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INTERNATIONAL DEVELOPMENT ASSOCIATION



# Water Resources

IDA at WORK

IMPROVING SERVICES FOR THE POOR

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SUSTAINABLE DEVELOPMENT NETWORK



THE WORLD BANK



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# Water Resources

IDA at WORK

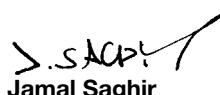
INTERNATIONAL  
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IMPROVING SERVICES FOR THE POOR

The management of water resources dates back to the earliest civilizations. Yet the need for integrated management of those resources has never been more pronounced and the vulnerability of the poorest communities in the poorest countries never greater. Environmental integrity, water quality, efficient allocation across uses and users, adaptation to climatic variability and change, and appropriate infrastructure all converge as imperatives to managing this very basic resource. Cutting across a wide range of sectors, the potential impacts of good management are profound and broad, including protecting the environment, mitigating water-borne disease, producing clean energy, improving agricultural incomes, increasing water security, promoting regional cooperation, and avoiding resource conflicts.

This booklet describes how the International Development Association (IDA), the concessional lending arm of the World Bank, has assisted the poorest countries in improving the management of their water resources. It also offers several examples of how countries have succeeded in implementing innovative water resources management (WRM) initiatives, resulting in tangible benefits across multiple sectors and at all levels.

The commitment to integrated water resources management is necessarily a long term endeavor that requires both the financial and technical support that IDA provides. The World Bank remains committed to confronting the challenge and to working with our partners in developing and donor countries to consolidate and extend the many achievements to date.



J.SAGHIR  
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# IDA at WORK

## Water Resources: Managing a Scarce, Shared Resource

Water security is fundamental to poverty alleviation. However, it is expected that by 2025, 3.5 billion people will live in water-scarce or water-stressed areas, up from 1.0 billion in 2005. The world's poorest countries and the poorest communities within these countries are the most vulnerable to inadequate management of water resources.

The International Development Association (IDA), the World Bank's fund for the world's poorest countries, has a unique role to play by working across sectors, institutions and countries involved in water resources management. The Bank has proven to be an "honest broker," bridging sensitive trans-boundary issues, coalescing policy across different parts of an economy, and weaving infrastructure with environmental management, social participation and institutional development. The World Bank's sharpened focus on climate change will primarily assist IDA economies that depend heavily on climate-sensitive sectors such as agriculture, forestry, fisheries, a reliable water supply, and other natural resources. In its role, and in collaboration with other donors, IDA directs critical funding towards countries that would otherwise have a hard time investing in the management of public goods management on a long-term,

continuous basis for water security.

The impact of water resource management projects is often profound. Evidence from recent lending demonstrates that such support has increased agricultural incomes, reduced the losses from flooding, nurtured regional cooperation, reduced sediment loadings and mitigated water-borne diseases. Several IDA countries are making significant progress in water resources management, having established basic policies and capacity. Ongoing, flexible support will be needed to secure and extend these achievements, and deepen their impacts on poverty alleviation and sustainable development.

### Water: Our Common Link

While world population tripled over the last century, the use of water increased six fold. Irrigated agriculture accounts for about 70 percent of water use, and about 90 percent in some water-stressed regions. Low-income IDA borrowing countries account for about 80 percent of countries with the worst water poverty ratings (see map).

#### At a glance

- While world population tripled in the 20th century, the use of water increased six-fold.
- Irrigated agriculture accounts for about 70 percent of global water use, and more than 90 percent in some water-stressed regions.
- Low-income, IDA countries account for about 80 percent of the most water-poor countries.
- More than 260 rivers in the world run through more than one country, presenting both opportunities and challenges, especially in Africa.
- Total IDA funding for water resource management amounted to about US\$1.3 billion, spanning 107 projects between fiscal years 2000 and 2009.

Analytical work has demonstrated connections between water and almost all types of economic activity—including farming, manufacturing, energy and transport—as well as the business climate.

Climate change is projected to alter the amount, intensity and frequency of precipitation, directly affecting the magnitude and timing of runoff, floods and droughts. For regions that are already highly vulnerable to climate variability, the potential impacts on all sectors that depend on water—from domestic water supply and agriculture to health and the environment—could wreak havoc on economies and livelihoods.

