



Niujuangou Gully, Sichuan, China

Water and Vulnerability

In the Hindu Kush Himalayas, water is both the most vulnerable resource and a cause of vulnerability in mountain communities. The most profound effects of climate change are likely to be on the availability of water, whether too much or too little.

ICIMOD made notable progress in the area of water and water-induced hazards in 2011. ICIMOD began to analyse water from a basin approach in order to tackle flood risk and water issues in a more holistic way. The Centre also initiated a system for managing flood risk by estimating rainfall in real time to predict potential flood-related risks.

By linking upstream and downstream areas, the basin approach allows for the integration of information about snow and glaciers in analysis of downstream flood risk and water availability. Since this approach will be especially useful for analysing the effects of climate change and adapting to them, it is gaining greater acceptance among key stakeholders in ICIMOD's regional member countries.

The Koshi River basin is an excellent example of a compact transboundary river basin, traversing China, Nepal, and India. To build transboundary cooperation, ICIMOD developed proposals for a multidisciplinary transboundary Koshi basin programme, which have been submitted to potential development partners.

The Indus basin covers over 1 million square kilometres in the mountains of Afghanistan, China, India, and Pakistan. During the dry season, the flow from the mountains is particularly important and affects all aspects of lives and livelihoods. In 2011, ICIMOD conceived a new Indus basin initiative to provide the basic information needed to support wise decision making and planning to ensure water availability, and developed a framework for its coordination. ICIMOD has successfully implemented an approach for glacio-hydrological modelling and assessment of climate change impact in the pilot

catchments of the Indus basin in Afghanistan and Pakistan and built capacity of key stakeholders in glacio-hydrological modelling and monitoring.

In November 2011, the ICIMOD Country Office in Pakistan, the Pakistan Meteorological Department, and the Water and Power Development Authority jointly organized a workshop for the upper Indus basin. The workshop took stock of hydrometeorological monitoring and modelling activities in the upper Indus basin, identified capacity gaps, and developed mechanisms to share scientific information and develop joint monitoring programmes with national and international partners. The 40 participants from various government and non-governmental organizations and academia formed a small working group to develop a broad agenda for the Indus basin initiative. The ICIMOD Country Office Pakistan will serve as the secretariat.

To support regional flood forecasting, ICIMOD tested a remote sensing approach for measuring rainfall and monitoring flow in pilot catchments in China, India, Nepal, and Pakistan. ICIMOD's materials and methodology for flash flood management and related capacity building are being used by partners such as Focus Humanitarian Assistance in Pakistan and the National Disaster Management Authority (NDMA) in India. A community early warning system for flash floods was implemented in Assam, India.

ICIMOD has also developed standardized methods for monitoring snow and glaciers for more accurate information, which is contributing to knowledge on water availability in the region. Data from the member countries are compiled in the online Mountain GeoPortal, which makes the information available in the region and around the globe.

Creating a System to Send Flood Warnings Faster than Flood Waters

By linking on-the-ground data measurements with satellite information, ICIMOD aims to improve the capacity of six Hindu Kush Himalayan countries to estimate rainfall and predict potential floods and to share the information among the countries and their populations.

The problems that result in floods know no borders; intense rainfall and snow melt in one country or transboundary area can result in floods in other countries. Floods have undone decades of development progress in South Asia and exacerbated poverty in the affected areas. Every year, large swathes of India and Bangladesh are inundated with floodwaters, which displace millions of people. The 2010 Pakistan floods killed about 2,000 people and affected 20 million. In 2008, a breach of an embankment in Nepal displaced more than 70,000 people in the country and over 4 million

in neighbouring India. The impact of flooding is exacerbated by increased migration of poor people to flood-prone lowlands, the growth of dense settlements along the riverbanks, and the effect of climate change on the frequency and intensity of monsoon precipitation.

