WATER
P-NOTES
ISSUE 44
APRIL 2010

55275

# Environmental Flows in Water Resources Policies, Plans, and Projects

## Part 1: Findings and Recommendations and Part 2: Case Studies

Environmental flows are central to equitable distribution of and access to water and services provided by aquatic ecosystems. They refer to the quality, quantity, and timing of water flows required to maintain the components, functions, processes and resilience of aquatic ecosystems that provide goods and services to people. They are fundamental for sustainable water resources development, benefits sharing, and poverty alleviation. Nonetheless, water resources development planners have often overlooked environmental flows or addressed them inadequately. This two-part report, based on the Bank's economic sector analysis, shows their central importance for Integrated Water Resource Management (IWRM) and presents data, findings, and recommendations, based on indepth case study analysis, to help make environmental water allocation an integral part of IWRM.

## Water Resources, Economic Development, and Climate Change

Environmental flows are linked to IWRM in fundamental ways (see box), but they can be impeded or compromised by many facets of economic development and resource use. Investments in water resources infrastructure, especially dams for storage, flood control, or regulation, have been vital for economic development. When they are improperly planned, designed, or operated, however, there can be problems for downstream ecosystems owing to the impact on the volume, pattern, and quality of flow. Changes in flow often lead to the degradation of downstream ecosystems that many of the poorest communities rely on for their livelihoods. If water resources are to be developed and managed

**Environment flows are linked to IWRM in three fundamental ways:**

1. The aquatic (and related terrestrial) ecosystem provides habitat for fish, invertebrates, and other fauna and flora. The aquatic ecosystem is thus a water-consuming sector just like agriculture, energy, and domestic and industrial supply.
2. The design and operation of hydraulic infrastructure for water supply, sewerage, irrigation, hydropower, and flood control often affect ecosystems, both upstream and downstream of the infrastructure, and communities—farming, pastoral, and fishing—dependent on those ecosystems. Conversely, the reoperation and rehabilitation of existing infrastructure have been used to support the successful restoration of degraded riverine ecosystems.
3. Integrated water resources planning and management are facilitated by policies, laws, strategies, and plans that are multisectoral, based on the allocation of water for all uses; protection of water quality and control of pollution; protection and restoration of lake basins, watersheds, groundwater aquifers, and wetlands; and control and management of invasive species.

This note reports key points from this two part publication by Rafik Hirji and Richard Davis from the World Bank's Environment and Development Series, 2009. Readers may download the complete papers from www.worldbank.org/water.

in a sustainable manner, infrastructure projects must include a full accounting of the social and environmental impacts both downstream and upstream, and allow for full representation of all the affected populations in the planning, implementation, and operational stages of the project.

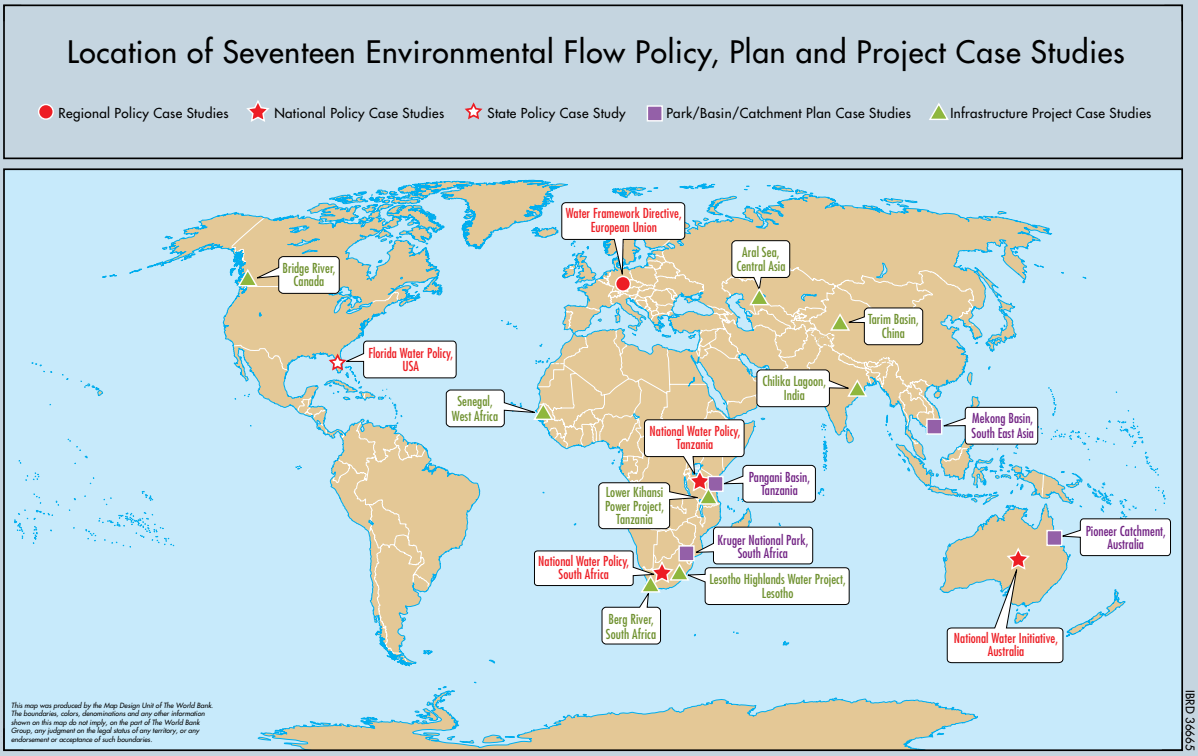
Climate change also affects the supply of and demand for water resources. Sea-level rise along coastlines will cause saltwater intrusion and affect estuarine processes that rely on freshwater environmental flows. In some nations, adaptation to climate change is likely to involve more investment in dams and reservoirs to buffer against increased variability in rainfall and runoff. This will further affect downstream ecosystems unless the impacts are properly assessed and managed.