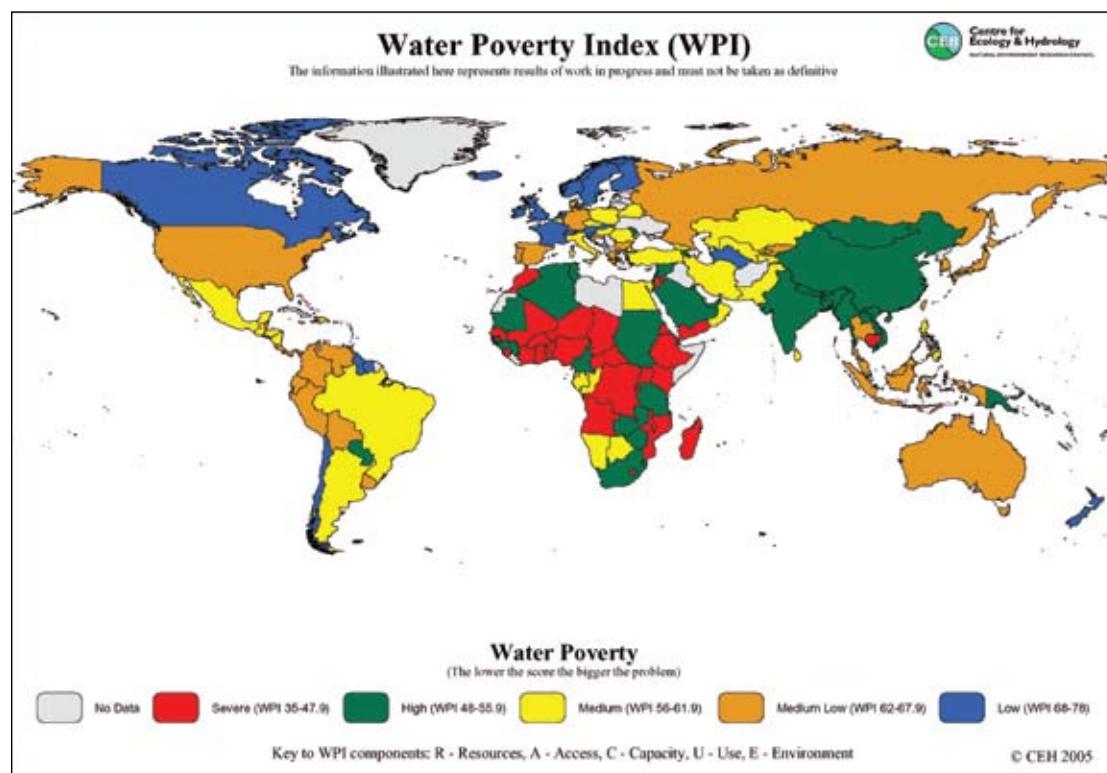
Tensions over water allocation and rights are increasing at the local, national and regional levels.

Climate change poses risks to World Bank

investments in the water sector. The Bank reviewed its water portfolio to understand its exposure to climate change. From FY06-08, the water portfolio comprised 191 projects in 83 countries with a total commitment of US\$8.8 billion, as well as a pipeline for FY09-10 of 220 projects with projected commitments of US\$11.3 billion. The resulting projections indicate that about half of the Bank's water portfolio would potentially be at high to medium risk of exposure to climate change impacts in the year 2030.

The review also illustrates that the World Bank is already responding to this challenge. Out of the 191 projects approved during FY06-08, 35 percent considered strategies to reduce the impacts of climate variability and change, including adaptation

#### **The Water Poverty Index illustrates the degree to which water scarcity impacts on human populations.**



and/or mitigation measures. For the total active portfolio, however, only 20 percent of the projects address climate variability and change.

### Key trends.

Water resources management is a complex and relatively new area of focus for many countries. It requires action at the policy, legal and institutional levels while addressing direct impacts at the community level. It is further complicated by impacts and influences from other sectors, such as industrial pollution, agricultural intensification or hydropower generation. Some of the key trends and priorities in water resources management include:

- Developing a better understanding of water-related linkages across economic sectors at the country level.
- Strengthening institutions for effective local and basin-level management.
- Creating and implementing innovative mechanisms for sharing economic, social and environmental benefits of water.
- Managing water resources across national boundaries.
- Contributing to the development of environmentally-sustainable water infrastructure for storage and other uses.



- Identifying and implementing measures for increasing the efficiency of water use.
- Addressing water management challenges associated with rapid urbanization and changes in water use patterns as tension between urban and rural water use grows.
- Mitigating water pollution for protecting the environment and facilitating water reuse.
- Accelerating efforts to examine and develop hydropower as a climate-friendly renewable source of energy.
- Developing an appropriate menu of adaptation and mitigation options for addressing hydrologic variability and climate change in water management.

Building the intellectual and financial capital to improve water security requires concerted and long-term support from an array of players, including international financial institutions, bilateral aid agencies and non-governmental and civil society groups.

### Challenges.

Water resources management cuts across sectors, skills, institutions and sometimes countries. Water resources have multiple uses, and can be a private or public good depending on the use, which contributes to the potential for contention around ownership and stewardship. Water resource management initiatives frequently lack revenue streams, placing an additional burden on already over-taxed public finances. Because they reach across land areas and economic and social sectors, many water management reforms and initiatives require a high level of coordination. There needs to be collaboration by players at the community, national, and international levels, across sectors as diverse as agriculture and



hydropower. Furthermore, the range of tools required to address water resources issues extends from analysis to participatory processes, to investments in structures, and civil works. Not surprisingly, this sector requires a long-term commitment.

## IDA CONTRIBUTIONS

IDA's work in the water resources sector is guided by the 2003 Water Resources Sector Strategy.

**The strategy emphasizes the need to address both management and development issues; tackling institutional reforms along with infrastructure upgrades.**

To better integrate water management into country programs and development plans, the strategy recommends preparation of Country Water Resources Assistance Strategies in consultation with client governments. Eighteen such plans have been produced to date for IDA countries.

Total IDA funding for water resources management amounted to US\$1.3 billion, across 107 projects during FY00-09. IDA funding for this area reached an unprecedented amount of US\$334 million in FY08. But in the following fiscal year, IDA funding for water resources management amounted to US\$145 million, less than half of the previous year. All commitments in FY09 were split between three regions - South Asia (35 percent), Africa (33 percent), and the Middle East and North Africa (32 percent) - and was concentrated in the rural sector (58 percent) and water sector (32 percent).

Given the nature of water resources management, aggregate impact measures are not available. However, on-the-ground results related to IDA

activities can be highlighted in six critical areas.

