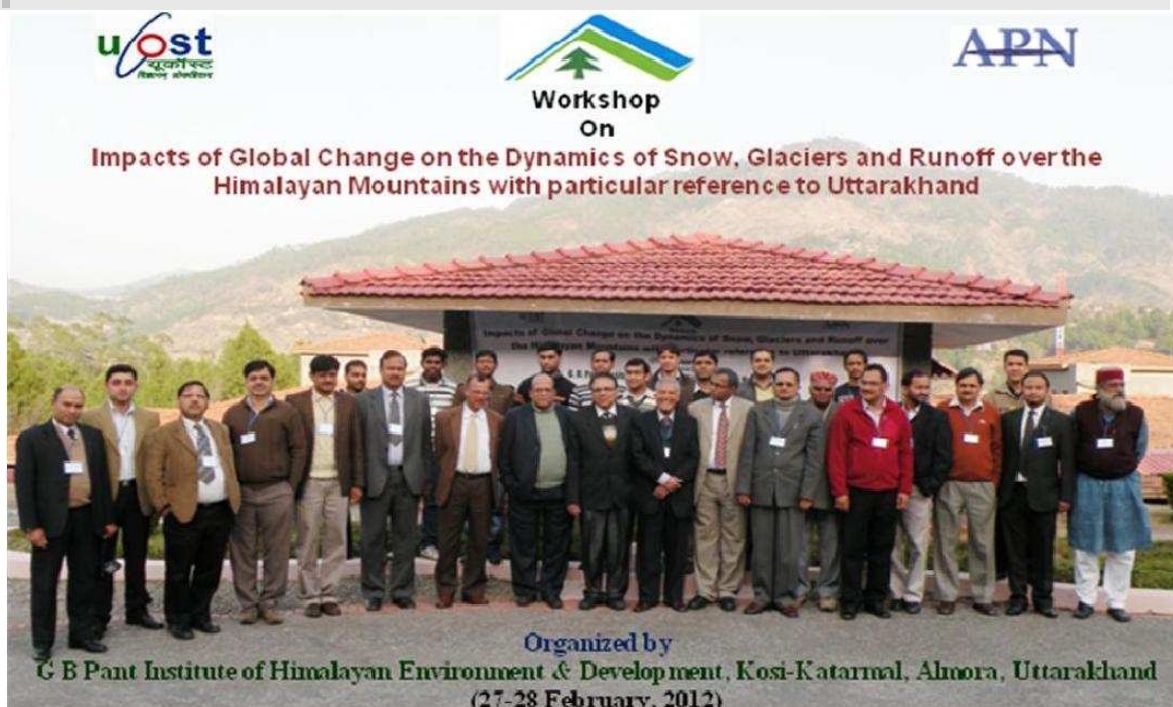


Geo News

Report on Workshop
on
“Impacts of global change on the dynamics of snow, glaciers and runoff over the
Himalayan Mountains with particular reference to Uttarakhand”
27-28 February, 2012
Organized by
G B Pant Institute of Himalayan Environment & Development, Kosi-Katarmal,
Almora, Uttarakhand



Himalaya, often referred as the water tower of Asia, stores a significant quantity of fresh water in the form of seasonal snow cover and glaciers. It is a serious concern that the Himalayan glaciers, largest outside of the polar region, are showing a decrease in snow cover and glacial retreat. The recession and overall decrease in the volume of glaciers is adding to the total area of erosion every year. Focusing on these aspects, a two days workshop “Impacts of global change on the dynamics of snow, glaciers and runoff over the Himalayan Mountains with particular reference to Uttarakhand”, was organized by G. B. Pant Institute of Himalayan Environment & Development (GBPIHED), Kosi-Katarmal, Almora during 27-28 February, 2012 in collaboration with Uttarakhand State Council for Science and Technology (UCOST), Dehradun and the Asia Pacific Network for Global Change Research (APN), Japan. Main aim of the workshop was to bring together leading experts working in the area to (i) discuss changes in the dynamics of Himalayan snow, glacier & runoff vis-a-vis climate change, (ii) address issues related to the impacts of changes in hydrological regimes on livelihood of people inhabiting the upstream/downstream areas, and (iii) provide much needed science based information for identifying

