT

International Water Management Institute

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Water Management for Food and the Enviroment

Increasing Green and Blue Water Productivity to Balance Water for Food and Environment

Thematic Document
Framework Theme 4
Water Management for Food and the Enviroment
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Setting the stage

The Water for Food and Environment Challenge

Why is so much water used for "irrigation"? Can we not reduce this to satisfy the needs of rapidly growing cities and safeguard the environment? Obviously, people need more water than for drinking, washing and other domestic needs alone. Few people realize how much more. As much as seventy times more water is required to grow a person's food than is required for domestic needs. Even more water is required to maintain the ecosystem services without which our lifestyle is not sustainable. That frames the challenge on water for food and environment: finding water for expanding cities, often taken from agriculture, growing food for a growing population, providing jobs for the rural poor while sustaining the environment.

If we fail in this challenge, poor people will pay the price. Poor urban people are most affected by low access to safe and affordable drinking water and sanitation. For poor rural people, low access to safe and affordable water is crucial for domestic use as well as for their livelihoods. Degraded natural resources affect all people, but particularly the poor, in cities as well as rural areas.

Is it possible to overcome this challenge? We believe it is. Communities in hundreds of "bright spots" demonstrate that technologies are available and effective if used appropriately. It requires a shift in how natural resources are managed. Many river basins, particularly in Asia, are already "closed", i.e. there is no additional water available for development that does not take away water already used by someone else. Water and land need to be managed at basin and landscape scale —re-allocating water among users. The value to society generated by these multiple,

interlinked uses of water needs to increase. This is often possible. If we understand the complex ways water is used and re-used as it flows through a closed river basin, we will be able to increase water productivity. At the same time in Africa, particularly, the available infrastructure to overcome rainfall variability is still so inadequate that investment remains a top priority.

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Setting the Stage Highlights

1. Poor access to reliable, safe and affordable water for food and livelihoods is a poverty trap for 70% of the world's poor people, i.e. the 800 million poor people that live in rural Africa and Asia.

2. People require, on average, seventy times more water to grow their food than for their domestic use.

3. Plants use between 500 and 4,000 liters of water to produce one kilogram of staple food grains such as rice or wheat.

4. Many rivers in the arid and semi-arid regions of the world no longer reach the sea. These river basins are closed or closing with all water used before it reaches the mouth of the river. Developing water resources in closed basins is robbing Peter to pay Paul.

5. The value of water in agriculture is measured in cents, while the value of water for domestic use or industry is measured in dollars. The consequence is that urban people out-compete farmers for water everywhere. Water is moving out of agriculture to satisfy the rapidly growing urban and industrial demand in developing countries.

6. Agriculture competes for water with nature. All water in the hydrological cycle provides environmental services. Every shift of rainfall, river or groundwater from ecosystems to rainfed or irrigated agriculture represents a trade-off between ecosystem services and food or livelihood benefits.

Contents

Theme 4. Water Management for Food and the Environment

The rapidly expanding requirements of water for food production, both in rainfed and irrigated agriculture, have entailed very large water withdrawals, significant modification of flow regimes, and degradation of water quality —all with major implications for ecosystem health. Water, food, and the environment form a nexus, an inextricable web. Actions targeted at the local level and at a range of larger scales are needed in order to reconcile the trade-offs associated with increased food production imperatives and growing recognition of intrinsic environmental and biodiversity value as well as the amenities provided by robustly functioning ecosystems.

The Water, Food, and Environment (WFE) Theme of the 4th World Water Forum aims to bring together a range of stakeholders to address the linkages between concepts and actions, and between actions and outcomes. Discussion and debate based on real evidence from basins around the world is needed to build consensus on the way forward.

This Document

This **document** has been produced for the 4th World Water Forum to **provide 'KEY MESSAGES'** which reflect valuable information, insight and opportunity for action within the framework of the water-food-environment nexus. The document is based on the knowledge and experience of IWMI and a diversity of partners.

The main aim is to present opportunities in the water-food-environment nexus, in terms of specific interventions or intervention packages that have large potential net-benefits for society.

