ENVIRONMENTAL FLOWS

Environmental Perspectives on River Basin Management in Asia

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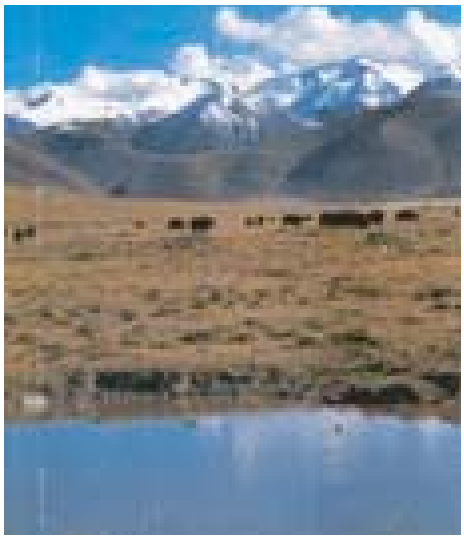
ENVIRONMENTAL WATER DEMAND AND THE INITIATIVE TO KEEP THE YELLOW RIVER HEALTHY: THE CHINESE APPROACH

The Yellow River is regarded as the mother river of China. As the Cradle of Chinese civilization, its water sustained millions of people. At the same time, with 1590 dyke-breaches from 602 BC to 1938, it probably killed more people than any other river on Earth. Protecting human life from Yellow River floods has always been the single most important activity of Chinese governments. However, after over 50 years of water resources development since 1949, the total storage capacity of big dams in the Yellow River basin has exceeded the river's total annual runoff. The total irrigated area expanded from 5% to 46% of the basin arable land, resulting in 4.4 times increase in water withdrawals from the river over the same period. Determining and maintaining the environmental water needs of the river has become an issue of the highest priority. This is, effectively, the issue of how to keep the river alive.

Environmental challenges

The Lower Yellow River has been drying up almost every year since 1972. The situation worsened in the 1990s. According to the Institute of Geography of the China Academy of Sciences, during 1995-98, there was no flow in the lower reach for about 120 days every year during this period. The dry section of the river extended 700 kilometers upstream of the river outlet. Furthermore, the annual water inflow to the estuary has decreased by 77% over the past 20 years, causing a retreat of the shoreline in the delta, saltwater intrusion and increased salinity.



Headwaters of the Yellow River

This situation has serious repercussions for downstream provinces, the transport of sediment to the sea, the ecological balance of the delta and costal fisheries. Wetlands in the delta used to host a rich array of aquatic species, providing habitats for migrating birds and serving as the basis for fisheries. But the wetland area has now shrunk to a mere 30%.

In contrast to the sharp reduction in runoff, waste water discharge into the river has increased several times over. An estimated 4 billion m^3 of effluent was discharged into the river during 2000–more than twice the volume in the 1980s. This has drastically reduced water quality, accelerated ecosystem degradation, biomass and biodiversity reduction and will eventually impact human health.

Unified water allocation and minimum environmental flow for the estuary

The unprecedented decline in river flow became a hot socio-political issue in 1997-98. A proposal by 138 Chinese scientists to prevent the river from drying was submitted to the State Council in March 1998. And in December 1998, the Yellow River Conservancy Commission (YRCC) was entrusted by the State Council to conduct a unified water allocation in the entire Yellow River Basin. The YRCC has managed since 1999 to nominally end absolute flow interruption, although, in critical periods, flow levels have remained largely symbolic.

Since 1998, there has been a great deal of research on the concept of eco-environmental flow. It now represents one of the most important research topics in the field of water resources management not only in the Yellow River, but also in all river systems in the dry region of northern China. International methods of estimating environmental flow have also been introduced in China. The first national workshop on environmental flow, water rights and water market was held in 2001. Case studies on environmental flow and water required for ecosystem rehabilitation in different regions and rivers of China (e.g., instream, lake, wetland, river mouth, etc.) were presented at the workshop. However, workshop participants could not agree

on neither a definition of environmental demand nor method to calculate it.

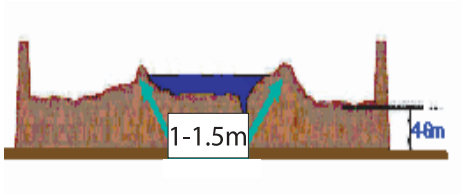
In the Yellow River context, the most important component of environment water demand is the flow requirement for the estuarine wetland. This is also a critical factor in the unified water allocation in the entire basin upstream. The annual average discharge of the river is over 1500 m^3/s. However, in the present water allocation practice, the minimum environmental flow at the outlet is set to 50 m^3/s. This regarded as the minimum flow demand for fish migration and spawning. However, in some extremely dry months, the *actual* discharge is even lower. A number of researchers have pointed out that the present minimum estuarine environment flow standard is too low. Thus, a new 3-year research project, entitled *Study on the Yellow River Estuary Ecological and Environmental Water Demand*, is using remote sensing data and a habitat model to revise and scientifically justify environmental flow estimates.

