ENVIRONMENTAL FLOWS

Environmental Perspectives on River Basin Management in Asia

IWMI International Water Management Institute

Global Water Partnership
GWP Advisory Center at IWMI

Vol. 2 Issue 2 **September 2005**

ENVIRONMENTAL FLOWS–THE KEY TO SUSTAINABLE DEVELOPMENT OF THE MEKONG RIVER BASIN

The Mekong River is the blood supply to the heart of mainland Southeast Asia. The river is vital to the people of the region, supporting one of the world's largest fisheries as well as much of the agricultural production.

The Mekong fishery is estimated to constitute approximately 2 percent of the world's annual fish catch. Most of it is conducted by subsistence fishers who eat their harvest or trade it for other food requirements. The extraordinarily productive fishery of the Mekong river is thought to be related to the nature of its flood pulse. While the size of the Mekong flood, in relation to the dry season flows, is not extraordinary, a vast area of the floodplain is inundated. Many of the Mekong fish breed in the dry season, when the river is shallow and slow flowing. The successive wet seasons (with warm water rich in nutrients and organic material) are thought to provide the environment in which fish larvae can grow rapidly. Fish are a source of proteins, minerals and vitamins for many of the basin's poorest people.

The major agricultural product in the Mekong basin is rice. Much of the rice produced in the poorer parts of the basin is flood recession rice, which as the name suggests, depends on the Mekong flood water. Water receding slowly, together with direct rainfall, provides many of the poorer farmers an alternative to irrigated rice.

Both the people and the biodiversity of the Mekong River depend on the cycle of dry season low flows and wet season floods. The Mekong has one of the largest fish diversities of any river, and it is also a recognized biodiversity "hot spot" for freshwater mollusks. The diversity of birds, amphibians and reptiles present here is also high.

The Mekong countries are poor, and regard their water resources as one of the key resources for development and income generation. In areas with extensive floodplains, irrigation is seen as providing opportunities for agricultural intensification. In the mountainous areas, hydropower is seen as an important development opportunity, both to improve security of supply within countries of the region, and potentially as an export product that can produce foreign exchange.

The challenge for the Mekong countries is to achieve the right balance in the trade-off between developing the water resource and maintaining the existing benefits from the river. Increasing dry season flows while decreasing flood flows, is likely to result in hydropower development, which will deleteriously affect the fisheries. National governments need to know the real costs as well as the real benefits of development proposals in order to make informed decisions.

The four lower Mekong countries: Laos, Thailand, Cambodia and Vietnam signed an agreement in 1995 to cooperate in the sustainable development of the lower Mekong Basin. The agreement identified the need to develop the basin for the benefit of all four participating countries while protecting the environment and ecological balance. Specifically the agreement identified the need to utilize the waters reasonably and equitably, and to develop guidelines to manage the flows in the river.

The focus of the flow management guidelines specified in the agreement signed in 1995 was on maintaining dry season flows, not increasing wet season flows, and providing sufficient flows to the Tonle Sap Great Lake. While this agreement was far more advanced than

Mekong at Xieng Kok—northern Laos.

most of the other similar international agreements of that time, it is clear that managing these aspects of flow would not be sufficient to ensure the ecological balance of the Mekong Basin. For example, excessive dry season flows could be just as damaging for the fishery as insufficient dry season flows.

The Mekong River Commission (MRC) received support from the World Bank for a Water Utilization Project (WUP) to address some of the issues of water sharing in the basin. The project included development of hydrological modeling capability to allow predictions of the consequences of various development proposals on downstream flows. It also supported a process to develop procedures on data sharing, and proposed to support the development of guidelines on flows.

The WUP developed an Integrated Basin Flow Management (IBFM) component to address development of flow guidelines. The WUP has also suggested some guidelines on flows based on an analysis of the existing hydrology of the river. This approach is based primarily on a simple hydrological statistical analysis. In a second phase, a broader approach is being taken, using an expert team and existing data to evaluate the potential impacts of possible changes to the flow regime of the river.