### Policy and legal framework.

In most countries, and particularly in IDA countries that struggle with low capacity and poorly-developed institutions, the Bank pays considerable attention to the foundational components of water resources management, namely development of policy and legal frameworks. A large percent of IDA-funded water resources management projects include institutional and/or policy components. In Tanzania, for example, IDA funding supported the development of a National Water Policy, which was adopted by the Cabinet in 2002 and which subsequently formed the basis for a National Water Sector Development Strategy. As a result, water and water resources management are now firmly entrenched as key priorities in the National Development Vision. Similarly, IDA funding has supported the development of water laws in Senegal and Yemen. In both cases, policy reform was accompanied by sector-specific actions.

### Institutions and capacity-building.

In the case of water resources management, relevant institutions span the range of local, basin, national and international levels.

Yemen's water law enacted in August 2002 led to the establishment of the Ministry of Water and Environment to consolidate public management and support an integrated approach to water resources management. From this platform emerged the Sana'a Basin Commission that has demonstrated an ability to make substantive decisions, taking into account the range of associated sectors. The IDA-financed Sana'a Basin Water Management Project (2003-2009) was the first initiative in Yemen to address the crisis in groundwater depletion.

## IDA at WORK: Water Resources

At the local level, IDA funding has expanded the involvement of local stakeholders in water management through the creation of water user associations. In Yemen, 34 irrigation water user associations were established over a three-year period in the Sana'a Basin, along with 15 recharge water user groups.

In China, the Tarim Basin Projects (1991-1997 and 1998-2004) resulted in the first fully functional integrated river basin management system in the country.

In India, new participatory micro-watershed planning approaches resulted in highly-integrated micro-watershed plans being prepared by communities, which have greater ownership and commitment. Between 2001 and 2007, one project, financed with \$100.4 million from IDA, created 4,300 area groups of farmers and 738 micro-watershed user groups to support project implementation and longer-term operations. Recent evaluations indicate that more than 70 percent of these groups are operating effectively, allowing the voices of all social groups in the communities to be heard in watershed development.

Little recognition or significance is given to the vital function of groundwater in the global water cycle or to the immense benefits resulting from proper management of groundwater as an integral part of the overall management of the resource. The need for a strategy to promote good governance of groundwater and to build a broad coalition for change is being addressed by the World Bank at the global level. The initiative will promote alternative approaches to current groundwater use. Good governance of groundwater is identified as a high priority issue in the water sector in many IDA countries and was also highlighted as an emerging global priority issue at the Fourth World Water Forum in Mexico in 2006. This will be addressed through a consultative process at the Fifth World Water Forum in 2009 in Turkey.

### **Trans-boundary river management.**

More than 260 of the world's rivers run through multiple countries, presenting unique opportunities and challenges, predominantly in Africa.

IDA funding produced power, environmental and agricultural benefits for Senegal, Mali, and Mauritania through investments in infrastructure, equipment and trans-boundary management institutions in the Senegal River Basin.

In Mozambique, an International Rivers Office was established within the Water Resources Department, providing improved technical capacity to assess water resources and basin plans, and stronger technical ability to engage in dialogue with other countries on riparian rights and basin management issues. Increasingly, water resources management is emerging as a vehicle for regional peace and stability as well as more effective water management and allocation.

### **Hydropower.**

Hydropower is a major contributor to the growth of renewable energy, outpacing capacity growth in wind, biological sources, geothermal and solar. Much of this growth has come in developed and emerging economies. In FY09, IDA contributed additional financing for the hydropower rehabilitation components in the Pamir Supplemental Financing Project in Tajikistan, and the component for village electrification through micro-hydropower in the Power Development Project in Nepal. IDA also continues to support lending for hydropower rehabilitation in Africa as part of the Niger Basin Water Resources Development and Sustainable Ecosystems Management Project, and the Renewable Energy Project in Armenia.



## Agriculture.

In many low-income countries, agriculture employs the largest share of people and is therefore a critical sector for achieving targets for global poverty reduction. IDA lending to agriculture increased steadily during the past years. Yet agriculture's share of total IDA lending remained static at about 9 percent over FY04-08 before shooting up to 16 percent, or US\$2.2 billion, in FY09. The largest share of resources for agriculture has gone to Sub-Saharan Africa, followed by South Asia as the second largest beneficiary. Irrigation and drainage has tied with general agriculture as the leading sub-sectors of IDA annual commitments to agriculture.

Due to a number of factors, global food prices more than doubled from 2006 to mid-2008. In late 2008 they declined by 30-40 percent, and then rose again until June 2009. The price spikes in early 2008 led to sharp increases in staple food costs in many developing countries, and contributed to civil unrest in nearly 40 countries in 2008. At the same time, the price of inputs to agricultural production such as fuel and fertilizers tripled, undercutting the profitability of smallholder farmers. It was estimated that without adequate collective response, the rise in global food prices could result in an additional 100 million people in low income countries falling below the poverty line.

The *World Development Report 2008: Agriculture for Development* led to a broad, renewed consensus on the importance of agriculture for development. It called for greater investment and more donor support for agriculture, for leveraging global partnerships, and for a more strategic approach and improvements to encourage the development and functioning of markets. In 2008, in response to rising food prices, a strategic and coordinated approach was adopted with partners, under the coordination of

the United Nations Secretary-General. In May 2008 the World Bank initiated the Global Food Crisis Response Program. Supported by other donors, the US\$1.2 billion rapid financing facility helped to speed up assistance to the neediest countries, most of which receive IDA financing. In response to high demand, the program ceiling was increased to US\$2.0 billion by the World Bank Board of Directors in April 2009. IDA also provided support for agricultural productivity interventions through the Global Food Crisis Response Program. In Nepal, for example, small scale irrigation through community grants is being supported, together with the distribution of seeds and fertilizers. To implement the advice contained in the 2008 World Development Report and significantly expand support for agriculture, the World Bank is now preparing an Agriculture Action Plan for the 2010-12 fiscal years. Among the strategic priorities is the need to raise agricultural productivity, including through improved agricultural water management in irrigated and rain-fed areas.