Sedimentation in the Lower Yellow River

Water for sediment flushing as part of environmental flow

Water demand for sediment flushing is considered part of the overall environmental flow demand in the Yellow River context. Flood and sediment problems are closely linked in the basin. The Yellow River is now short of water and high in sediment. The annual average runoff and sediment load is 58 billion m^3 and 1.6 billion tons respectively. The annual average sediment content in the main stream is about 35 kg/m^3 with a maximum of 911 kg/m^3. Most of the water and sediment passes through the river in the flood season from June to October.

The lower reach of the Yellow River is protected by embankments on both sides. The river bed is 4-6 m higher than the ground of main dykes (figure below).



The dams built in the main stream reduced flood and sediment transport to the lower reach. Sediment is deposited in the main channel. This makes the main river bed to rise. The bankfull discharge has declined from 8000 m^3/s in 1950 to less than 3000 m^3/s in 2002.

In the 1950s, out of the 1.6 billion tons of sediment runoff, there were 0.36 billion tons (28%) deposited in the lower river channel. About 0.1 billion tons of this amount were deposited in the main channel. However, the main channel and the inner flood plain rose simultaneously. After the construction of the large Longyangxia Dam in 1986, followed by a period of drought, 0.22 billion tons of the 0.66 billion tons of annual sediment runoff were deposited in the river channel of Low Yellow River. Eighty percent of this volume was deposited in the main channel. This has not only increased the inundation risk of the inner flood plain, jeopardizing the lives of over 1.80 million people, but also increased the risk of the dike breaching.

The initiative to keep the Yellow River healthy

At the Dialogue for Environmental Protection sponsored by the GWP-China in March 2003 in Wuxi, Mr. Li Guoying, Commissioner of the YRCC, advanced the concept of maintaining the health of the Yellow River. This concept, which is in line with IWRM principles, has now found acceptance among policy makers and water managers in China and is being put into practice. The YRCC is working hard to establish three programs, which will keep the Yellow River healthy. These include the Water and Sediment control program, (including legislation and policy), the Scientific Theory and River Health Indicator System and the Ethics of keeping the healthy life of the Yellow River.

The Scientific Theory And Health Indicator System mentioned above will identify the physiographic, ecological and socio-economic indicators of the river, to determine the river life water demand and the difference between the latter and environmental water demand. It is also expected to suggest technical, social, and economic measures, which will ensure the health of the river.

The frameworks of all three systems were drafted in 2004 and debated in several national seminars. The primary output will be presented at the second International Yellow River Forum to be held in Zhengzhou, China in October 18-21, 2005.

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INDIAN NATIONAL WORKSHOP ON ENVIRONMENTAL FLOWS

The first Indian National Workshop on Environmental Flows, which took place in New Delhi during 23 and 24 March 2005, was organized by the National Institute of Ecology (NIE) and the International Water Management Institute (IWMI) with support from WWF, the Ministry of Environment and Forests (MoEF), the Ministry of Water Resources (MoWR) and the Indian Council of Agricultural Research (ICAR). It brought together various government departments, non-governmental and research institutions to discuss the subject in Indian context. The workshop was attended by over 60 participants including representatives from the MoEF, MoWR, Central Water Commission (CWC), Central Inland Fisheries Research Institute (CIFRI, Barrackpore), ICAR, Central Fisheries Center (Karnal), National Institute of Hydrology (NIH, Roorkee), Spatial Planning and Analysis Research Centre (Bhubaneshwar), Energy Research Institute (TERI), Institute for Social and Economic Change (Bangalore), Indian Commission on Irrigation and Drainage (ICID), Upper Yamuna River Board, Indian Institute of Management (IIM, Kolkata), Challenge Programme for Water and Food (CPWF) and others. International participants included IWMI, WWF, the World Bank, DHI, the Shastri Indo-Canadian Institute and the Max Planck Institute for Limnology, Germany.

Workshop Discussions

The Workshop was opened by Dr P. Ghosh, Secretary, MoEF, who delivered the keynote address. Dr D.N. Tewari, President of the NIE, chaired the opening session. Introductory and welcoming statements were made by Dr B.R. Sharma (IWMI), Dr B. Gopal (Secretary General, NIE), Dr K.K. Vass (Director, CIFRI) and Mr A.D. Mohile (ex Chairman, CWC).

More than 20 presentations were made at the Workshop. Mr M.K. Sharma (CWC, Chairman of the Working Group on Minimum Flows, formed by the Water Quality Assessment Authority—WQAA), presented a detailed overview of the Indian efforts and the discussions in the Group on the subject. Ms R.Tharme (IWMI) provided a summary of various EF methodologies used worldwide. Dr V. Smakhtin (IWMI) presented the hydrological perspective and Dr W. Junk (Germany) elaborated on the ecological aspects of flows in river-floodplain ecosystems.