The Netherlands Government is funding the Environment Program of the MRC to conduct field-based studies to provide a stronger knowledge platform from which to predict the social and ecological consequences of the flow regime changes. That work commenced in 2005 together with the WUP Phase II project, and will expand in 2006. The work constitutes part of the Mekong Wetlands Biodiversity Conservation and Sustainable Use Project, which is conducted jointly as a GEF project between World Conservation Union (IUCN), United Nations Development Program (UNDP), and Mekong River Commission (MRC).

The work on environmental flows in 2006 will use the DRIFT method as a model for data collection and analysis. A DRIFT method is a comprehensive environmental flow assessment approach which combines hydrological analysis with detailed multidisciplinary research of various aspects of river and floodplain ecology. The method was developed by the South African- based company—Southern Waters. A team of international mentors working with national experts will work with Dr. Jackie King, from the University of Cape Town/Southern Waters, collecting flow-related information at several sites within the basin. Information on geomorphology, hydrodynamics, water quality, fish, invertebrates, vegetation, birds, and human uses of riverine resources are among the disciplines to be incorporated in the study.

It is envisaged that the study will continue for a further 4 years. Each year there will be a period of field work and data collection, complemented by a data interpretation workshop where specialists from the various disciplines will come together to exchange information, discuss their findings and provide data which may be valuable to other specialists. The findings from these workshops can be progressively used by the MRC and the four national governments in their decision-making processes.

A key issue in this work, as with all other environmental flows studies, is ensuring that the decision makers have access to, and understand, the information generated. Using the existing network developed within the MRC structure, and a combination of international and local specialists, it is hoped that information can be directly transmitted to relevant politicians and government officials. In addition, the use of international mentors should assist in the development of technical capacity within the four member countries, and the development of local expertise, which local decision makers can recourse to in the future.

Dr. Ian Campbell, Senior Environment Specialist, Mekong River Commission (MRC). E-mail: campbell@mrcmekong.org

ENVIRONMENTAL CHALLENGES IN THE ORUMIYEH LAKE BASIN, IRAN

The lake and its value

The Orumiyeh Lake is located in the north-west part of Iran at an elevation of 1,276 m asl, covering an area of 5,100 km^2 and draining a "closed" catchment of over 50,000 km^2. It is a hyper saline water body with an average depth of 5 m and volume of some 18 billion cubic meters (BCM).

The salinity of the lake (about 260 g/l) is too high to support the diversity of aquatic fauna, except for algae and microscopic shrimps that are called Artemia. The microscopic shrimps are, however, the main reason of bird

Location of the Orumiyeh Lake

diversity and, particularly, the migration of Flamingos to this area. The lake area has been the national park since 1971, and the second Ramsar site since 1975. The lake is also surrounded by a number of saline and freshwater wetlands.

The total estimated surface water resources in the entire basin equate to 9 BCM (7 BCM surface water and 2 BCM groundwater). The average annual precipitation rate over the lake is approximately 250 mm, which corresponds to about 1.2 BCM. The annual average rate of water inflow to the lake is about 4.6 BCM. The average annual rate of evaporation from the lake surface is about 5.8 BCM, which is equal to the total input to the lake from rain and inflow. The existence of the lake is, therefore, dependent on the equivalent freshwater inflow. Reduced water inflow may lead to declining water levels and increasing the salinity concentration to levels exceeding the tolerance limits of Artemia. The loss of Artemia shrimp in turn may cause a decline in the number of birds which migrate to the lake. It also could lead to the loss of economical income of the local people selling Artemia. The decline of water level may expose the salty land, which leads to salty winds that are extremely damaging to the environment, and the 380,000 ha irrigated as well as the 420,000 ha rain-fed land. All this will have an adverse impact on the 4.4 million people living in the basin.

