

INTERNATIONAL DEVELOPMENT ASSOCIATION



# Water Resources

IDA at WORK

IMPROVING SERVICES FOR THE POOR



THE WORLD BANK



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The management of water resources dates back to the earliest civilizations. Yet, the need for integrated management has never been greater and the vulnerability of the poorest communities in the poorest countries, never more serious. 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 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 provides several detailed 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 one 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.



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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 billion in 2005. The world's poorest countries and the poorest communities within them are the most vulnerable to inadequate management of water resources.

The International Development Association, the World Bank fund for the world's poorest countries, has a unique role to play, 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. In this role, and in collaboration with

other donors, the IDA directs critical funding towards countries that would otherwise have a hard time investing in the management of public goods on a long-term, continuous basis.

The impact of water resource management projects is often profound. Evidence from recent lending demonstrates 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.

#### At a glance

- While world population tripled in the 20th century, the use of water increased six-fold.
- Irrigated agriculture, in the drive for food security, accounts for 70 percent of water withdrawals in water stressed regions.
- Low-income, IDA countries account for about 80 percent of the most water-poor countries.
- Over 260 rivers in the world run through more than one country, thus presenting unique opportunities and challenges, especially in Africa.
- Total IDA funding for 56 projects with water resources management components amounted to about US\$2.5 billion between Fiscal Years 2000–06.
- Although aggregate outcome measures are hard to come by, IDA projects have produced results affecting millions of people from Senegal to Yemen and China.

## Sectoral Context

While world population tripled in the last century, the use of water increased six-fold. Irrigated agriculture, in the drive for food security, accounts for 70 percent of water withdrawals in water stressed regions. And low-income IDA borrowing countries account for about 80 percent of countries with the worst water poverty ratings (see map).

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

Shifting patterns of precipitation and runoff associated with climate change compound the challenge of managing scarcity, as do the destructive

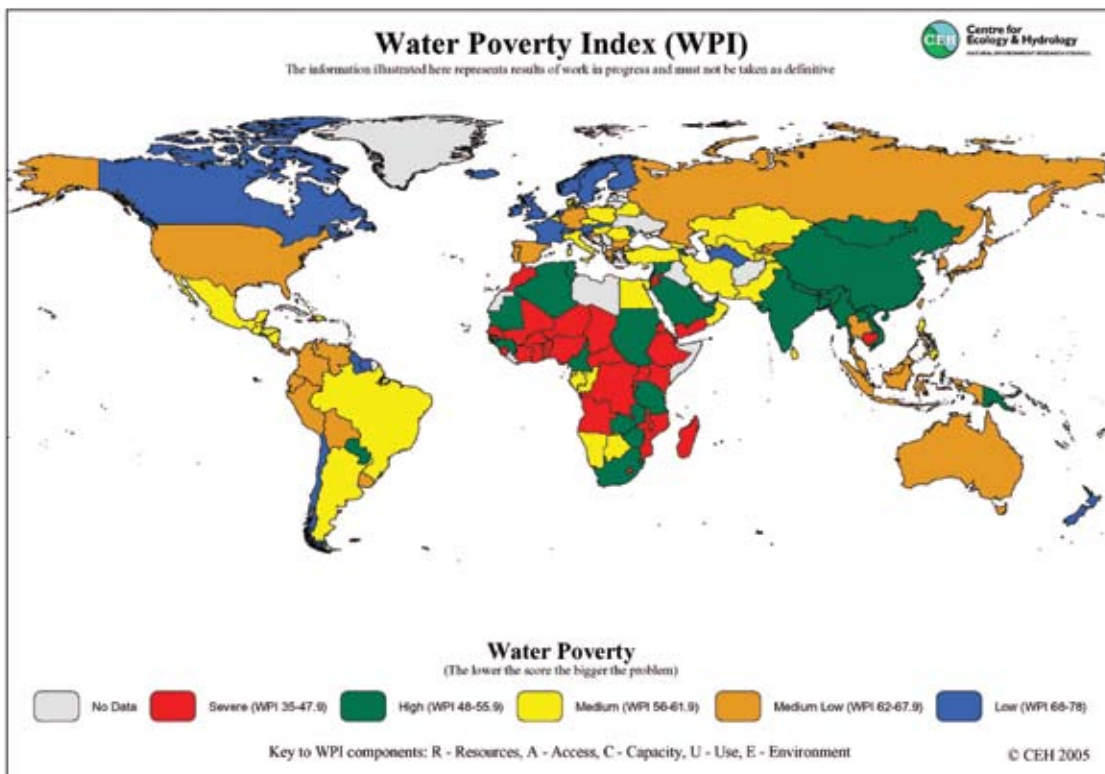
forces of water through drought, flood and water-borne contamination.

