WATER

P-NOTES

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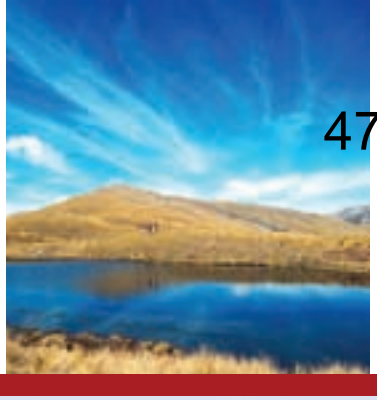

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Managing Lakes and Lake Basins for Sustainable Use

Lakes and reservoirs are the world's major repository of accessible freshwater. They are central to the livelihoods and economies of a large fraction of the world's population, as well as being centers of aquatic biodiversity. They play a central role in integrated water resources management. Yet in spite of their importance and the growing threats to them, they have not received sufficient attention in the global discussion on water policy.

The Lake Basin Management Initiative (LBMI) was implemented as a Cooperative Program supported by a partnership of many international agencies[1] to draw on global knowledge on lake basin management. An analysis of experiences from 28 lakes around the world sought to identify practical lessons learned from management of lake basins, create new knowledge on lake basin management, fill an important gap in knowledge of lake management in developing countries, and derive lessons from internationally funded projects.[2]

Understanding the characteristics of lakes

Uncontrolled use, over abstraction and degradation of the resources of a lake and its surrounding area or basin, typically results in rapidly declining lake levels, overuse of water, declining water quality and destruction of ecological integrity. Such degradation may include the surrounding lands and waters. To understand how to manage lake resources in a sustainable way, it is critical to understand three defining characteristics of lakes: *their integrating nature; long retention time; and complex response dynamics*.

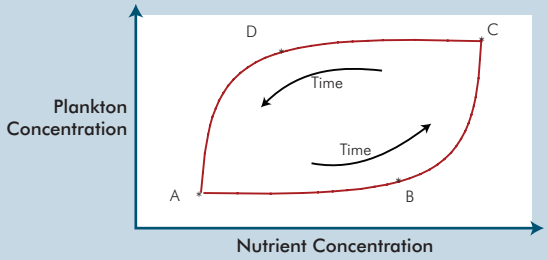
- The *integrating nature of lakes* means that connections between users are particularly strong. For example, a polluter is often a victim of pollution. Also, the connections among the water flows, substances and animal and plant life of the region are also quite strong.
- The relatively *long retention time* of most lakes, compared to rivers, means that the "lake time scale" is different from the "political time scale". Lakes are stable, buffer floods and droughts, sinks for pollutants, but slow to respond to management. There is usually a significant delay between an action that impacts the lake and the change in a lake. This holds true for actions that are positive (e.g., improvement in the trophic state of a lake) or negative (such as the consequences of increased nutrient load).

[1] The partnership consisted of the World Bank, Global Environment Facility (GEF), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), Ramsar Bureau, United States Agency for International Development (USAID), the Bank- Netherlands Water Partnership Program (BNWPP), the Shiga Prefecture in Japan, and two NGOs—the International Lake Environment Committee (ILEC) and LakeNet. The World Bank was the GEF implementing agency and ILEC was the executing agency.

[2] Table 2.1 from *Lessons for Managing Lake Basins for Sustainable Use*, Report 32877, World Bank, December 2005.

This note summarizes key findings of the final report of the Lake Basin Management Initiative, "*Managing Lakes and Their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders*", by the International Lake Environment Committee Foundation, 2005. The report was prepared with support from over 280 lake, water and environmental specialists from 41 nations. Its preparation was managed by Rafik Hirji (Team Leader) and Masahisa Nakamura (Project Manager, ILEC). Readers may download the complete paper from www.worldbank.org/water.

Figure 1



- The *complex response dynamics* of lakes means that connections are often indirect and not easy to determine. Lakes do not always respond linearly. Changes are often irreversible or extremely costly and time consuming as indicated in the hysteresis in Figure 1.