and implementing adaptation and mitigation strategies for sustainable development of the region. About 50 delegates, including distinguished scientists, academicians, and research students from various organizations of India and from Nepal participated in the workshop. The inaugural session of the workshop started with a welcome address by Dr. Rajesh Joshi, scientist, GBPIHED. Addressing the gathering, Dr. L.M.S. Palni, Director, GBPIHED, highlighted R&D activities of the Institute in the entire Indian Himalayan Region (IHR). He specifically elaborated about the national/international programmes of the Institute and expressed need for further developments in the field of glacier studies in the country. Briefing about the objectives of the workshop, Er. K. Kumar, scientist, GBPIHED advocated the need for more scientific information on climate change impacts on water resources in the Himalaya. Later, Dr. K.L. Shrestha, Institute for Development and Innovation (IDI), Kathmandu, Nepal, in his inaugural speech emphasized the necessity for dedicated efforts to study Himalayan climate and cryosphere. Dr. P.S. Rao, Adviser, DST, Govt. of India, New Delhi, and Guest of Honor on the occasion, stressed upon the need for comprehensive studies for climate change and glaciers in the Himalaya. He suggested and encouraged data sharing at institutional level so that coordinated & multi-disciplinary team work gets benefited for high altitude in the Himalaya. Presiding over the function, Dr. Rajendra Dobhal, Director General, UCOST, pointed out the limited empirical database on climate change and glacier studies in Himalaya, and expressed the urgent need for making a single knowledge repository for all such databases for the entire IHR. During the workshop, presentations and deliberations were held under the following technical sessions: (i) Dynamics of Snow & Glacier, (ii) Climate Change Patterns, (iii) Climate Change and Flow Regime, and (iv) Consequences of Changes: Upstream-Downstream Linkages.

Dynamics of Snow and Glacier

In his keynote address, a systematic overview of glaciers of Uttarakhand was presented by Dr. Deepak Srivastava, (Centre for Glaciology, Dehradun). He mentioned that average annual retreat of the majority of the glaciers is about 0.30% of the total length and average annual recession, in terms of area vacated by the glacier, is about 0.11 % of the total area. He further mentioned that the small size glaciers (length wise) are retreating relatively faster as compared to large glaciers. Rainfall and moraine mass/debris deposition is causing further retreat, and the changes in climate and mass balance results in glacial fluctuations. He stressed on the need for taking up new glaciers, irrespective of the ease of accessibility, for glaciological studies to help strengthen databases and for filling up research gaps. Dr. I. M. Bahuguna (SAC, Ahmedabad) deliberated on the progress in snow and glacier studies of Himalayan region using RS and ground data, and underlined the importance of these tools for snow cover & glacier monitoring and mass balance studies. Dr. K. L. Shrestha presented a case study of Koshi river basin (Nepal), wherein the results of PRECIS and WRF RCM simulations clearly show increasing trends of discharge with rise in temperature. The study emanated from a project funded by APN, Japan and implemented in China, India, Nepal, and Pakistan. Dr. Rajesh Joshi (GBPIHED, Almora) presented the work being carried out in the Indian part under the same project. Reporting the findings, he presented seasonal snow cover variation in Upper Bhagirathi basin using MODIS satellite data. Based on past 10 years data (2000-2010), shift in accumulation & ablation duration and decrease in winter & spring seasonal snow cover was found to be prominent. Such changes in seasonal snow cover affect stream flow and water availability in the downstream areas.

Climate Change Patterns

Deliberating on the patterns of climate change in North-West Himalaya, Dr. M. R. Bhutiyani (SASE, Chandigarh) mentioned that Himalayan region is warming at rates higher than the global average; particularly in the winter season-this is significant due to which snow and glacial cover of the region is declining. Indicating the evidences of perceptible human induced climatic change, he provided insights on (i) significant increase in the population and urbanization, (ii) increase in per capita consumption of petroleum products and the concentration of greenhouse gases in NWH. He stressed on the need to restore glacial health and snow cover for which the following was suggested: (i) identifying river basins/areas where 'Mountain-Spring-Heat-Island effect' can have dangerous effects, (ii) highly reflective roofing material may be used for households in urban areas to alter the energy balance, (iii) snow harvesting techniques using snow pits, snow fences and check

walls to retain snow cover for longer duration, (iv) formation of zone avalanche control structures, catchment dams in the avalanche tracks, and (v) artificial increase in the concentration of aerosol particles in higher reaches to ensure lower shortwave radiation. Dr. J. C. Kuniyal (GBPIHED, Himachal Unit) dwelt on distribution of aerosol, gaseous pollutants such as SO₂, NO₂, O₃, PM₁₀ particles, and –SO₄ in Kullu valley. He mentioned that, fine size aerosols are increasing at the rate of 0.7% per year and elaborated that the region has both local sources (biomass burning and vehicular emissions) and external sources (episodic sources mainly from the NW countries) of aerosols. Dr. Varun Joshi (GGSIP University, Delhi) mentioned that the mean CO₂ concentration at Dokriani (383 ppm) glacier is higher than the global mean atmospheric CO₂ value (380 ppm). Since, troposphere baseline data of CO₂ concentration has not been measured over the IHR, precise measurements of atmospheric CO₂ under diverse environmental settings of IHR are required.