Tensions over water rights are increasing at the level of the village, the nation and across boundaries.

### Key trends.

Water resources management (WRM) is a complex and relatively new area of focus for many countries. It requires actions at the policy, legal and institutional levels while addressing direct impacts at the community level. It is further complicated by the impacts and influences of other sectors, such as industry, agriculture, and hydropower. Some of the key trends and priorities in water resources management include:

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



## IDA at WORK: Water Resources

- 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 (versus physical entitlements).
- Managing water resources across national boundaries.
- Contributing to the development of environmentally sustainable water infrastructure for storage and multiple uses (storage capacity in some developing countries is as low as 38 m<sup>3</sup>/capita compared with North American statistics of 5,961 m<sup>3</sup>/capita, notwithstanding potential variability).
- Identifying and implementing water efficiency measures.

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 nongovernmental and civil society groups.



### Challenges.

Water resources management cuts across sectors, skills, institutions, and sometimes countries. A public good, water resources usually have multiple users, thus leading to potentially contentious issues of ownership and stewardship.

WRM initiatives frequently lack a revenue stream, thus placing additional burden on already over-taxed public finances. Because of their sector and geographic reach, many reforms and initiatives in WRM require a high level of coordination across players, from community to national and international levels of management processes, or across sectors as diverse as agriculture and hydropower. Furthermore, the range of tools required to address water resources issues extends from analytical work to participatory processes to investments in structures and civil works. Not surprisingly, this sector demands 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 for IDA countries so far.





Total IDA funding for 56 projects with WRM components amounted to about US\$2.5 billion between Fiscal Years 2000–06. The funding specifically to the water resources management components of these projects totaled US\$640 million. Most spending occurred in Africa (34 percent) and South Asia (31 percent), and was concentrated in the rural sector (80 percent).

Because of water resources management's nature, 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 WRM, namely development of policy and legal frameworks. About 75 percent of IDA-funded WRM projects include institutions 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 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 Yemen and Senegal. In both cases, policy reform was accompanied by sector-specific actions.

### **Institutions and capacity-building.**

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

The water law in Yemen 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 which has demonstrated an ability to make substantive decisions, considered from a multi-sectoral base. The Sana'a Basin Water Management Project was the first initiative in Yemen to address the crisis in groundwater depletion.

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 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, who have greater ownership and commitment. One project 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.

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

Over 260 rivers in the world run through more than one country, thus presenting unique opportunities and challenges, especially 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, thus 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, WRM is emerging as a vehicle for regional peace and stability as well as more effective water management and allocation.

### **Agriculture.**

IDA's water resource management projects in agriculture have simultaneously increased water efficiency and agricultural yields.

In the Loess Plateau Watershed Rehabilitation Project in China, 1 million farmers directly benefited from increased yields (annual grain output increased from 427,000 to over 698,000 tons) and diversification into higher value produce (from 80,000 to 347,000 tons in fruit production), with corresponding increases in farmers' per capita incomes (from Y360 to Y1263 per year). A second project co-financed by IDA and the Bank's commercial lending arm, the International Bank for Reconstruction and Development (IBRD) further contributed to the plateau's sustainable development, benefiting an estimated 1.5 million people.

In Tanzania, through a combination of policies on water rights and fees, training of irrigators' organizations, and enhanced irrigation efficiency, agricultural yields doubled and household income tripled for more than 5,000 families.

In China's Tarim Basin, lining canals to prevent leakage increased water-conveyance efficiency from 60 percent to 95 percent and saved an estimated

600–800 million cubic meters of water every year. This water was reallocated to environmental, municipal and industrial uses and enabled the reclamation of land and the expansion of irrigation to more than 41,000 hectares of new farmland. From 1998 to 2003, an additional 41,460 hectares of land were reclaimed for irrigation, while the productivity of more than 123,000 hectares of low-yield irrigated land was substantially increased.

This contributed to an increase in production of 220,000 tons per year of wheat, 82,000 tons of cotton and 116,000 tons of maize. Higher value crops such as orchards (apples, apricots, pears and grapes), oil seeds, melons, vegetables and alfalfa were planted on about 148,000 hectares of land.

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

In the Loess Plateau (China), better management of agricultural land and improved soil conservation reduced sediment loading to the Yellow River by more than 57 million tons per year; a post-project review concluded that the project was one of the most successful erosion control programs in the world.

