

Indian Himalayan capacity and adaptation programme: capacity-building in Himalayan glaciology

Himalaya is the highest, youngest and one of the most fragile mountain ecosystems of the world. The Himalayan region has the largest concentration of glaciers outside the polar realm. With glacier coverage of ~33,000 sq. km, the region is aptly called the 'water tower of Asia' and provides ~86,000,000 cubic meters of water annually to Asia's seven great rivers. These rivers provide freshwater to support livelihood of people (~1.3 billion) living downstream. Changes in climate have affected the entire earth with more dramatic effects on the high Himalayan glaciers. These glaciers are more susceptible to climate change, because of their latitudinal and altitudinal position and other interrelated processes, which need detailed multidisciplinary investigations.

There are only few Indian Himalayan glaciers which have been monitored regularly for more than 10 years. The Himalayan ecosystem is vital to the ecological security of the Indian land mass, in terms of forest cover, feeding perennial rivers that are the source of drinking water, irrigation and hydropower, conserving biodiversity, providing a rich base for high-value agriculture and spectacular landscapes for sustainable tourism. The Himalayan ecosystem is vulnerable and susceptible to the impacts and consequences of: (a) changes on account of natural causes, (b) climate change resulting from anthropogenic emissions and (c) developmental paradigms of the modern society.

Under the National Mission for Sustaining the Himalayan Ecosystem (NMSHE), the Climate Change Division of the Department of Science and Technology (DST), New Delhi decided to develop the human, institutional and knowledge capacities in the Indian Himalayan region. DST has initiated a scientific cooperation programme with the Swiss Agency for Development and Cooperation (SDC) in the field of glaciology and related areas. The Indian Himalayan Climate Change and Adaptation Programme (IHCAP) will help in this mission in a number of ways. The Indo-Swiss Capacity Building Programme on Himalayan Glaciology has been conceptualized under IHCAP jointly by SDC and Climate Change Programme of DST.

Under NMSHE, the Climate Change Division of DST is entrusted with the responsibility of developing the human, institutional and knowledge capacities in the Indian Himalayan region. The IHCAP builds on capacity and knowledge enhancement related to three pillars: (a) scientific and technical knowledge cooperation between Indian and Swiss scientific institutions; (b) adaptation of measures for vulnerable communities and (c) main streaming of adaptation policies for improved action in the Indian Himalayan region.

Capacity Building Programme on Himalayan Glaciology will be conducted each year for the next few years and will comprise of three levels. Level I will provide a basic course of four weeks duration to approximately 30 researchers. About 15 participants from the basic course will be selected for the advanced level II, course of approximately two months duration, including glacier field work. Finally, about 2–5 participants will be selected by an expert committee based on their performance in level II for proposed research under DST Climate Change programme on specialized topics to be jointly supervised by Indian and Swiss faculty (level III).

The Capacity Building Programme in its first year has been organized by the School of Environmental Sciences, Jawaharlal Nehru University (JNU) and coordinated by M. Stoffel, Anil V. Kulkarni and A. L. Ramanathan. Level I of the training programme commenced in April 2013. A total of 29 researchers with experience and exposure to the diverse fields of glaciology were selected. Faculty from around 22 universities and institutions across India and Switzerland imparted training in theoretical glaciology. The level II course started on 20 September 2013 with a field trip to Chhota-Shigri glacier under the supervision of Ramanathan. In this course, 15 selected researchers were exposed to extensive field study on various aspects of glaciology. The participants were trained in hydrology, mass balance studies, geomorphology and snout monitoring by the experts. Detailed mass balance techniques for direct/*in situ* ablation and accumulation measurement have

been utilized. The objective of the field training programme was to train the participants in the field, so that independent glaciological work can be carried forward by them to generate field data for future prediction and modelling.

The rigorous training on Chhota-Shigri glacier has facilitated the young researchers in understanding the glacier system and its process. The challenges of carrying out field studies on Indian Himalayan glaciers were encountered and possible solutions to deal with these problems were provided during the training. The successful completion of the field training has inculcated determination and self-reliance in the participants to pursue such studies in the near future.

This field training was followed by classroom sessions on glaciology and related areas at JNU by experts from India and Switzerland, which included lectures related to various fields of glaciology and high mountain hazards, paper presentations on different climate-related topics and modelling exercises using different climate as well as hazard prediction models. Discussions in the field, classroom lectures by eminent scientists and academicians from India and Switzerland, paper presentations and the exercises have imparted self-confidence and motivated the participants to nurture and visualize various concepts of glaciology and pursue a career in the same field.

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