

A map of the Hindu Kush Himalayan (HKH) region, showing the boundaries of Afghanistan, Pakistan, Nepal, and India. The map highlights the Indus River Basin and the Ganges River Basin. The title 'WATER, HAZARDS, AND ENVIRONMENTAL MANAGEMENT (WHEM)' is centered over the map in large blue letters. The text 'The focus of the Water, Hazards, and Environmental Management programme is on improving knowledge and regional cooperation on environmental services and hazard mitigation to reduce the physical vulnerability of mountain people and the downstream poor. The programme is divided into three areas: Flood and Disaster Mitigation; Glaciers, Glacial Lakes, GLOF, and Climate Change; and Highland-Lowland Environmental and Economic Linkages.' is located below the title. A legend in the bottom left corner identifies the symbols for River Basin Boundary and HKH Region Boundary. The Arabian Sea is labeled in the bottom left corner.

WATER, HAZARDS, AND ENVIRONMENTAL MANAGEMENT (WHEM)

The focus of the Water, Hazards, and Environmental Management programme is on improving knowledge and regional cooperation on environmental services and hazard mitigation to reduce the physical vulnerability of mountain people and the downstream poor. The programme is divided into three areas: Flood and Disaster Mitigation; Glaciers, Glacial Lakes, GLOF, and Climate Change; and Highland-Lowland Environmental and Economic Linkages.

 *River Basin Boundary*
 *HKH Region Boundary*



Pradeep Mool

Landslide on Prithivi highway, Nepal

Myanmar

Salween
River
Basin

Mekong
River Basin

Bay of Bengal

Flood and Disaster Mitigation

Owing to its complex geology, hydrological conditions, and the geographical location of the HKH, the management of freshwater poses a tremendous challenge. Increasingly, extreme floods during monsoon, acute water shortages during winter months, and deteriorating water quality are of concern in the region. Proper management of water resources is required to make water available for irrigation, water supply, and other multiple uses as well as improvement of water quality. There is a need to improve the understanding of complex hydrological processes. The prosperity and development of HKH countries lie in proper management and wise use of water resources.

Regional cooperation in flood forecasting and information exchange

The Indus, Ganges, and Brahmaputra rivers originate in the Himalayas and the Tibetan Plateau; and they flow through several countries before reaching the ocean. These river basins are home to over 600 million people, meeting their needs for water, irrigation, hydropower, and inland navigation, and sustenance for wetlands and biodiversity. However, floods are an annual phenomenon in these rivers and affect the poor and marginalised people the most. Flooding also places severe constraints on socioeconomic development and investment in agriculture, infrastructure, and industrial production. Timely warning about flood disasters is crucial, not only to save lives and property but also for the development, operation, and management of large water resource projects. Adequate lead-time is needed to warn people, for which sharing reliable hydro-meteorological data and real-time information between countries is required.

In 2001, ICIMOD and the World Meteorological Organization (WMO) initiated a project to address these issues and promote regional cooperation in flood disaster mitigation. The project is co-financed by the US Department of State, Regional Environment Office for South Asia, and US Agency for International Development, Office for Foreign Disaster Assistance. The participating countries are Bangladesh, Bhutan, China, India, Nepal, and Pakistan, while Afghanistan and Myanmar are observers. Following the First High-Level Consultative Meeting on Developing a Framework for Regional Cooperation in Flood Forecasting and Information Exchange in the HKH Region in 2001 and the First Meeting of the Consultative Panel in May 2002, a draft project document on HKH-HYCOS – Establishment of a Regional Flood Information System in the HKH – was prepared.



National consultation meeting in China

File Photo

The Second High-Level Consultative Meeting was held in March 2003 in two parts: a technical conference on flood forecasting and information exchange and discussion on the draft project document. Participants supported the establishment of a regional flood information system and recommended national consultations be held. There was a consensus to build on existing bilateral treaties and agreements.

National consultation meetings are being held in each participating country to identify needs and priorities for establishing a regional flood information system and to select a basin for the pilot phase. National consultation meetings have been held in Bhutan (July), China (September), and Bangladesh (October). Participants assessed institutional capacities (including technical know-how and human resources), needs, and requirements, and they made recommendations on the institutional linkages, frameworks, and cooperative mechanisms required within each country and outside for a regional flood information system.