In the Tarim Basin (China), IDA support helped to restore 300 kilometers of the lower reaches of the watercourse that had run dry. Forests in the region increased by more than 30 percent; the grassland areas grew by 15 percent. This contributed to halving the socio-economic costs of wind and sandstorms.

In the Senegal Basin, the high incidence of water-borne disease was tackled by several pilot interventions (such as distribution of medications and bed-nets, as well as sanitation programs) that resulted in direct reductions in disease and estimated potential reductions in the order of 40 percent for infant mortality due to diarrheal diseases, and 50 percent for bilharzia (caused by parasitic worms) and intestinal parasitosis. These pilots provided the



basis for a basin-wide strategy for water-borne 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 environmental assets downstream.

IDA-funded flood projects (both infrastructure and management) in Uganda, Kyrgyz Republic, Yemen, and Bangladesh enhanced protection of populations, infrastructure and property. An IDA-supported Lake Victoria environmental management project helped reduce water hyacinth to non-nuisance levels and revive fish species—thought to be extinct—in satellite lakes.

### **Cross-sectoral management.**

Frequently, water resources management projects involve more than one sector and combine investment initiatives entailing both institutional development and capacity-building.

In a proposed project in Kenya, for example, WRM lies at the heart of community-driven development with investments in agriculture, forestry, catchments management, and infrastructure for flood and sediment management.

Beyond investment lending, IDA provides the expertise and convening power needed to take the sector forward.

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**Analysis and technical assistance.**

Expertise offered by IDA ranges from analytical work to technical assistance for public administration, legal frameworks, public participation and environmental safeguards.

This enables IDA to bring diverse tools for WRM together in coherent and coordinated programs. IDA carried out 42 analytical studies (economic and sector work) and 40 non-lending technical assistance activities in 2000–06.

The analytical work has significantly changed countries’ understanding of the role of water in development and poverty alleviation and created a new paradigm 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 drop by as much as 38 percent when rainfall

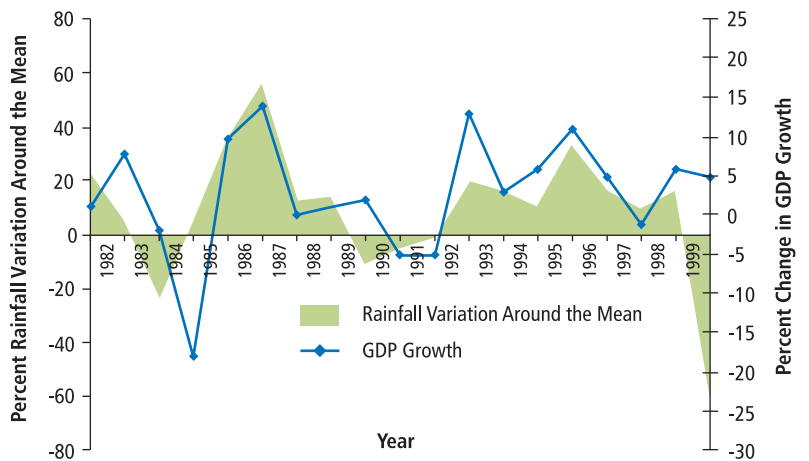
variability is taken into consideration. The correlation between rainfall and overall GDP is illustrated below. This empirical work highlights the importance of considering hydrology and hydrologic variability when diagnosing economic performance.

**Global and regional partnerships.**

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

- The Netherlands financed a US\$20 million trust fund specifically for innovation in WRM, with a priority focus on Africa, downstream operational impacts, as well as the gender/poverty nexus.
- The World Bank is one of the three implementing agencies of another important partnership, the Global Environment Facility. This multi-donor,

**Ethiopia: Rainfall and GDP Growth**



Source: World Bank, 2006.

multi-billion dollar fund addresses critical threats to the global environment including the degradation of international waters and persistent organic pollutants.

- The Bank was invited to coordinate international support to Nile cooperation in 1997, and since 1999, the Bank has been promoting dialogue and supporting joint actions, with a major focus on 'changing hearts and minds' over the shared usage of Nile waters. The Bank now coordinates the involvement of about 17 multilateral and bilateral development partners of the Nile Basin Initiative (NBI). The multi-country NBI, which involves nine African countries, has helped articulate common benefits of river basin management through analytical work, country dialogue and communication.

The NBI has also provided the political environment and institutional capacity to move forward and pave the way for IDA financing demand from these countries. It is anticipated that IDA investments will reach US\$200 million in FY 2007–08, US\$500 million in FY 2009–10, and US\$2 to US\$3 billion in FY 2011–12, with development benefits reaching far beyond the river to regional economic cooperation and stability. IDA projects related to and facilitated by the Nile Basin Initiative, will cover all of the NBI countries between 2007–12.