Specifically, the main report, based on 17 case studies (see Figure A.1.), documents the changing understanding of environmental flows by water resources practitioners and environmental experts both within the Bank and in borrowing countries; examines lessons learned from past efforts at managing environmental flows; develops an analytical framework to support the effective integration of environmental flow considerations into the planning, design, and operations decision making of water resources infrastructure projects, as well as the legal, policy, and institutional organizations that govern these projects and also restoration programs; and provides recommendations for incorporating environmental flow considerations into the preparation and implementation of lending operations.

## Sustainable Water Development Assistance Requires Environmental Flow Information

Environmental flows provide a whole host of economic, social, and environmental services, including clean drinking water, groundwater recharge, food sources, flood protection, navigation routes, natural biochemical waste removal, recreational opportunities, and cultural, aesthetic, and religious benefits. Assigning water between environmental flows and consumptive and non-consumptive purposes is a

**Figure 1. Location of Case Studies**



social, not just a technical, decision. To achieve equitable and sustainable outcomes, however, these decisions should be informed by scientific information and analysis. The impacts of development on downstream communities are often diffuse, long term, poorly understood, and inadequately addressed. The causes of changes in river flow can also be broader than just the abstraction or storage of water and the regulation of flow by infrastructure, as upstream land-use changes due to forestry, agriculture, and urbanization can also significantly affect flows. The impacts of environmental flow can extend beyond rivers to groundwater, estuaries, and even coastal areas.

An environmental flow assessment (EFA) is the first step in the process for estimating environmental flow requirements. EFAs are an intrinsic part of IWRM. Although it is desirable for EFAs to be integrated into strategic environmental assessments (SEAs) for policy, plan, program, or sector-wide lending, and into environmental impact assessments (EIAs) for project-level investments, the practice of SEA and EIA has yet to mature to a point where EFAs are effectively integrated. As a result, most EFAs have been undertaken separately, either in conjunction with or after the EIAs have been completed.

The Bank has four entry points for helping countries integrate environmental flow considerations into their decision making:

- Water resources policy, legislation, and institutional reforms;
- River basin and watershed planning and management;
- Investments in new infrastructure; and
- Rehabilitation of existing infrastructure or degraded ecosystems.

Consistent with its commitment to sustainable development, the Bank, as it has done in dam projects since the 1990s, must support measures to promote the integration of environmental flows at an early stage in the decision-making process through dialogue on water resources policy, river basin planning, and programs that entail major changes in land-use.

The science underpinning EFAs has advanced considerably, with more methods for estimating environmental flow requirements, more information available on the ecological response to different flow regimes, and more experience in integrating information from across a range of physical, ecological, and socioeconomic disciplines. In addition, a wide variety of EFA methods now have a considerable history, which demonstrates their utility for differing levels of environmental risk, time and budget constraints, and available data and skills. A growing body of experience in implementing environmental flows provides guidance for the monitoring and adaptation of management procedures.