A number of IDA-funded operations related to water management and the agricultural sector have been successful. Some also had significant environmental benefits. Three completed projects are highlighted here.

The On-Farm Irrigation Projects in the Kyrgyz Republic (2000-2013) set out to achieve increased crop production through reliable and sustainable water distribution in formerly state and collective farms across seven administrative regions. A core activity has been strengthening services to about 450 water users associations, including training and support. The project focused also on rehabilitating on-farm infrastructure under the management of user associations that had met certain milestones, and improving operation and maintenance. Considerable success was achieved in establishing and improving

## IDA at WORK: Water Resources

water user associations. Dedicated support units earned the respect and trust of water users and played a key role in the establishment and effectiveness of the user associations. Over 50,000 people were trained, and approximately 450 user associations, with 166,000 members, were formally registered to manage irrigation areas covering 710,000 hectares, or about 70 percent of the country's irrigated land.

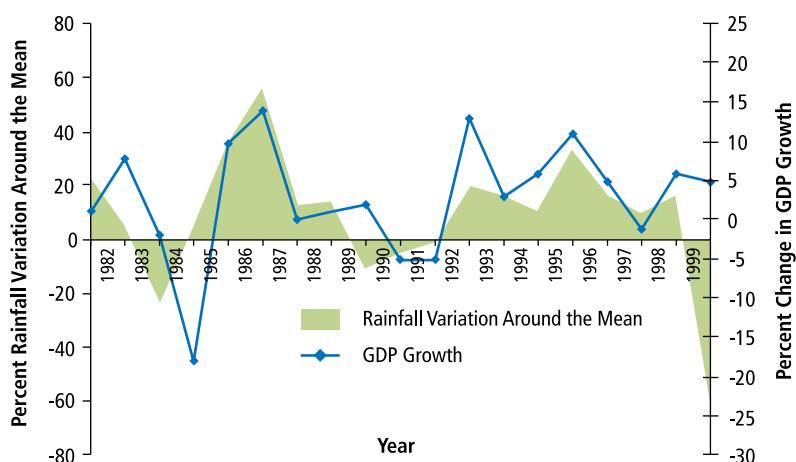
Infrastructure on 121,000 hectares managed by 63 water user associations was rehabilitated. Water delivery to farmers in 80 percent of the rehabilitated schemes now closely matches irrigation water demands. Irrigation service fees have doubled on average, and collection rates by the user associations amount to close to 100 percent of total assessed fees. A follow-up project now focuses on continued assistance to associations and additional rehabilitation works.

The Tanzania River Basin Management and Smallholder Irrigation Project (1996-2004) focused on water-related environmental concerns at the national level and the particular problems in the two largest basins. It provided support to improving water

access and use by low-income smallholder farmers in 15 irrigation schemes through better agricultural water management, infrastructure, and stakeholder participation. More than 1,500 farmers were trained in water management, crop production techniques, agro-business, and financial management and leadership skills. Through a combination of activities, including policies on water rights and fees, crop yields for more than 5,000 households doubled, and agricultural incomes tripled.

The Second Loess Plateau Watershed Rehabilitation Project (1999-2005) in China supported one of the world's largest erosion control programs in the heavily degraded Loess Plateau, with the aim of returning this poor part of the country to an area of sustainable agricultural production. The project substantially raised agricultural productivity, increased and diversified farm incomes, improved the environment, and created conditions for sustainable water and social conservation. Over the project period, the yearly per capita income of project households, comprising 1.9 million people, more than doubled. Per capita grain production increased by 78 percent. Vegetation cover in the project area

### Ethiopia: Rainfall and GDP Growth



Source: World Bank, 2006.



increased from 17.3 percent to 33.5 percent. A grazing ban introduced through the project and implemented in most of the Loess Plateau has dramatically changed the landscape of a whole region of China. Increased income and the prospect of a sustainable natural resource base have allowed farmers to invest in a wide range of enterprises and social programs which benefited communities as a whole.

### **Environmental and social benefits.**

In the Senegal Basin, pilot activities indicated that activities such as improving sanitation and the distribution of medications and bed-nets, could directly reduce infant mortality due to diarrheal diseases by 40 percent, and due to bilharzia and intestinal parasites by 50 percent. These trial projects provided the basis for a basin-wide strategy for waterborne disease reduction that is currently being implemented as part of an IDA-funded multi-purpose water resources management project.

In Pakistan, watercourse improvements have led to water savings of approximately 85,000 acre-feet and reduced water logging and flood threats in numerous villages. In other IDA projects, improvements in water use efficiency freed up water for regeneration of the environment downstream.

IDA-funded flood projects in Uganda, Kyrgyz Republic, and Bangladesh enhanced protection of populations, infrastructure and property. In the Lake Victoria Environmental Management Project, water hyacinth was reduced to non-nuisance levels and fish species—thought to be extinct—were discovered in satellite lakes.

### **Management across sectors.**

Frequently, water resources management projects involve more than one sector and combine investment initiatives entailing both institutional develop-

ment and capacity-building. Expertise ranges from analytical work to public administration, legal frameworks, participatory methodologies and environmental safeguards.