## Outlook

Overall, 81 percent of IDA's water resources management projects completed between 2000 and 2006 were found to have satisfactory outcomes by the Bank's Independent Evaluation Group (IEG) and 77 percent of projects were deemed likely to be sustainable. Although relatively small in magnitude, the pipeline of upcoming IDA projects suggests a

IDA's analytical work has significantly changed countries' understanding of the role of water in development and poverty alleviation and created a new paradigm for management and investments.



strong upward trend of WRM lending in the near future as the 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 poor countries finance WRM activities including policy, institutional and analytical work.**

WRM is emerging as a basic challenge to development. Important foundational steps have been taken, which are enabling to projects to scale up and deepen impacts. In Tanzania and Senegal, initial work on legislation and capacity building has evolved into more extensive river basin management structures and consideration of significant infrastructure investments in hydropower and water regulation. These projects would not have been viable without the foundations of previous IDA support.

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 WRM across local and indigenous, urban and rural populations.
- Building trans-boundary coalitions and mechanisms for regional river management and development.
- 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. Water resources management in Africa and other regions is emerging as a success story, with important public benefits. 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

Yemen is vulnerable to periodic flooding. In the spring of 1989, heavy rainfall and widespread flooding caused devastating damage to houses, public infrastructure, flood control and irrigation structures, crops, and livestock, with total losses estimated at US\$161 million representing 13 percent of GDP. Wrecked housing left 30,000 people homeless and 6 percent of total annual agricultural production was destroyed. In 1996 floods again caused substantial loss of human lives and extensive damage. Losses affected mostly the Marib and Shabwa governorates and amounted to 12 percent of GDP.

### Approach

In response to the 1989 floods, the government requested IDA's assistance in developing and securing additional funding for a Flood Reconstruction Program (FRP). The project financed the most urgent components of the FRP and consisted of provision of materials, equipment, and civil works for constructing houses to replace damaged units, rehabilitation of schools, flood protection and irrigation structures, and health centers and hospitals. Building on IDA's expertise, institutional capacity to manage disaster recovery was strengthened and programs developed to mitigate vulnerability to floods. The second Emergency Flood Reconstruction Project focused on four rural governorates that were most affected by floods. Its objectives were to support economic recovery and help affected communities receive food, water supply and sanitation services.

### Results

**IDA's assistance helped to restore and rehabilitate the country's essential economic and social infrastructure, and to reduce the deprivation and suffering of flood victims.**

### Highlights:

- New schools, equipped with furniture, serving 11,000 students and spread over three southern governorates were rehabilitated to replace 10 schools destroyed due to floods.
- Destroyed flood control mechanisms were rehabilitated to standards that reflected greater flood resistance. Achievements included the construction of earthworks embankments and gabion protection to train flows within the Wadi bed, and prevent erosion of valuable agricultural land; and the reconstruction and other measures to improve conditions at canal heads.
- A total of 13 health facilities were rehabilitated and equipped with medical equipment, which formed the primary network that provided vital access to basic health care for the residents of four southern governorates.
- An Emergency Reconstruction Unit (ERU) was established, whose main tasks were to coordinate and manage current and future flood relief programs.
- Ten major crossings/roads and four major bridges damaged by the floods on major road arteries were constructed.
- The project introduced an early warning system that aims at reducing the impact of future floods.
- Rehabilitation of all 31 flood damaged retention

weirs to new standards, as well as 20 km of flood damaged agricultural services road was completed under the project.

- More than 5,000 people benefited from the employment opportunities generated by the construction works financed by IDA.

### IDA Contribution

- About US\$10 million out of US\$15.4 million project costs for the first project.
- US\$30 million in grant financing for the second project.

### Partners

Under the first Emergency Flood Reconstruction Project, partners included the Islamic Development Bank, UNDP and Saudi Arabia. Under the second project, the Abu Dhabi Fund joined IDA.

### Next Steps

A technical assistance component which funded a study for flood emergency preparedness and mitigation program was delayed due to civil war in 1994. Both projects' sustainability would be further bolstered once the proper national framework for flood emergency response is in place. Though government preparedness for emergencies benefited from both projects, a long process of capacity building and institutional development is needed to bring about a multi-sectoral response in these emergency situations.



After two devastating floods, IDA assistance helped restore and rehabilitate the country's essential economic and social infrastructure, and reduced the deprivation and suffering of flood victims.

## 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.







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