Together with the World Meteorological Organization (WMO) and partner countries, ICIMOD is implementing the HKH Hydrological Cycle Observation System (HKH-HYCOS) as a part of WMO's World Hydrological Cycle Observing System (WHYCOS). The HYCOS project promotes regional cooperation in real-time data sharing to increase the lead time for flood forecasts of national agencies and enable timely warnings to minimize the adverse impacts of floods. In 2011, ICIMOD entered into agreements with partner countries to select and upgrade hydrometeorological stations and to develop a Regional Flood Information System, in accordance with the interest expressed by Bangladesh, Bhutan, China, India, Nepal, and Pakistan. The aim is to upgrade 28 hydrometeorological stations selected by partner agencies with instruments of international standards for real-time data transmission, and to integrate 216 stations of the WMO Global Telecommunication System in the Regional Flood Information System. The capacity building and technical support of the project are already having tangible benefits at the national level.

Flood in Pakistan



“The main benefit of working with ICIMOD is the opportunity to receive assistance on various issues, due to the vast experience that it has in the region. As well, the chance to interact with similar organizations in the region, which ICIMOD facilitates, is also unique and rewarding. The Department of Hydro-Met Services of Bhutan is a very new organization after the recent restructuring. As we are starting in a new context, working with ICIMOD is proving to be fruitful in achieving our objectives of expanding the network, automation of observation stations, and increasing the capacity.”

– **Chhimi Dorji**, Planning, Coordination and Research Division, Department of Hydro-Met Services, Bhutan

Building the Capacity to Monitor Ice and Water Resources

ICIMOD is training partners to carry out field-based glacier mass balance measurements and helping them to establish a long-term scientific programme to monitor the cryosphere – glaciers, snow, and ice.

The capacity building is part of a project to establish a glaciological and hydrometeorological observation network in selected glacier catchments for monitoring and assessing changes in glaciers, snowfields, and glacio-hydrology. The project is creating an HKH regional snow cover and glacier inventory database, with standardized data and information from a single consistent source that can be used across the Hindu Kush Himalayan region. It is planned that the information and knowledge generated through the project will be shared through conferences, workshops, networking, and data sharing, cementing ICIMOD's role as a cryosphere knowledge hub.

Without scientific information, it is impossible to predict the possible impacts of climate change with any certainty. With limited capacity among the HKH regional partners, there has been little on-the-ground meteorological and hydrological observation in the high Himalayas. Only three meteorological stations are located above 5,000 m and 38 above 4,000 m elevation. For glacier mass balance monitoring, which tells how much ice is stored in glaciers and the rate at which this amount is changing, in situ measurements are important. Such direct glacier mass balance measurements are complemented by analyses from remote sensing products (e.g. satellite imagery) and modelling.

The project has initiated a web-based cryosphere portal and an operational database of information on hydrology, glaciology, and water-induced disasters, which is already being used by project partners and academic institutions. In Nepal, ICIMOD, in collaboration with partners, has developed a functioning system for regular monitoring of snow and glacier data to analyse the changes each decade in two selected glaciers, Yala and Rikha Samba, and their catchments.

The effort to build regional capacity in cryosphere monitoring has begun with data and information gathering, information exchange, and training for

professionals in Bhutan, China, India, Myanmar, Nepal, and Pakistan. The project partners have also started an M.Sc. course on glaciology research in Nepal, which is the first of its kind in South Asia.

Imja Lake, Nepal



“The Cryosphere Monitoring Project has given us training on mass balance, modelling, remote sensing, safety measures, surveying, and using automatic instruments, which is very essential for us aspiring students. For me, there were many new topics, which were very useful in our field trip to Rikha Samba and Yala glaciers. As an aspiring glaciologist, I have to thank the project for all this training.”

– **Niraj S. Pradhananga**, Climate Section,
Department of Hydrology and Meteorology,
Kathmandu, Nepal

“The Cryosphere Monitoring Project has given us several training courses that enhanced our knowledge and enabled us to extract the data from the field, analyse the data, and reach a conclusion based on the acquired data. This training has set a positive track in my career as a glaciologist. Also, the training offers a chance to interact with well-known individuals engaged in the field of glacier studies, share ideas, and hear about their experiences on the glacier.”

– **Ms Sonika Shahi**,
M.Sc. student in glaciology, Nepal