IDA can bring diverse tools for water resources management together in coherent and coordinated programs. The analytical work carried out by IDA has increased governments' understanding of the role of water in development and poverty alleviation and has created a new structure for management and investments.

For example, research for the Ethiopia Country Water Resources Assistance Strategy (2006) generated economy-wide models for Ethiopia that show projections of average annual GDP growth rates can be significantly impacted when rainfall variability is taken into consideration. The correlation between rainfall and overall GDP is illustrated in the figure below. This highlights the importance of considering the variability in water flows—whether rainfall, river flows, or even the flow of water underneath the Earth's surface—when assessing economic performance

### **Global and regional partnerships.**

The Bank also convenes partners to support innovation in integrated water resources management. Given the broad reach of water resources management needs and initiatives, this type of collaboration has been significant.

- The Bank/Netherlands Water Partnership Program, funded by The Netherlands, is a US\$11 million trust fund specifically for innovation in water resources management, with particular emphasis on Africa, the quality of lending operations, downstream operational impacts, as well as gender equality, and poverty reduction. This trust fund has now evolved into the new Water Partnership Program - a multi-donor program -

with additional participation from Denmark and the United Kingdom. The Water Partnership Program focuses on both water resources management and water and sanitation services. The Program will be implemented during fiscal years 2009-2010, and amounts to US\$20 million.

- The World Bank is one of the three implementing agencies of another important partnership, the Global Environment Facility. This multi-donor, multi-billion dollar fund addresses critical threats to the global environment including the degradation of international waters and persistent organic pollutants.

In 1997, the World Bank was invited to coordinate international support for cooperation in managing the Nile's water resources, and since 1999 it has been promoting dialogue, and supporting joint actions, with a major focus on attitudes toward the shared usage of Nile waters. The Bank now coordinates the involvement of 17 multilateral and bilateral development partners of the Nile Basin Initiative, which involves nine African countries. This initiative has helped articulate common benefits of river basin management through analytical work, country dialogue, and communications.

### Outlook

IDA projects under preparation suggest a strong upward trend of water resources management lending in the near future as the World Bank's water strategy, Country Water Resources Assistance Strategies, and renewed IDA commitment to infrastructure translate into country programs.

**There remains a strong need for interest-free credits and grants to help low-income countries finance water resources management activities**

### **including policy, institutional and analytical work.**

Water resources management is emerging as a basic challenge to development. Important foundational steps have been taken, which are leading to projects to broaden and deepen impacts. In Senegal and Tanzania, initial work on legislation and capacity building – supported by IDA - has evolved into more extensive river basin management structures and consideration of significant infrastructure investments in hydropower and water regulation.

In IDA countries, the challenge of achieving water security will last for decades. It will require continued support in building institutions, capacity, management programs and infrastructure. Specific challenges include:

- creating an adequate platform of water infrastructure so that growth varies less with water availability;
- ensuring equitable sharing of benefits of water resources management across local and indigenous, urban and rural populations;
- building trans-boundary coalitions and mechanisms for regional river management and development;
- increasing the role of hydropower as a climate-friendly source of energy;
- putting groundwater governance, as an integral part of water management, on the global agenda;
- addressing climate change and variability in practical ways, including mitigation, adaptation and “smart” design of programs, institutions and infrastructure.

Support to date has been modest but catalytic. Continuous IDA support will be critical to securing these achievements and increasing the benefits to poverty alleviation and sustainable development.

## Regional Cooperation and Benefit Sharing in the Senegal River Basin

### Challenge

The four riparian countries of the Senegal River Basin—Guinea, Mali, Mauritania and Senegal—rank among the twenty-five poorest countries in the world. All riparian countries are facing energy shortages and growing water constraints, which is hampering their economic performance. The Basin's hydropower potential is estimated at 1200 MW, of which less than 25 percent is currently exploited. Similarly, potential irrigable area is estimated at 320,000 ha, of which less than 32 percent is currently developed. Health issues also represent a major challenge: waterborne diseases have steadily increased, yet control intervention is among the lowest in the world. Although the Senegal River Basin Organization (OMVS) has existed since 1972, the structure has not been fully inclusive due to the lack of involvement of upstream riparian Guinea. This has limited the development opportunities and shared benefits that could arise from cooperative and integrated management of the entire basin.

### Approach

- The project's primary development objective is to enhance the regional integration of the riparian countries of the Senegal River Basin for multi-purpose water resources development that fosters growth, including improved community livelihoods. The project draws on the strong foundation established by an earlier IDA-funded Hydropower Development Project in Mauritania, Senegal and Mali, which supported joint ownership of water infrastructure.
- Focus is placed on three activities to reach this objective: (i) *regional institutional development for water resources*, including modernizing and building the capacity of the OMVS and making the necessary legal and institutional changes required to include Guinea; (ii) *local level multi-purpose water resources development* to promote income-generation activities and to create tangible basin-wide benefits at the ground level; (iii) *regional*



### Senegal River Basin

*multi-purpose and multi-sector master planning,* including feasibility studies to identify future potential water infrastructure investments in the basin.

#### Results

**Integrated river basin management coupled with the development of multi-purpose water resources infrastructure is expected to yield expanded opportunities for growth, reduced immigration and poverty, and improved health and livelihoods of the population while also preserving the environment.**

The multi-purpose approach will also broaden the scope of potential investments, generate a wider range of direct and indirect benefits (e.g., the development of a least-cost energy market in the context of the West Africa Power Pool), and enhance the participation of local communities in water management.