These characteristics mean: (i) that problems can often spread throughout a lake, (ii) stresses (e.g., from pollution) maybe slow to notice, but take equally long time to fix, and (iii) problems are not always clearly linked to their causes—good science is needed to establish causes.

The figure above illustrates that a large change in nutrient concentration (pollution load from sewage or fertilizers, for example)) as depicted by moving from point A to B is accompanied by a very small, and hardly noticeable increase in plankton concentration (consequence of pollution load). Once a critical nutrient load is reached, however, a relatively small additional increase in nutrient load (from point B to C) generates a substantial reaction in terms of increased plankton concentration (often, this is when aglal blooms occur). Once this occurs, the challenge for lake managers is to reduce the nutrient loads from C to A. However for that to happen, large sums of funds are needed for nutrient reduction measures, and even than, after substantial nutrient reduction from point C to D, the response in plankton reduction is barely noticeable until a critical point is reached D before noticeable changes will occur from point D to A.

Understanding the value of lakes, their common uses and problems

Lakes provide value through indispensable goods and services that are often undervalued or even ignored. Lakes and lake basins sustain human livelihoods (fisheries, agriculture, pastoralism, aquaculture, human settlements, rural water supply), support economic activities (commercial fisheries, agriculture, horticulture, mining, industry, forestry, navigation, hydropower generation, tourism, urban water supply and sink for stormwater and waste disposal), provide habitat for biodiversity, and offer important aesthetic, cultural and spiritual values. In addition to their dramatic and picturesque features, lakes have a rich endowment of resources, and are major components of the water cycle. Lakes play an important role in buffering against water and climate fluctuations, and collect inflowing materials across their basins. At the same time, the majority of goods and services provided by lakes are not directly bought and sold on markets. This is a key reason why the value of a lake may only become apparent once a lake has become polluted or impaired.

To improve sustainable management of lakes and develop adequate responses to different uses, it is necessary to understand the key problems generated by human use of lakes. Results of the LBMI study indicate that many lake management issues actually originate within lake drainage basins. Lake problems also originate within the lake, in the litoral zone of the lake and from outside the basin. The most commonly cited issues for the 28 lakes studied in this project include the following:

- Inflow of sediments to lakes
- Introduced fauna and flora
- Unsustainable fishing practices
- Issues that are well-known, but have not reeived adequate attention, such as dropping lake levels due to over abstraction or reduced groundwater flows
- Other emerging issues that are less well known, such as atmospheric nutrient pathways, climate change, shrinking lake size, trade globalization impacts, and environmental flows.

Impairment of lakes typically arises through overuse and/or when two or more users are in conflict. Lake levels respond to changes in inflows and outflows, with consequent drying or flooding of shoreline habitat and wetlands. Temperature changes lead to shifts in stratification levels with consequent effects on biogeochemistry and food chains. As in rivers, chemical pollution, effluent

discharges, and sediment loads can affect lake biota in diverse ways. Introduced flora and fauna can also have major impacts on biodiversity and productivity. Lakes are particularly sensitive long-term indicators of climate change, integrating over short-term temperature fluctuations to expose long-term changes. Overall, the trend shows worsening conditions in the quality of the lake environment globally.

The challenge of managing lake basins

The goals of managing each lake will vary and change over time. Goals should aim to reconcile the diverse management objectives in each lake basin, to minimize problems and maximize values derived from a lake, while addressing equitable distribution of benefits and responsibilities.

An integrated approach to management of the lake together with its drainage basin is required to respond adequately to lake use management. This creates a variety of challenges, particularly because the boundaries of lake basins rarely coincide with established political systems. Addressing problems in a lake basin may require crossing political jurisdictions—national and/or international jurisdictions. This is becoming increasingly necessary, as the particular problem may lie well beyond the lake's basin.

Lessons learned from the 28 case studies establish six necessary components to an effective management response: adequate institutions for implementing change; efficient, effective and equitable policies; meaningful participation of all stakeholders involved; technical measures to ameliorate certain problems; appropriate information about current and future conditions; and sufficient financing to accomplish these aims. These components are described in Box 1.