The document begins by **SETTING THE STAGE** through providing some key facts about the current water situation and issues to be considered for the future. The main body of the document focuses on presenting **KEY MESSAGES** which are clustered into three main categories:

1. **CONTEXT MESSAGES**- these tell important facts and ideas about the current and future water situation and its connection to agriculture and the environment.
2. **DRIVERS MESSAGES**- these messages highlight and explain relevant external forces, pressures, global situations and contributing factors to the water situation (current and future) and that influence (and will influence) the water-food-environment relationship.
3. **ACTIONABLE MESSAGES**- these messages reflect the overall theme of the World Water Forum in which we attempt to identify, explain and promote ACTIONS which can contribute to overcoming water-food-environment issues and challenges.

Summary of Messages

1. Increasing Blue Water Productivity: **getting the most out of renewable water resources.**

2. Increasing Green Water Productivity: **making the most of soil moisture.**

3. Increasing Access to Water Resources: **investments in water resources development are crucial to achieving MDGs in Africa.**

4. Balancing Water for Food and Other Ecosystem Services: **giving voice to the silent actor.**

5. Investing in Water Security for Poverty Alleviation: **target poor areas with pro-poor designs.**

Acknowledgements

This document is based on the collective wisdom and experience of the International Water Management Institute (IWMI) and its many partners and based on projects carried out around the world, particularly in Asia and Africa. An important source was the emerging conclusions from the "Investment in Agricultural Water for Poverty Reduction and Economic Growth in Sub-Saharan Africa" collaborative program of ADB, FAO, IFAD, IWMI and World Bank.

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Context: What is the situation with water resources now and for the future?

Is the world running out of water? Not really. The world water crisis has more to do with managing water resources badly than with a lack of resources. We need to understand the nature of water scarcity to take the appropriate action. Water poverty, or water insecurity, is the lack of access to safe and affordable water to satisfy a person's needs for drinking, washing or their livelihoods. When a large number of people in an area are water-insecure for a significant period of time there is water scarcity. Water scarcity can be physical, economic or institutional. We also need to understand how much water we have. Discussions of water availability tend to include only the "renewable water resources" —that is only some 40% of the total rainfall worldwide. The other 60% is crucial for both food production and the environment.

1. **Nature of water scarcity: equitable access contributes as much, or more, to water poverty as does scarcity in resources.**

   i. Physical water scarcity, where the resources cannot satisfy the demands, dominates water poverty in the arid areas of the Middle East, North Africa and the dry parts of Asia.

   ii. Economic water scarcity, where lack of water infrastructure is more important than the lack of resources, affects the overwhelming majority of water poor farmers in Sub-Saharan Africa and many others in parts of Asia.

   iii. Institutional water scarcity, where water resources and infrastructure may be available, but people are water-poor because they are tail-enders, or landless farmers, or do not have rights to land or water, affects poor rural people anywhere, even in the heart of well-endowed irrigation systems.

2. **The myopic focus of water resources management on blue water alone needs to be replaced by an approach to manage the complete water cycle, including green and blue water.**

   i. Traditionally, what is counted as renewable water resources is only the rainfall that runs off into rivers and recharges the groundwater; this is only 40% of total rainfall —the blue water.

   ii. Sixty percent of all rainfall never reaches a river or aquifer; it replenishes the soil moisture and evaporates from the soil or is transpired by plants —the green water.

   iii. Green water cannot be piped or drunk, and is safely ignored by urban water managers. But green water is crucial to plants, both in ecosystems and in agriculture, and needs to be managed carefully.

   iv. Management of water for food and environment should take into account the complete hydrological cycle, including all rainfall and evapotranspiration, that is, both green and blue water.

   v. The traditional split between rainfed and irrigated agriculture has become obsolete. It should be replaced by water management for agriculture, accounting for the complete spectrum from pure rainfed, via rainwater harvesting, to supplemental or deficit, to full irrigation.

Factors driving the water-food-environment nexus

Some factors outside the water sector, and out of the control of water managers or users, are nevertheless likely to have a major influence on the water-food-environment nexus. We call these factors "drivers". The three key drivers we see are: population growth and economic development; world trade negotiations related to agriculture; and climate change.

1. **Population growth and economic development, with a fixed resource base, is the key driver of increasing water scarcity in Africa and Asia.**

   i. Increases in the world population in coming decades, concentrated in the developing countries where water is already scarce, will significantly exacerbate the current water crisis in a business-as-usual scenario.

   ii. The current rapid economic growth in Asia leads to a more water-intensive lifestyle, for example through changing diets such as increased meat consumption.