#### Highlights

The earlier Hydropower Development Project produced a number of positive impacts that the Multi-Purpose Water Resources Development (MWRD) Project builds on. These include:

- Preparation of a Water Charter, which establishes principles for guiding water resources management and allocation amongst the signatory states.
- Establishment of operating procedures for the Manantali dam, which resulted in managed flooding of approximately 50,000 ha for traditional recessional agriculture.
- Piloting of health projects, which, when extended, are expected to decrease the prevalence of bilharzia and malaria by 50 percent, infant mortality due to diarrheal diseases by 40 percent, and intestinal parasitosis by 50 percent.

The expected outcomes of the first phase of the MWRD Project are:

- Equitable sharing of benefits among all riparian countries and communities living in the Basin.
- Benefits flowing to two million people in the project area.
- Higher agricultural productivity and incomes through improved water and land management.
- Reduction in the prevalence of malaria and schistosomiasis through improved access to and utilization of control interventions.

#### IDA Contribution

- The total project cost at the time of approval was US\$141 million, with IDA contributing US\$110 million. This includes an IDA credit of US\$31 million each to Senegal, Mali and Mauritania and an IDA credit of US\$18 million to Guinea.



- In its support for the Senegal River Basin Organization (OMVS), the project is firmly grounded regionally. It will assist in consolidating thirty years of cooperation and joint development in various economic sectors within the Basin. For the first time, upstream riparian Guinea will be fully involved in decision-making and the benefits that derive therefrom.
- The design of the project takes into account the water balance of the Senegal River and the countries' different interests and levels of capacity and development, and tailors the activities to suit regional, national, and local levels.
- The approach adopts a long-term vision, takes the river basin as the basic unit for water resources planning and management, and promotes an un-fragmented institutional framework that includes both top-down strategies and bottom-up stakeholder participation.

### Next Steps

Phase 2 components will depend largely on the results of phase 1, including the involvement of Guinea. Phase 2 will include selection of the second round of local level multi-purpose water resources development activities to be scaled up and the development of water resources infrastructure, including multi-purpose hydropower, for which the relevant studies will be done under the first phase.

Integrated river basin management coupled with the development of multi-purpose water resources infrastructure is expected to yield expanded opportunities for growth, reduced immigration and poverty, and improved health and livelihoods of the population while also preserving the environment.



## Recovering from Devastating Floods in Yemen

### Challenge

Taiz, with 540,000 inhabitants, is one the largest cities in Yemen, located at the base of Mt. Sabir. The city is subject to severe seasonal flash flooding that claims lives every year, injures scores of residents, and inflicts significant damage on city infrastructure. Particularly vulnerable are the poorest urban dwellers who live near the flood zone in precarious dwellings made of wood, aluminum, and other scavenged materials.

### Approach

In response to this daunting challenge, the IDA-financed Taiz Municipal Development and Flood Protection Project aimed to build flood protection structures that would channel floodwater to a catch basin south of the city, thereby protecting city residents and businesses. The project financed Yemen's first resettlement operation, which far exceeded the typical "do-no-harm" approach to social safeguards. The integrated urban resettlement village, located at Al Birarah, included access to decent housing, tenure security, and adequate services.

### Results

**Flood-protection infrastructure transformed major parts of Taiz city and has had an immediate and substantial impact on the lives of city residents in the affected areas (an estimated 10,000 households and 1,000 businesses were direct beneficiaries). In project areas, there have been zero flood-related losses in lives or property.**

### Highlights:

Project infrastructure improvements directly led to:

- Reduction in loss of lives from a baseline of 6 deaths per year prior to project implementation to none in 2007,
  - Reduction in significant damage to residential properties adjacent to the flood paths from a baseline average of 160 houses per year to none in 2007,
  - Reduction in significant damage to business establishments adjacent to the flood paths from a baseline average of 660 incidents prior to project implementation to none in 2007, and
  - Reduction in damage to public infrastructure from an annual baseline cost of US\$95,000 to none in 2007.
  - Construction of 20.7 kilometers of flood protection channels
  - Construction of 28.5 kilometers of newly paved or upgraded roads, leading to an increase of the primary road network by some 30 percent: Street paving greatly improved access and economic opportunities. Buildings that could previously only be reached by foot or donkey can now be easily accessed. Transportation costs are reduced.
  - Construction of 20 pedestrian bridges and 18.3 kilometers of footpaths,
  - Construction of 33 kilometers of expanded wastewater network, and
- The project also resettled 240 low-income families out of harm's way to a model resettlement village, which greatly improved their livelihoods. Highlights include:
- For the first time, property titles were issued jointly in the name of both spouses.

- Al-Takaful, a local NGO, played a strong role in the resettlement. It conducted a comprehensive social study of the group, organized the move-in process, and continued to provide support long after the families moved in—managing literacy and skills-development programs, and introducing new amenities and facilities.
- Representatives of the NGO, the Akhdam community, and Local Council traveled to India to participate in a knowledge exchange with an NGO that has extensive experience in providing affordable housing for slum dwellers and implementing integrated community development programs. This experience bridged the gap between policymakers, NGOs, and community organizations to develop a common vision for urban upgrading in Taiz.

### **IDA Contribution**

- By the closing date of the parent Credit in June 2008, the total project cost was US\$52 million, of which IDA provided about US\$47 million and the Government US\$5 million.
- IDA's global experience in disaster risk management, municipal capacity building, and resettlement of vulnerable populations allowed it to share best practices with the Government of Yemen. IDA was instrumental in bringing awareness to the plight of vulnerable populations living in informal settlements and brokering important collaboration between municipal authorities and NGOs that proved crucial for service delivery.