## Achievements and Challenges

Environmental flows work within the Bank is shaped by evolving global knowledge, practice and implementation and helps to shape the repository of global knowledge and experience on environmental flows. There have been considerable advances in the science of environmental flows over the last 15 years, including improvements in basic scientific understanding and the development of EFA techniques. Environmental flow considerations were initially introduced into assessments for new infrastructure projects. They are now being gradually mainstreamed into more strategic levels of decision making, including national water resources policies and formulation of basin- and catchment-level plans as well as in the restoration of degraded ecosystems and re-operation and rehabilitation of existing infrastructure projects.

The Bank and environmental flows practitioners face many challenges, including overcoming the misperceptions arising from the term "environmental flows"; developing methods for systematically linking biophysical and socioeconomic impacts; incorporating the whole water cycle (surface, groundwater, and estuaries) into EFAs; applying EFAs to land-use activities that intercept and exacerbate overland flows; including climate change in the assessments; integrating environmental flow assessments into strategic, sectoral, and project EFAs; and understanding the circumstances in which benefit sharing is a viable approach.

## The Way Forward: A Framework for Bank Action

The analysis suggests a framework for improving the Bank's approach to environmental flows:

1. **The Bank must strengthen its capacity to assess and oversee environmental**

**flows**. This can be accomplished by promoting a common understanding amongst water and environmental stakeholders about the concepts, methods, and good practices related to environmental flows, including the need to incorporate EFAs into environmental assessment at both project (EIA) and strategic (SEA) levels. The Bank can expand its in-house capacity by broadening the pool of ecologists, social scientists, and environmental and water specialists trained in EFA.

2. **Environmental flow assessments should be made part of lending operations** through training Bank and country staff, disseminating guidance and support materials, and access to international experts. The Bank can assist in identifying settings, approaches, and methods for the select application of EFAs in the preparation and implementation of project-level feasibility studies and as part of the planning and supervisory process. It can also provide support for hydrological monitoring networks and hydrological modeling to provide the basic information for undertaking EFAs. *The Bank should prepare an update of the environmental assessment (EA) sourcebook concerning the use of EFAs in SEAs and EIAs, as well as a technical note that defines a methodology for addressing downstream social impacts of water resources infrastructure projects.*

   The Bank must test the application of EFAs by including infrastructure other than dams as well as activities such as investments in large-scale land-use change and watershed management that effect downstream flows and ecosystem services, broadening the concept of environmental flows to include groundwater systems, lakes, estuaries, and coastal regions. The provision of support material for Bank staff and counterparts in borrowing countries, such as case studies, training material, and technical notes would also be of considerable help.

3. **Efforts are needed to promote the integration of environmental flows and water needs into policies and plans** through dialogue and specific instruments such as country water resources assistance strategies (CWRASs), country assistance strategies (CASs), country EAs, and development policy lending. The Bank must promote plans that include environmental flow allocations and use CASs and CWRASs to promote Bank planning and water policy reform so that the benefits of environmental water allocations for poverty alleviation are integrated into country assistance.

   Where sectoral changes will lead to large-scale land-use conversion, the Bank should incorporate environmental water needs into Bank SEAs and sectoral environmental assessments. There is a need in developing countries to harmonize sectoral policies with environmental flows requirements and increase institutional awareness of the impact of policies on downstream communities. Valuable lessons can be adapted from developed countries that have experience with incorporating environmental flows in water resource planning. Support material must be provided for Bank staff on how to include environmental flows into basin and catchment planning and into water resources policy and legislative reforms.

4. **Collaborative partnerships between the World Bank and NGOs, research organizations, and international organizations must be expanded** in order to take advantage of their experience in conducting EFAs and building environmental flow capacity in developing countries. By strengthening relationships with industry associations, the Bank can promote awareness of the impact of environmental flows on ecosystem services delivered downstream and the social and economic outcomes they allow.

Adoption of this framework will improve the Bank's ability to implement its strategy of increasing investment in water resources infrastructure, while reducing the risk of detrimental environmental impacts that threaten the livelihoods of downstream communities.

WATER PARTNERSHIP PROGRAM

The Water Sector Board Practitioner Notes (P-Notes) series is published by the Water Sector Board of the Sustainable Development Network of the World Bank Group. P-Notes are available online at *www.worldbank.org/water*. P-Notes are a synopsis of larger World Bank documents in the water sector.

Water Sector Board