2. **The world trade negotiations are expected to have a very significant impact on the demand for water resources to grow food and fiber.**

   i. The world trading patterns in food and fiber products are greatly affected by the agricultural subsidies and tariffs that are currently the subject of intense WTO negotiations.

   ii. If the WTO negotiations have the effect desired by developing countries, i.e. greater access to the markets of OECD countries for their agricultural products, then the additional water required to grow these products in developing countries is potentially very large.

3. **Climate change will increase climate variability while the capacity to deal even with the current climate variability is very low.**

   i. In order to adapt to climate change, which is expected to increase climatic variability, that is to say increase droughts and floods, greater attention needs to be paid to developing mechanisms to ensure adequate storage infrastructure and delivery systems for water resources.

   ii. Due to the difficulty in obtaining localized forecasts of the impacts of climate change, it is not prudent to wait for accurate predictions as the basis for action. As a precaution, the capacity to deal with current climate variability should be increased.

Actionable Messages- Things We Can Do

Increasing Blue Water productivity

~Getting the most out of our renewable water resources~

For most regions of the world increasing water productivity of water used in agriculture, both irrigated and rainfed systems, rather than allocating more water, holds the greatest potential to improve food security and reduce poverty at the lowest environmental cost. This will require a combination of agronomic, socio-economic and institutional interventions. Irrigation systems in Africa and Asia typically require 2000 tonnes of water to produce a tonne of cereal grains such as rice or wheat. On the best systems it takes only 500 tonnes. That is the promise —and the challenge for the sector.

Actions:

Improving irrigation management.

Irrigation system management can be improved to provide more reliable water supply to farmers through improved reservoir operation, better control structures as well as more responsive management. More reliable water supply allows farmers to invest in better on-farm water management such as better land-leveling, zero tillage, or pressure irrigation. Improved management usually requires improved institutions as well as improved technologies. Governments rarely manage to operate and maintain irrigation systems successfully on their own. Farmer participation increases success rates. Schemes have to be financially self-sufficient on operation and maintenance and farmers can, and do, pay on well-performing systems.

Adapting farming practices to increased water scarcity.

When water is relatively abundant, and its cost to farmers is negligible, farmers are not motivated to conserve water. As water moves out of agriculture to cities, and population densities increase in rural areas, the scarcity and value of water increases. Farmers can, and will, respond to increased scarcity, or higher cost such as pumping cost at greater depth at realistic energy prices by using water more effectively.

Enhancing the safe and productive use of wastewater in irrigated agriculture.

Growing water demands of rapidly expanding urban areas also create the opportunity to re-use the equally growing wastewater flows. Making an asset out of wastewater for peri-urban small-scale farmers may make sanitation affordable for poor urban dwellers. Development of appropriate treatment systems to make the waste-water biologically safe, but keep the nutrients that replace fertilizer for farmers, is the challenge. Potential benefits include improved health in urban slums, livelihoods for peri-urban farmers, improved nutrition (vegetables) for the urban poor, and reduced pollution.

Multiple use systems: single systems for domestic use, agriculture, aquaculture, agroforestry and livestock.

Rural people often do not distinguish between water for domestic or livelihood purposes. Water projects and water experts usually still focus on a single purpose, however. Increased value can be captured by designing, planning and managing projects that look at multiple uses in an integrated manner.

Increasing Green Water productivity

~Making the most of soil moisture~

Rainfed agriculture and natural ecosystems have in common that they both depend on the 60% of the rainfall that does not make into rivers or aquifers, but is stored directly in the soil as "soil moisture" —the green water. Increasing the productivity of green water used in rainfed agriculture has great potential to reduce the area needed for agriculture. Agricultural production of staple crops in Africa has, over the last 40 years, increased almost exclusively by area expansion, at the cost of large areas of natural ecosystems. To enable sustainable increases in food production in Africa, agricultural intensification is absolutely necessary. Increasing the productivity of green water used in rainfed agriculture —particularly by adding a limited amount of blue water (from rivers or aquifers) through supplemental irrigation has great potential.

Actions:

Rainwater harvesting.

Capturing a larger share of rainfall close to where it falls both increases the water available to plants and people in that location, but also prevents soil erosion. Rainwater harvesting can focus on: (1) capturing water for domestic use, e.g. by collection of rain falling on rooftops in cisterns; or (2) replenishing green water, e.g. through stone bunds on the contour line; or (3) increasing blue water available locally, e.g. through small check dams that either increase recharge to the groundwater or store water in small reservoirs. Rainwater harvesting has been used successfully by hundreds of thousands of communities, particularly in India, to increase water for domestic, agriculture and ecosystem uses. It has brought rivers back to life. But practiced on a large scale in upper watersheds, it will reduce water available further downstream.