The programme has so far been successful in bringing together high-level people from upper and lower riparian countries to discuss regional cooperation in flood disaster mitigation and technologies for timely and reliable forecasts. It has made a significant contribution to building confidence and trust among participating countries. A strong network on floods and disasters has been formed. There is an increase in understanding and mutual cooperation between partners. Although some countries may be constrained in changing their policies in the short term, all collaborating institutions continue to support the development of a regional flood information system.

The website, www.southasianfloods.org, is continually updated with the latest flood information from participating countries.



Discharge measurement in the Brahmaputra River at Bahadurabad, Bangladesh

Mandira Shrestha



A meteorological station in Bhutan

Mandira Shrestha

HKH-FRIEND

HKH-FRIEND, the Hindu Kush-Himalayan Flow Regimes from International Experimental and Network Data project, is one of eight regional networks for hydrological research and data exchange under UNESCO's International Hydrological Programme.

3rd steering committee meeting: HKH-FRIEND held its Third Steering Committee Meeting in May 2003. During the first part of the meeting, there were six presentations from invited guests. This was followed by a review of progress since the Second Steering Committee Meeting in 2000 and guidance for future activities. In addition, a new Chairman and Executive Secretary were elected.

Water quality training: After the Third Steering Committee Meeting, an HKH-FRIEND regional training course on 'Capacity Building for Monitoring of River Quality in the Hindu-Kush Himalayan Region' was held in Dhulikhel, Nepal, as a follow-up to the water quality workshop held in Islamabad, Pakistan, in May 2001. Sixteen participants from government and non-government organisations from Bangladesh, India, Nepal, and Pakistan were trained on biological techniques (rapid bio-assessment) for monitoring the water quality of surface water bodies. The focus was on organic pollution, biological indicators, and methods to pre-evaluate the ecological status of rivers in the HKH region.

A website, www.hkh-friend.net, has been launched to bring together information on the background to HKH-FRIEND, archive reports, and list activities. It also houses the Regional Hydrological Data Centre (RHDC).



Mandira Shrestha

Water quality
sampling,
Dhulikhel,
Nepal

Flood risk and vulnerability mapping project-a case study of Ratu River: Rivers originating from the Siwaliks pose a unique challenge in terms of flooding and its impacts on people's livelihoods. The Ratu River originates in this region and is highly prone to flooding. Annually thousands of hectares of fertile land are washed away and many lose their lives. There are also extreme problems of sedimentation, bank cutting, and inundation. Therefore, the Ratu River Basin has been selected for a study to prepare a flood risk and vulnerability map.

A team from ICIMOD visited the Ratu River Basin to obtain a better understanding of the issues. They learned about the devastating impacts of flooding in the region and provided inputs on flood risk and vulnerability mapping. They discussed problems associated with flooding and the various coping mechanisms of inhabitants with government officials and representatives of affected villages and towns.

Following a literature review, stakeholder surveys, and collection of field data, GIS maps were prepared that delineate the nature of flood types, their magnitude, and recurrence intervals within the Ratu River Basin. Hydraulic analysis using the HEC-RAS model was also conducted. The risk to biophysical, socio-economic, and service infrastructure was assessed. The usefulness of GIS and remote sensing as an important tool for disaster mitigation was demonstrated through this study.

The next phase of the project will focus on community preparedness and awareness, application of hazard maps, and monitoring of the Ratu River for flood hazard mitigation.

Snow and glacier aspects of water resource management in the Himalayas

(SAGARMATHA): The glaciers in the high mountains are a reliable source of freshwater for the many millions of people living downstream, meeting their needs for water supply, irrigation, hydropower, and navigation. There is evidence to suggest that glaciers all around the world are melting rapidly, with many threatened with extinction. Some argue that the apparent deglaciation of the world's glaciers is a clear indication of man-induced global warming and climate change. The continued rapid melting of glaciers is likely to result in an increase in glacial meltwater in the short-term, but a depletion of the resource in the longer-term.