Speakers among hydrologists were Mr A.D. Mohile, Mr B.P. Das, Mr S.Mishra, Mr L.N. Gupta and Dr R. Jha, who presented several case studies. Mr R Iyer (former Secretary, MoWR) advocated the priority of river systems in water allocation. Prof. J.Bandyopadhyay (IIM) focused on the socio-economic dimensions of EF and Ms L. Korsgaard (DHI, Denmark) examined the economic evaluation of environmental flows. Several speakers discussed the impacts of river regulation and pollution on fisheries and fish species composition. The main message was that river regulation in the country has by and large ignored the requirements of fish, despite the fact that fish are often a base for local economies. It was further stated that in the EF concept, water quality seems to remain a minor issue, whereas for a healthy fishery, it is a major concern.

Presentations were followed by intense discussion, which often highlighted the conflicting viewpoints of water resource managers, fisheries scientists, environmental scientists, and NGOs (on behalf of the local communities). Some participants also raised the concern that environmental flows, if accepted, will have to be satisfied, in many cases, from the already allocated water.

Workshop Resolution

Workshop participants discussed at length the resolution and recommendations, which were then adopted by general consensus. The text of the Resolution is given below:

Expressing concern over the degradation of riverine ecosystems, deterioration of river water quality and the loss of biodiversity of aquatic ecosystems, (including fisheries), that have significant consequences for the livelihood of millions of people,

Recognizing that both terrestrial and aquatic ecosystems provide valuable goods and services to society,

Stressing that flows are the major drivers of ecosystem functions, goods and services,

Emphasizing that water is a scarce and precious natural resource which requires a holistic, cross sectoral and integrated approach to its development, management and conservation,

Further recognizing the need for ensuring environmental flows, which are defined as "the flows required for the maintenance of the ecological integrity of the rivers and their associated ecosystems, and of the goods and services provided by them",

Having discussed the international experience in environmental flows and a large variety of methodologies used to determine them,

Taking note of the current efforts of the Water Quality Assessment Authority (WQAA) to determine the minimum flow requirements of the Indian rivers,

Observing that the issues related to environmental flows are interdisciplinary in nature and that their resolution requires a multi-stakeholder participatory approach, and

Having taken into account the near total lack of studies in India on the subject,

We the participants of the Workshop on Environmental Flows, organized jointly by the NIE and IWMI

(New Delhi, 23-24 March 2005), with the support of Worldwide Fund for Nature (WWF), the Ministry of Environment and Forests, the Ministry of Water Resources, the Central Water Commission, the Fisheries Division of the ICAR, the CPWF, various Universities, research institutions and NGOs, ***hereby adopt the following recommendations*** for consideration and implementation by various Ministries and Departments concerned with water and aquatic ecosystems:

1. The minimum flow cannot be equated with the Environmental Flow; hence the term 'Environmental Flow' (EF), which reflects the total requirement of water for maintaining the ecological integrity and the goods and services of rivers and their associated ecosystems, needs to be used.
2. The EF assessments need to be an explicitly integral component of the water resource planning process at all levels. Further, both the surface and ground waters need to be considered together in an integrated manner.
3. The EF requirements differ considerably in different rivers and their different reaches, and have therefore to be assessed and prescribed separately but integration between reaches and river-estuary should be ensured.
4. The assessment of EF requirements should employ comprehensive holistic (whole ecosystem-focused) methods. The recommendations based on hydrological methods of EF assessment may be an immediate step in the right direction and suitable at planning/reconnaissance level but must be treated only as preliminary.
5. The EF assessment process should adopt a hierarchical framework, and should ensure public participation and socio-economic and cultural considerations at all stages.
6. The implementation of EF in rivers must ensure that the water released for this purpose is of appropriate quality. Polluted waters cannot be considered to meet the EF objectives.
7. The development of an appropriate methodology for EF in India, as well as the environmental management of rivers and their associated ecosystems, has been constrained by the access to long-term hydrological data. Therefore, the hydrological data for all river systems, together with water quality and environmental data should be placed in the public domain to facilitate research and development in EF-related areas. These data should be available freely to all researchers in different disciplines related to water and riverine ecosystems, as also recommended by the National Commission for Integrated Water Resources Development.
8. Whereas the EF requirements should be made mandatory for all new water resource development projects, steps are also required to make possible interventions to remedy the shortcomings (e.g., those concerning fish migration) in the existing water infrastructure.
9. Immediate action is required to undertake and fund research on EF requirements in different reaches of both Himalayan and Peninsular rivers, giving due emphasis on geomorphology, habitat, water quality, biodiversity and fisheries, socio-economic and socio-cultural aspects.
10. The concept and issues related to EF should be included in all education, training, and awareness programmes on environment and other concerned sectors.

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NEWS IN BRIEF

- A workshop organized by IUCN—Viet Nam and held in Hanoi in December 2004, conducted a first preliminary environmental flow assessment in the country, using the Huong River in the Hue Province as an example. For details, contact Ms. Jessica Illaszewicz, IUCN Vietnam: jessica@iucn.org.vn or Mr. Ly Minh Dang dang@iucn.org.vn
- IWMI released a research report, which illustrates the application of hydrology-based methods of environmental flow assessment in Nepal. The report (N89) is available for downloading at: http://www.iwmi.cgiar.org/pubs/rrindex.htm

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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