### **Next Steps**

Additional financing of US\$20 million became effective in June 2008. Specifically, the investment will benefit approximately 10,300 households and 450 businesses by protecting areas that are still vulnerable to flood damage from seasonal flash flooding. It will also upgrade infrastructure services in the same areas.



Flood-protection infrastructure transformed major parts of Taiz city and has had an immediate and substantial impact on the lives of city residents in the affected areas.

## Comprehensive Water Management Brings Widespread Benefits to Tamil Nadu

### Challenge

Tamil Nadu is a water short state, with limited potential for further water resource exploitation. Its ability to meet rapidly growing water demands in a sustainable manner is contingent on managing the challenge of allocating water across sectors and within sectors. At the time of project preparation, the state lacked the institutional apparatus to support comprehensive multi-sectoral water planning and management. Irrigation constituted over 75% of total water use, but system performance was disappointing resulting in inequitable supplies and significant waste. This affected access to water not only within poor agriculture-dependent communities and but also within other sectors vying for limited water supplies. Groundwater extraction rates were beyond safe yields in several parts of the state, leading to contamination from salt water intrusion. Other water quality issues with associated health consequences were pervasive, primarily due to untreated industrial effluents and sewage.

### Approach

The project's primary objectives were to support water resources planning on a river basin basis and across all uses of water; to improve institutional and technical capability for managing the state's water resources; to improve agricultural productivity through modernization and completion of irrigation systems; to upgrade water management and farmer participation; and to assure sustainability of water infrastructure and the environment.

### Results

**Substantial institutional restructuring and development occurred to enhance multi-sectoral water management on a river basin basis. Environmental considerations were**

**mainstreamed into water planning and management. Significant agricultural productivity and income gains were registered through improved water use, supported by irrigation system improvements and farmer participation in newly formed water users associations.**

### Highlights

- The State Water Policy was updated in accordance with the National Water Policy and a State Water Plan was prepared.
- A Water Resources Organization was formed as an independent organization, responsible for multi-sectoral water management and structured on river basin lines. This included the establishment of new decentralized field management under basin managers. A framework water resources plan and five detailed river basin plans were completed. Two River Basin Organizations were created, the first of their kind in South Asia.
- A State environmental planning framework was developed and environmental units were created in several agencies. Environmental and social assessments and environmental action plans were produced for all major river basins. A water and soil monitoring program was operated, with over 400 sampling locations across multiple basins.
- An inventory of about 3.3 million wells throughout the State was completed. The Tamil Nadu Groundwater (Development and Management) Act was passed.
- The Tamil Nadu Farmers' Management of Irrigation Systems Act was passed. 1566 water users associations were formed—covering an area of over 630,000 ha—and given responsibility for the O&M of canals serving less than 700 ha. Training was given to tens of thousands of farmers.
- There were dramatic increases in yields, by over 40% for some crops. Scheme improvements converted almost 218,000 ha from partial to full

irrigation and created over 73,000 ha of new irrigated area, directly benefiting 3.2 million people. Scheme completions increased irrigated area by about 60,260 ha and improved irrigation on about 95,300 ha, directly benefiting over 87,000 people.

- One catchment with depleted cover in a sub-basin of the Cauvery was restored.

#### **IDA Contribution**

- IDA financed the full cost of the project, US\$206.1 million.
- The project grew out of Tamil Nadu's long term strategy to promote rural development. IDA played a key role in helping the government design the ambitious project, spread across 20 districts and involving policy, institutional and expenditure reform, changes in planning and decision-making processes, and mobilization and capacity building of water users. It assisted in coordinating project activities, many of which involved several line departments, government and university institutions, and non-governmental organizations.

#### **Next Steps**

The Government of Tamil Nadu has indicated its resolve to continue the reform process, including by:

- Increasing irrigation water charges to a level that would meet O&M costs.
- Extending the concept of integrated river basin management to more basins and establishing the administrative and legislative measures required to make River Basin Organizations fully functional.
- Allocating funds under the state budget to support the further training of water users associations.

The Government has also specified that it would welcome further Bank support to consolidate the impressive gains made under the project.



Tamil Nadu has tackled the challenge of meeting rapidly growing water demands through enhanced multi-sectoral water management on a river basin basis.

## Reversal of Degradation in China's Loess Plateau Doubles Incomes

### Challenge

Home to more than 50 million people, the Loess Plateau in China's Northwest takes its name from the dry, powdery, wind-blown soil. Centuries of overuse and overgrazing led to one of the highest erosion rates in the world and widespread poverty.

### Approach

Two projects set out to restore China's heavily degraded Loess Plateau through one of the world's largest erosion control programs with the goal of returning this poor part of China to an area of sustainable agricultural production.

### Results

**More than 2.5 million people in four of China's poorest provinces—Shanxi, Shaanxi and Gansu, as well as the Inner Mongolia Autonomous Region—were lifted out of poverty. Through the introduction of sustainable farming practices, farmers' incomes doubled, employment diversified and the degraded environment was revitalized.**

### Highlights:

- Incomes doubled: People in project households saw their incomes grow from about US\$70 per year per person to about US\$200 through agricultural productivity enhancement and diversification.
- Natural resources were protected: Uncontrolled grazing, subsistence farming, fuel wood gathering and cultivation of crops on slopes had left huge areas of the Plateau devastated. The project encouraged natural regeneration of grasslands, tree and shrub cover on previously cultivated slope-lands. Replanting and bans on grazing allowed the perennial vegetation cover to increase from 17 to 34 percent.