Proper understanding of the variability of water resources, particularly due to the impacts of climate change and deglaciation is essential in the HKH region because a significant portion of the low flow contribution during the dry season is from snowmelt and glaciers. A consortium led by the Centre for Ecology and Hydrology (CEH), Wallingford, UK, and involving the International Centre for Integrated Mountain Development (ICIMOD), His Majesty's Government of Nepal/Department of Hydrology and Meteorology (DHM), Tribhuvan University (Nepal), Jawaharlal Nehru University (India), and the University of Salford, UK, began a project to assess the seasonal and long-term water resources in snow and glacier-fed rivers originating in the Himalayan region, and to determine strategies for coping with impacts of climate change induced deglaciation on the livelihood of people in the region. The UK Department for International Development is funding the three-year project, called SAGARMATHA. The project has developed a regional hydrological model, incorporating snow- and glacier-melt modelling components, that will provide predictions of the effects of deglaciation on the availability of water resources in the Indus, Ganges, and Brahmaputra river basins applying certain climate change scenarios. Implementation of the model into a user-friendly software package has also been developed. It has also developed adaptation strategies, in consultation with local stakeholders.



The
Annapurna
range
Ghandruk,
Nepal

Glaciers, Glacial Lakes, GLOF, and Climate Change

Glacial lake outburst flood (GLOFs) events have been documented on an increasing scale in the HKH in recent years, causing loss of life and property and the destruction of valuable forest and pasture resources, farmlands, and mountain infrastructure. Some GLOFs are reported to have created long-term secondary environmental degradation physically and socioeconomically, both locally and in neighbouring downstream countries. Accurate knowledge of GLOFs and potential GLOF sites will enhance each nation's ability to deal with them. Therefore, an inventory of glaciers and glacial lakes is an important undertaking.

ICIMOD has continued its efforts to establish an extensive inventory and digital database on mountain glaciers and glacial lakes. Following on from work already carried out in Nepal and Bhutan, the project has established an extensive GIS and remote-sensing database on mountain glaciers, glacial lakes, and potential GLOFs in the mountain areas of India, Pakistan, and China/Tibet Autonomous Region. CD-ROMs of these databases are available. Workshops were held in the Tibet Autonomous Region of China, Pakistan, and India to disseminate the results to wider audiences – including key partners, scientists, policy-makers and the general public. This initiative is co-funded by the International Centre for Integrated Mountain Development (ICIMOD) in collaboration with the Asia-Pacific Network for Global Change Research (APN), Global Change System for Analysis, Research, and Training (START), United Nations Environment Programme's Regional Resource Centre for Asia and the Pacific (UNEP/RRC-AP), Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), Bureau of Hydrology Tibet (BHT), Pakistan Agricultural Research Council (PARC), and CSK Himachal Pradesh Agricultural University (CSKHPAU)



Piradeep Mool

Gelhaipuco glacial lake in Pumqu basin in China, which burst out on 21 September 1964 and brought down huge floods and debris in Natangqu, Pumqu, and even on the Arun River inside Nepal.

Highland-Lowland Environmental and Economic Linkages

The eco-environmental system in the HKH provides goods and services that sustain the lives of 150 million people living within the region and some one billion people living downstream. In addition, this mountain ecosystem is also vital for providing essential global environmental services. To overcome the pressing challenges of poverty and environmental degradation in the HKH region, there is a need to link poverty alleviation with environmental enhancement through policies that provide operational trade-offs, incentives, and/or compensation for mountain communities. Mountain economies can become part of the globalisation process by taking advantage of mountain specificities to create highland-lowland linkages that benefit both parties.

During 2003, ICIMOD focused on the development of legitimate mechanisms for assessing environmental services provided by the HKH. A concept note on Environmental Services' Assessment in the HKH Region was prepared for presentation to the UN's Millennium Ecosystem Assessment programme. It was accepted as a sub-global assessment, and ICIMOD was granted associate status in the programme. At the programme's sub-global workshop in Stockholm in June, ICIMOD acted as a facilitator to the new initiative on the Great Asian Mountain Assessment (GAMA) and agreed to host a GAMA Inception Workshop. At the inception workshop in September, participants developed a joint proposal to integrate the six existing candidate assessments that cover 15 countries in the HKH and Central Asia into GAMA. ICIMOD will coordinate this initiative.



Daniel Miller

The high
Himalayas and
lower mountain
region