Supplemental and micro-irrigation.

Supplemental irrigation with about 100mm of water, provided during crucial drought spells, can double rainfed yields from about 1 to 2 tonne of cereals per hectare, increasing water productivity to 0.5 kg per cubic meter of water consumed. There are many technologies for supplemental irrigation that range from farm ponds to micro-irrigation with shallow groundwater pumped with treadle pumps.

Increased infiltration and reduced runoff through land and water conservation.

Improving productivity of rainfed systems through improved land management techniques and agricultural production systems. Use of terracing, contouring and micro-basins are important measures in maximizing rainfall infiltration into the soil to increase yields especially for farmers in Sub-Saharan Africa, Latin America and South Asia. Conservation or zero tillage —where crop residue is used as mulch— is a promising technology.

Actionable Messages- Things We Can Do

Increasing access to water resources

~Investments in water resources development are crucial to achieve MDGs in Africa~

In Asia, massive investments in water resources development, in dams by governments and in wells by private sector farmers, have successfully alleviated poverty. In Africa, failed irrigation projects in the 70s and 80s that cost as much as 25 thousand US$ per hectare have led to unwillingness to invest. Modern irrigation systems built in Africa in the 90s though, with costs ranging from only 4 thousand for upgrading to 6 thousand US$ per hectare for new development have proven successful with returns on investment of 10% or higher. Rice-based schemes (where productivity is at least 3 to 4 tonne per hectare) and mixed cereal-horticulture schemes have proven to be viable. Irrigated horticulture is proving highly profitable and a fast expanding sector, driven by private sector investments.

Actions:

Coping with climate variability requires investment in water storage, through large and small dams.

Scale matters. A 10% larger water resources development project is shown to have 7% lower unit costs and 3% higher returns on investment. But few large-scale government-run projects are successful and well-designed large dams therefore need to be combined with small irrigation systems managed largely by empowered farmers in a decentralized system.

Farmers are the private sector and will invest in water and land development, management and conservation wherever this is a viable business proposition.

Farmers need to be recognized as the key private sector actors; they are the primary investors in groundwater development and small scale irrigation in Asia and Africa. More than half the irrigated area in Africa is privately financed and managed. At farm level, irrigated agriculture is a complete private sector enterprise. Smallholder farmers invest in water control when they have access to profitable markets, technology and investment resources, as shown by their fast response to opportunities in (peri)urban agriculture as well as horticulture for export.

Returns to agricultural water investment increase with access to markets and when combined with hydropower, livestock, acquaculture or drinking water.

Multi-functional investments offer scope for increased returns. While multiple-use of water comes naturally to smallholders and the rural poor, governments, donors and NGOs are still often focused and organized around single objectives. In the Nile basin the water demands of lifestock (for drinking and feed/fodder) are as high as or higher than those of people (for drinking and crop-based agriculture). Links are both through prevention or natural resource degradation (overgrazing, soil erosion, pollution of water sources) as well as increased water productivity for fodder production (rainfed or irrigated). Low-intensity fisheries and aquaculture in reservoirs or farm ponds can contribute as much as 20% to the value of the crops grown. High intensity aquaculture has much higher water productivity than most crops and competes for scarce water resources in many closed basins.

Making an asset out of wastewater holds the promise to make sanitation affordable for poor people.

Meeting the MDG on sanitation for Africa requires innovative approaches. Reduction in the African burden of diarrhea of 25 million DALYs per year may become more affordable when the wastewater is treated as a valuable resource. When wastewater is treated it will be re-used. Safe re-use in peri-urban agriculture has such a high value that it may help make sanitation affordable. Technologies are available but remain untested. This is a major challenge and opportunity for research that is a high-potential investment opportunity.

Actionable Messages- Things We Can Do

Balancing water for food and other ecosystem services

~Giving voice to the silent actor~

Future management of water must continue to work towards achieving a sustainable balance between water for agriculture and water for natural ecosystems. There is, therefore, a need to develop, test and apply best practice frameworks that enable explicit inclusion of the environment as a sector in basin water resources development and management to avoid the often irreversible and costly damage to the environment. The starting point for the discussion is that all water in the hydrological cycle has a value in terms of ecosystem services; none of it flows to the sea wasted. All use for human purposes is a trade-off between current and future use.

