

**Global Change Impact Assessment for Himalayan Mountain
Regions for Environmental Management and
Sustainable Development (APN 2003-03)**

Project Leader:

Prof. K. L. SHRESTHA

President, Institute for Development and Innovation

21/85 Pimbahal, Lalitpur

P.O.Box 12088, Kathmandu

NEPAL

Tel: +977-1-553-3028, 553-7059

Fax: +977-1-422-5474

Email: klshrestha@wlink.com.np

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APN funding:

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Participating countries:

Participants from the following countries were funded: India, Nepal and Pakistan. The participants from India, Pakistan and a representative from IGBP's Mountain Research Initiative (MRI) were funded through the APN grant to attend the year-end workshop in Kathmandu in December 2003.

A representative of APN, Dr. C. Sharma (APN Liaison Officer for South Asia), was funded by APN directly.

Brief introduction and background:

The Himalayan Mountains are the youngest, largest and highest mountains in the world. Home to millions, they cause orographic precipitation, have a major influence on the region's weather, and provide a water tower that supplies and regulates water for billions of people living downstream. Moreover, due to their unique position and physical features, they act as a storehouse of valuable biodiversity resources and hold a mosaic of age-old human cultural diversity.

However, because of their young and fragile nature coupled with sharp gradients, the Himalayan Mountains are particularly susceptible to global change. In 2001, the APN supported a scoping workshop in Kathmandu to develop a project proposal on Global Change Impact Assessment for Himalayan Mountain Regions for Environmental Management and Sustainable Development (APN 2001-17). This two-year project, the follow-up of the scoping workshop, focused on the following activities related to the Himalayan mountain regions:

- Identification and understanding of key ecological and socio-economic parameters, including their sensitivities and vulnerabilities under global change and cumulative changes due to on-going human interventions;
- Assessment of the vulnerability to and impacts of global change on food security and water resources, including transfer of resources between uplands and lowlands;
- Assessment of the vulnerability of its mountain people to global change, and to investigate the factors that promote resilience of these groups in the face of multiple and interacting environmental stresses; and
- Informing, on a scientific basis, the policy-making processes at local to regional scales about global change impacts on food security and water as well as response strategies for coping and adapting to the changes.

Outline of activities conducted:

In the second year (2003-2004), project work focused on global change related vulnerability analysis and integrated impact assessment with respect to food security and water resources, including highland-lowland transfer of resources in the Himalayan Mountain regions. The Tank and DSSAT models were used to study the impacts on water resources and agriculture, respectively. In order to capture the impact in the far western region of the Himalayas, where the effect of the Southeast Monsoon is least, an additional site viz. Hunza Watershed in Pakistan was also included in the study this year. Thus, studied watersheds now include:

- Alaknanda in India;
- Kali-Gandaki in Nepal; and
- Siran and Hunza in Pakistan.

Studies focused on the identification of crucial factors that need close monitoring to reduce vulnerability of Himalayan water resources, agricultural systems and mountain peoples' livelihoods to global change. Activities conducted during the project period included the following:

1. Database generated during the first year was improved by collecting more data from concerned agencies, as well as through other measures including field studies and interviews with key-actors in the selected Himalayan river basins in the participating countries.
2. Earlier work on Himalayan glaciers was reviewed and clearly indicated a general trend of recession of glaciers in the region at rapid rates.
3. Field surveys, together with a number of participatory rural appraisals (PRA's), were conducted at three altitudinal transects in each of the four selected watersheds.
4. Through the analysis of field survey data using the SPSS package, extracted data and information includes altitudinal variations regarding the impacts of climatic extreme events on water availability, food security and peoples' livelihood together with their resilience capacity and coping mechanisms. Information on peoples' perception about global change and the perceived requirements of adaptation/mitigation measures were also ascertained.
5. Utilised Hadley Centre RCM data, obtained with the help of the Indian Institute of Tropical Meteorology (IITM), for both controlled as well as potential GHG emission conditions on daily temperature, precipitation and relative humidity for selected grid points in the selected study areas over a period from 2041 to 2060 to get a gross view of the envisaged change in the Himalayan mountain region half a decade later.
6. An Ecological Health model is being used to develop vulnerability and impact assessment scenarios.

Outcomes and products:

1. A general perspective on the trends of climatic, as well as socio-economic changes in the Himalayan mountain regions.
2. A general perspective of the retreating Himalayan glaciers and their consequences in terms of increasing threats of Glacial Lake Outburst Floods (GLOFs), as well as in terms of changes in the flow of snow fed rivers during

the dry seasons, and their impacts on irrigation and hydropower development schemes.

3. Derived trends of changes of meteorological, hydrological, food provision, and socio-economic parameters at the selected representative watersheds in the different regions of the Himalayas.
4. Country reports including field survey results on the observed impacts of global change including globalization of water resources, food security and livelihood of mountain people as well as their coping mechanisms.
5. Identification of villages and groups with greater water and food security as well as institutional and other strengths that provide resilience.
6. Country level workshops in Nepal and Pakistan with mountain stakeholders and policy-makers (similar event is planned for India soon).
7. An intensive workshop held in Kathmandu on 16-20 December, 2003 (in conjunction with the APN workshop on Water Resources in South Asia) to discuss research findings as well as plan a strategy for bringing the project work to a logical conclusion.
8. Press meeting with national newspapers, press agencies and the electronic media convened on 19 December, 2003 for disseminating APN project research.
9. A paper based on the synthesis report has been sent to the Journal on Global Environmental Research for publication.
10. Final report to be published and disseminated through the Internet. Relevant papers based on the research to be sent for publication in peer-reviewed journals.

Future directions and follow-up work:

A *no cost extension* of the project period for six months has been requested for the identification of model-based projected impacts through the synthesis of all collected information and data, and thus to bring the project to a logical conclusion. Tasks in this timeframe will include:

1. Validation of the data as well as the development of short-term scenarios (RCM data for the selected grid points covering the periods from 1980 to 2030 will be obtained through IITM.)
2. Using RCM data and assuming certain development paths, a few scenarios for global change impacts will be developed and the policy implications under the various scenarios for resource management and sustainable development in the Himalayan mountain regions will be ascertained and disseminated.
3. Although the mountain ecosystem is extremely important for the Indian sub-continent for the goods and services it provides, integrated studies on mountain ecosystems have, thus far, not been carried out adequately. The present initiative is one of its own kind where a multidisciplinary and multi-national approach has been adopted to identify the signatures of global change and its impact on the Himalayan mountain environment, as well as on the population living in the region. Hence, as a prerequisite to institutionalise this program in South Asia, necessary follow-up measures will be conducted.
4. As there are still large uncertainties in the potential impacts of global change on the studied processes, as well as the interactions between them, the need for further detailed studies is apparent. In recognition of this issue, SASCOM has adopted Mountain Ecosystems as one of its four priority research areas during this decade for South Asia. Mountain ecosystems have also been identified as a

major research component for the Earth System Science Partnership (ESSP)/START Monsoon Asia Integrated Regional Studies (MAIRS). In view of the aforementioned unique features of the Himalayan mountains, international programmes such as the 'Mountain Research Initiative' of the International Geosphere-Biosphere Programme (IGBP) have also expressed strong willingness to join regional programmes in such research initiatives. Accordingly, necessary follow-up work will be conducted.