Climate Change and Flow Regime

An important issue in global warming is its overall impact on the environment, and water resources in particular. The quantity and timing of river flows are critical in respect of water supply, water quality, and the ecological integrity of river systems, and thus changes in the river flow regime do reflect the climatic conditions, and naturally respond to changes. Dr. S.K. Jain (NIH, Roorkee), on the basis of hydrological studies carried out by NIH in Beas, Chenab and Satluj basins in the NW Himalaya, said that the stream flow and snowmelt runoff is more sensitive to temperature change in comparison to alterations in precipitation. Speaking on GLOFs, he provided insights on the effects of warming climate on frequency of GLOFs as well as emphasized the need for (i) regular mapping and monitoring of lakes, (ii) identification and prioritization of potentially dangerous glacial lakes and their monitoring on a continuous basis using high resolution time series satellite imageries, and (iv) need for appropriate measures to reduce the potential risks from these lakes. Dr. A. K. Lohani (NIH, Roorkee) discussed the importance of assessment and simulation of glacier lake outburst to estimate the resulting flood. He mentioned that keeping the possibility of flood hazard in mind due consideration to GLOF should be given while planning for dam break analysis. While discussing variable response of glacier melt to climate change, an overview of annual retreat of glaciers of Uttarakhand was presented by Dr. D. P. Dobhal (WIHG, Dehradun) for the period 1965-2010. He stated that the glacier retreat rates are controlled not only by changes in the climate but also on topographic and morphologic features. He further stated that over the years, retreating trends of glaciers are largely same; however, the magnitude of retreat has changed. The annual fluctuations in the retreat of any glacier may be due to variable winter snowfall; therefore, volume loss is more important than the snout retreat. Prof. R. Shankar (Institute of Mathematical Sciences, Chennai) shared the progress of development of flow line model for flow and retreat measurements of Satopanth glacier which can also capture the response of a debris covered glacier to the climate. Mr. Pradeep Rawat (Kumaun University, Nainital) presented spring hydrology of a non-glacial river basin wherein need for protecting the spring by creating spring sanctuaries was highlighted.

Consequences of Changes: Upstream-Downstream Linkages

The major glacier-fed Himalayan rivers along with glaciated catchments have regional importance; water from the glacier melt sustains not only the stream flow in these rivers during dry season but also the livelihood of people inhabiting both upstream & downstream areas. Addressing on these issues, Er. Kireet Kumar (GBPIHED, Almora) described hydrological response of glacial and non-glacial river systems of Himalaya. He indicated that, in glaciated catchments, response to seasonal climate variability is predominant in flow pattern as winter snow plays major role in controlling flow conditions and summer precipitation & lowering of temperature affects diurnal variations. But, in case of non-glacial catchments, inter-annual variations are more predominant under the influence of rainfall pattern; therefore, the hydrological response time in such catchments is much shorter (1-3 days). He underlined the need for considering watershed as a unit for conservation & management of water. Dr. M. Arora (NIH, Roorkee) mentioned that statistical downscaling technique may be adopted for using GCM output for regional climate impact studies. In his presentation, Dr. N.P. Chaulagain (AEPC, Kathmandu, Nepal)

presented socioeconomic dimensions of glacier melt in Nepal; wherein, he mentioned adverse affects of rise in glacier melt with the rise in temperature. Dr. S.C.R. Vishvakarma (GBPIHED, Almora) deliberated on climate change and its impact on water resources in the Kullu Valley; temperature rise being particularly higher during winter months affects snow and ice caps of NW Himalaya. Dr. Ravindra Kaur (SES, JNU, Delhi) spoke on 'Uttarakhand developmental policies, IEL compliance in climate change perspective' and debated for promotion of meticulously enforced eco-friendly infrastructure and technology in the state. In his concluding remarks, Dr. L.M.S. Palni emphasized on the need of collaborative and coordinated approach for glaciological studies and stressed for provision of incentives to researchers in the high altitude & difficult areas. He further stressed the need for human resource development. Dr. K.L. Shrestha called for trans-boundary collaboration and for a comprehensive strategy on long term research in glaciology. In addition, it was suggested that, proper attention needs to be given to socio-economic issues of the people inhabiting the upstream and downstream areas. Dr. P.S. Rao shared information about the new initiatives of DST, Government of India, such as extra incentives for researchers working in high altitude areas, and initiation of integrated programmes for long term glaciers research.

RECOMMENDATIONS

1. There is need to develop collaborative and coordinated approach for comprehensive strategy for long term research in glaciology, human resource development for glacier studies and provisions of incentives to researchers working in the high altitude & difficult Areas.
2. Since limited empirical database is available on climate change and glacier studies in Himalaya, therefore there is necessity of dedicated efforts and comprehensive studies on climate change and cryosphere supported by strong scientific information.
3. A mechanism for data sharing needs to be developed at institutional level so that coordinated & multi-disciplinary team work gets benefited for high altitude in the Himalaya; one single knowledge repository for all such databases for the entire IHR should be established.
4. Since Himalayan glaciers are showing a decrease in snow cover, therefore, possible options to restore glacial health and snow cover (e.g. snow harvesting, formation of zone avalanche control structures, and use of reflective roofing material etc.) may also be attempted.
5. Need for regular mapping and monitoring of GLOFs, their continuous monitoring using high resolution time series satellite imageries for identification and prioritization of potentially dangerous glacial lakes.
6. for glaciological studies with trans-boundary collaboration.

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ACKNOWLEDGEMENTS

The organizers thank all the speakers and delegates for active participation in various technical sessions. Uttarakhand State Council for Science and Technology (UCOST), Dehradun and the Asia Pacific Network for Global Change Research (APN), Japan are thanked for financial assistance, and being the co-sponsors of the workshop.