Box 1. Six components of lake basin management

An integrated approach to lake basin management requires the following six components:

- Institutions are needed to manage the lake and its basin for the benefit of all lake basin resource users. Institutions with authority and longevity are needed at all levels; at local levels (such as local councils), at regional levels (such as a lake basin authority), at national levels (such as a government department), at international levels (such as international commissions for transboundary lakes). Committed and visionary leaders can make a tremendous difference.
- Policies must be developed to govern people's use of lake resources and their impacts on lakes. Formal policies are enacted through laws, statutes and regulations implemented by institutions. Informal policies may be developed and accepted among traditional groups of people living in the lake area. Policies at the local level are implemented through education to change people's behaviors, and through rules, incentives and disincentives to support behavior change.
- Participation of people is essential in developing and managing the lake basin strategy. People are integral to establishing the value and use of the lake basin area; they provide knowledge and experience for management and enforcement of rules, and can demand accountability for use of resources. They may also be a source of finance for supporting lake management through user fees.
- Technological resources can sometimes have a dramatic impact on increasing access to a lake's resources and resolving some types of problems. One of the most frequent technological responses includes the building or upgrading of sewage treatment plants to remove contaminants from lakes, or the building of embankments to improve a lake's ability to buffer floods.
- Information sharing that is open and leads to improvements in understanding promotes efficient management of lake basins. Scientific knowledge can be applied to management strategies for effective use of a lake's resources. Traditional knowledge draws on local information sources to bring people into the process in developing and managing solutions to lake use.
- Financing is required to fund the development of lake basin management and support its on-going operation through management institutions and stakeholder groups. It is necessary for the implementation of technological solutions. Access to financing is often the weakest point of lake basin management in developing countries.

Strategic planning for sustainable lake basin management

Strategic planning is essential to attain lake basin management goals, and to bring the six components of lake basin management discussed in the previous section together. Plans must be as comprehensive and integrated as possible, to address the complex nature of lakes and their basins. Lessons on planning for sustainable lake basin management include the following points:

- *Plans for lake basin management must be aligned with regional and national plans for development and environmental protection.*
- *Vision statements can be useful first steps to establishing goals and developing more detailed management plans.*
- *Comprehensive plans seek to improve effectiveness through integrated action across sectors.* There are challenges to creating comprehensive plans, and they may be expensive to implement, costly to coordinate, and inflexible in responding to changing political priorities.
- *Strategic Action Programs have been largely beneficial in promoting contact between sectors and national institutions, and have laid the foundation for joint management interventions.* Strategic Action Programs have been promoted by the GEF International Waters projects.
- *Initial coordination between sector and regional plans should focus on areas in need of immediate attention; further coordination can be phased in over time and respond to opportunities as they arise.*
- *Sector or regional plans can be coordinated through different approaches.* Coordination can occur through: (1) creating a separate coordinating project; (2) revising expected outputs to be more integrated or (3) broadening the scope of a project as it achieves success and gains credibility.
- *Flexibility is key to the planning process, due to changing social needs and external factors.* Plans must be responsive to monitoring results; monitoring may identify new issues and provide valuable information on results of activities.
- *Lake basin management is a long-term process, not a project.*

Toward future management of lake basins

Lake basin management requires clear understanding of the importance, vulnerability, and unique characteristics of lakes and their basins. Learning from the experience that has emerged from this international study of lake basin management has allowed for the identification of key components to sustainable development: institutions, policies, participation, technology, information, and financing. Strategic planning is also a key means of developing goals and implementing management approaches. There are a number of difficult issues that will have to be addressed, depending upon the context. Some of the roadblocks commonly encountered include: policy conflicts; political motives; lack of a voice for local populations; corruption; complications due to jurisdictional boundaries; and lack of funding to carry out operations. Experience has shown problems can be overcome through creative and proactive approaches, efforts to build coalitions, develop shared visions, identify political support, leverage external support, pursue sector reforms, and marshal evidence to support lake basin management.

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

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