Actions:

Securing water for the needs of the environment.
Development and application of methodologies to determine the water requirements of ecosystems, or environmental flow requirements, must be followed up by actions to secure these water requirements through formal and informal mechanisms.

Enhancing benefits in agriculture-wetlands interactions.
Accounting for both livelihood and environmental service benefits offers the opportunity to use wetlands wisely. In Southern Africa, for example, irrigated agriculture (in Zambia and Zimbabwe) is closely linked to the development of small wetlands or dambos. While to date agriculture has often completely replaced the wetland ecosystem (through "land reclamation"), opportunities exist to optimize two functions jointly.

Manage agricultural water use sustainably: ignoring environmental impacts can lead to failed projects.
While all agricultural water use has positive and negative environmental impacts, failure to understand upstream soil erosion and resulting reservoir siltation, or impacts of flow reduction on downstream recession agriculture, or impacts of environmental changes in waterborne diseases such as schistosomiasis or malaria, has led to failed projects. The good news is that well-managed agricultural water use can offer major opportunities to improve health and environmental values.

Investing in water security to aid poverty alleviation

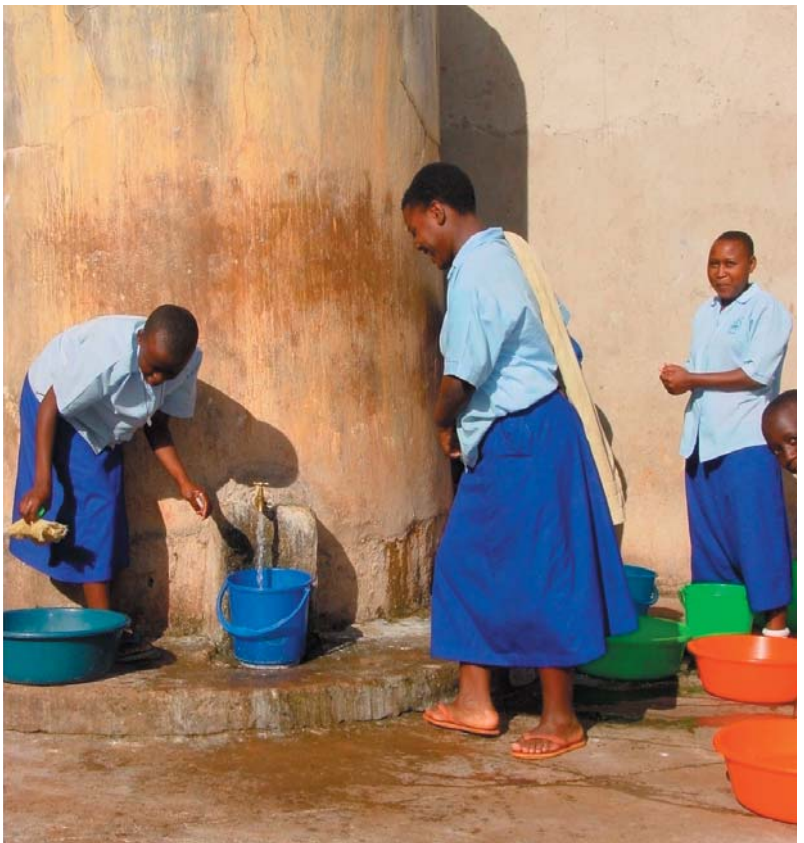
~Target poor areas with pro-poor designs~

Providing reliable access to water for productive purposes is one of the key opportunities in the water sector to alleviate poverty for a considerable share of the three-quarters of the world's 'dollar-poor' that live in rural areas. What is needed is an assortment of interventions that combine technology, institutions and social marketing, implemented through decentralized organizations closely linked to or directed by the users.

Actions:

Target geographic areas with high concentrations of poverty and focus on pro-poor project design.
While specific targeting of poor groups has run into implementation difficulties, targeting areas with high incidence of poverty and design of projects that are explicitly pro-poor, have been found to be effective.

Gender-equitable development boosts productivity.
Women form the majority of the agricultural labor force. In addition, in significant parts of Africa where men migrate to find work elsewhere, female headed households can imply that the majority of farmer decision-makers are women as well. Gender-equitable water development projects have a higher productivity and gender-equity is therefore not only a welfare issue. Where acceptance of women's roles remains problematic, affirmative gender-action can increase the success of water development projects.



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