Increasing water stress

The past two decades have seen an intensification of water resource and agricultural development in the basin. Future development may lead to the extension of irrigation by 235,000 ha, brining the total irrigated area in the basin to 615,000 ha. Due to the already existing development, the Orumiyeh Basin has suffered intensive and increasing water stress, which revealed itself through irrigation water deficit, rapid drawdown in some aquifers, a 3.5 m water level drop in the lake and a 7.3 km retreat of the shoreline during the recent droughts of 1988–2001, increasing salinity and crystallization of salt on the shores, and a significant decrease in Artemia and Flamingo populations in the lake and the surrounding wetlands. In the end of 2002 the salinity exceeded the tolerance level of the Artemia in the water, and it almost completely destroyed the shrimps, but fortunately some managed to survive in small pockets around the inlets of the largest rivers.

The Orumiyeh Lake Basin is relatively "rich" in water resources compared to many other semi-arid regions of Iran, but even here local and temporal water shortages occurred in all the key water user sectors, especially in the dry years, threatening both the unique ecosystem and the agricultural production. In the valleys, irrigated agricultural production provides an income to a large part of the population, producing mostly fruits and vegetables for the market. In the last decade, the irrigation needs could not be met in many cases at several locations. And with damages to orchards and agricultural lands, a serious depletion of groundwater resources occurred, including salt-water intrusion from Lake Orumiyeh.

The question of balance

The total annual gross water demand in the basin at present is estimated to be 4.4 BCM, of which agricultural demand is about 4.2 BCM and the balance is due to domestic requirements and industry. The projected total future demand for these sectors is about 6.4 BCM. The difference of 2 BCM between the present and the future water demand is mostly due to the increase in agricultural demand, which directly reduces the inflow to the lake.

In the case of the Orumiyeh Lake, environmental water demand may be perceived as the amount of water necessary to maintain it within such limits as to ensure minimal exposure to salty shores and keep salinity at a level that Artemia shrimps could tolerate. Both aspects need to be carefully quantified, which has not yet been done. To maintain the lake in the current state (which is already not exceptionally healthy), it is necessary to ensure a long-term mean annual inflow of 4.6 BCM. The variability of inflow between years and seasons will lead to Artemia losses and salt deposition at times (as has already occurred in the dry spells of 1998-2002), but the damage may not be irreversible. In other words, the present condition shows that there is a fragile balance between the inflow and evaporation from the lake. But with future irrigation developments the inflow to the lake will be reduced by about one-third (future increase in water abstractions by 2 BCM). In such conditions, the inflow to the lake will be below the required threshold, which is up to (estimated) 70 percent of the time throughout the year on average. This will lead to frequent drops of lake salinity levels below the acceptable range of salt content (about 150–280 g/l for Artemia).

The adverse environmental consequences of this are clear from the above, and the associated economic losses have to be quantified in order to ensure what decisions on future water resources development need to be taken. The challenge is to make a trade-off between water potential and the demands of different sectors in order to preserve the environmental sustainability in the region. Improvement of irrigation efficiency in

Artemia shrimps.

Flamingos at the lake.

order to reach a more sustainable coexistence between agricultural and environmental demands seems to be the major task of water and demand management in this basin. The present irrigation efficiency is 30-35 percent, which leaves a lot of room for improvement and saving water that may ensure future irrigation development and satisfy environmental water demand of the Orumiyeh Lake.