- Sedimentation of waterways was dramatically reduced: The flow of sediment from the Plateau into the Yellow River has been reduced by more than 100 million tons each year. Better sediment control has reduced the risks of flooding with a network of small dams helping store water for towns and for agriculture when rainfall is low.
- Employment rates increased: More efficient crop production on terraces and the diversification of agriculture and livestock production have brought about new on-farm and off-farm employment. During the second project period, the employment rate increased from 70 percent to 87 percent. Opportunities for women to work have increased significantly.
- Food supplies were secured: Before the project, frequent droughts caused crops cultivated on slopes to fail, sometimes requiring the government to provide emergency food aid. Terracing not only increased average yields, but also significantly lowered their variability. Agricultural production has changed from generating a narrow range of food and low-value grain commodities to high-value products. During the second project period, per capita grain output increased from 365 kg to 591 kg per year.
- The project significantly contributed to restructuring the agricultural sector and adjusting to a market-oriented economic environment, while creating conditions for sustainable soil and water conservation.
- Even in the lifetime of the project, the ecological balance was restored in a vast area considered by many to be beyond help.
- Terracing required the development of roads that facilitated the access of vehicles and farm equipment and labor to these areas. Sediment control and capture transformed previously unproductive land into valuable cropping areas, helped increase

water storage for communities and agricultural use and reduced flood risk. Terraces have reduced labor inputs and allowed farmers to pursue new income-earning activities.

### **IDA Contribution**

- First Loess Plateau project: out of US\$252 million (actual project costs), IDA contributed US\$149 million; government/counterpart funding was US\$103 million.
- Second Loess Plateau project: IDA contributed US\$50 million; IBRD US\$99 million; and government/counterpart funding US\$90 million.
- The physical and economic transformation of the Loess Plateau offers the clearest demonstration of what can be achieved through close partnership with the government, good policies, technical support and active consultation and participation of the people. IDA resources—through direct investments, policy and technical assistance, training and capacity building—along with the efforts and behavioral change of the people in the project area, helped demonstrate the effectiveness of a model that improved the lives and livelihoods of more than 2.5 million people, and many more through replication.
- Training and support services helped enhance existing research and development capacity in dry-land farming techniques, grassland improvement, orchard and livestock management and impact monitoring and evaluation.

The projects' principles have been adopted and replicated widely. It is estimated that as many as 20 million people have benefited from the replication of the approach throughout China.



One of the world's largest erosion control programs returned the Loess Plateau to an area of sustainable production and lifted 2.5 million people out of poverty.

## Tajikistan: Better Water Management Spurs Rural Incomes

### Challenge

Agriculture is critical to poverty reduction and economic growth in Tajikistan. The country's soils and climate provide excellent potential for the production of grains, cotton, and a variety of horticultural crops, including orchard crops. For years, Tajikistan enjoyed among the highest yields in the region. Ferghana Valley—which also stretches into Uzbekistan and the Kyrgyz Republic—is a focal point of Tajikistan's agricultural production. After a dramatic decline in Tajikistan's farm productivity in the mid-1990s, recent years showed some recovery. However, this turnaround was stymied by a crumbling rural infrastructure, in particular irrigation facilities. In many cases, water supply systems were barely kept running with shoestring repairs, but drainage systems quickly fell into disrepair—this led to waterlogging and yearly flooding in the worst cases. As a consequence of the collapse of irrigation systems, substantial areas have been lost to cultivation.

### Approach

The Ferghana Valley Water Resources Management Project was launched in 2005 to restore irrigated agricultural productivity in the Ferghana Valley by improving land and water management. It financed design and works for rehabilitation of pumped and gravity irrigation and drainage systems serving some 30,000 hectares of farmland in Kanibodom and Bobojon Gufarov districts. Agricultural productivity, irrigation, and drainage problems were addressed jointly. Furthermore, the project encouraged full community participation by establishing water user associations.

### Results

**The project made good progress, including work on rehabilitation of the Kayrakum reservoir dykes, collector drains, drainage tube wells, agriculture demonstration farms, and issuance of land use certificate.**

### Highlights

- Widespread impact. Overall irrigation efficiency improved on 442 hectares of land.
- Tubewells. 51 drainage tubewells were completed for about 1,030 hectares and 37 were restored.
- Canals. 3.26 kilometers of irrigation canals were rehabilitated.
- Demonstration farms. Six demonstration farms were established to show water use efficiency and improved crop yield and quality.
- Drain collectors. 7.4 km of drain collectors were rehabilitated; one pumping station was rehabilitated.
- Pilot community participation. The project established one pilot water user association, which is poised to manage about 2,000 hectares of newly irrigated land once the rehabilitation of irrigation system in Kanibodom is complete (in 2010).

### IDA Contribution

The Ferghana Valley Water Resources Management Project was financed through an IDA grant of US\$13 million and a Government contribution of US\$1.17 million, for a total project cost of US\$14.17 million.

### Partners

The project complements an irrigation project supported by the Asian Development Bank that is rehabilitating rural infrastructure at the lower end of the Kayrakum Reservoir. In combination, these two projects will improve water management and irrigation for the vast majority of the most valuable land in Konibodom and Bobojon Gufarov

### Next Steps

The project also aims to improve the safety and regulation of the Kayrakum Dam and Reservoir. Thus far, a panel of experts has been appointed to develop a strategy on Dam Safety Management. Additional financing may be forthcoming to maximize project impact. More work is needed to strengthen the capacity of water user associations so they assume more operations and maintenance work.



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