Abdolrahim Salavitabar, Water Resources Engineer, Yekom Consulting Engineers, Tehran, Iran. E-mail: a.salavitabar@gmail.com

NEWS IN BRIEF

Colorado, USA. An international workshop was convened in June under the auspices of the Global River Sustainability Project (GRSP), a new initiative with the main objective of characterizing and modeling the freshwater needs of riverine ecosystems in the face of growing human consumptive uses on regional to global scales. The workshop was convened in connection with the Global Water Systems Project (GWSP), which was created in 2001 under the Fresh Water Program of the Earth Systems Science Partnership, a coalition of four major scientific organizations in the International Council for Science (*http://131.220.78.1/gwsp/index.html*). The workshop brought together an international group of over 20 riverine ecologists and hydrologists. The workshop participants identified promising research opportunities in hydro-ecology and established a framework for conducting hydro-ecological assessments and evaluating ecological vulnerability from water resources for river basins around the world. The outputs of the workshop are summarized in a research paper, which was drafted by the workshop participants and is currently being finalized. More information is available from Prof. LeRoy Poff (Colorado State University), *poff@lamar.colostate.edu.*

Indonesia. The second southeast asia water forum held in Bali (August 29–September 3) had as its objective "to build a regional commitment toward enhancement of integrated water resources management and effective water governance among IWRM practitioners in recognition of the need of implementing IWRM principles and processes as well as water efficiency plan starting in 2005." The importance of environmental flow assessment and multi-stakeholder platforms as approaches towards more effective IWRM is increasingly recognized in the region. The Forum, therefore, represented an opportune time for an informed dialogue on environmental flows among delegates from across Southeast Asia.

A session entitled "Environmental Flows—Ecosystems and Livelihoods —The Impossible Dream?" on August 31, 2005, was coordinated by IUCN, in collaboration with colleagues from the International Water Management Institute (IWMI), the Vietnam Department of Water Resources Management, the Mekong Wetlands Biodiversity Program, the Huong River Projects Management Board in Central Vietnam, the Vietnam Water Partnership, and IUCN staff from across Asia. The session's objectives were to disseminate and debate the concept and practice of environmental flow assessment, and to assess its potential role in achieving improved water resource development in the Southeast Asian context. Some 60 participants from a range of nations and organizations actively participated in the session. A series of presentations enabled them to develop greater understanding of the opportunities and challenges presented by environmental flow assessment. Through interactive roundtable discussions, participants also had an opportunity to share with others their own views and experiences on environmental flows and river basin management, with specific discussion on how the issues of trans-boundary environmental flow assessment and local knowledge might be addressed in their own country and basin contexts.

Further information on the session outcomes, which is under compilation as a report, or on tools for environmental flow assessment can be obtained from IUCN—The World Conservation Union, Asia Regional Office, Thailand (John Dore: johndore@iucnt.org or IWMI—International Water Management Institute, Sri Lanka (Rebecca Tharme: *r.tharme@cgiar.org*).

Viet Nam. IUCN-Vietnam has published a report on Rapid Environmental Flow Assessment in the Huong River Basin. Copies are available in both English and Vietnamese. Contact Ms. Jessica Illaszewicz: *jessica@iucn.org.vn*

Acknowledgement

The Environmental Flows (EF) newsletter is produced with the support of the Global Water Partnership (GWP) Advisory Center (AC) at the International Water Management Institute (IWMI), Colombo: Sri Lanka.

Contact us

EF newsletter is also published on IWMI and GWP AC websites:

http://www.iwmi.cgiar.org/pubs/Newsletters/Index.htm

http://www.lk.iwmi.org/gwp/default.asp

Please send your questions, information and essays for publication in EF to:

Vladimir Smakhtin
Principal Scientist: Hydrology and Water Resources.
International Water Management Institute, P.O. Box 2075
Colombo, Sri Lanka
Tel: +94 11 2787404/27
Fax: +94 11 2786854
Email: *v.smakhtin@cgiar.org*

Lalith Dassenaike
Coordinator, GWP Advisory Center at IWMI, P.O. Box 2075
Colombo, Sri Lanka
Tel: +94 11 2787404/27
Fax: +94 11 2786854
Email: *l.dassenaike@cgiar.org*

More information on environmental flows can be found at:

http://www.lk.iwmi.org/ehdb/wetland/index.asp
and
http://www.waterandnature.org/flow/main.html