



# **INSTITUTE OF GREEN ECONOMY**

**IN PARTNERSHIP WITH INTERNATIONAL UNION OF FORESTRY RESEARCH  
ORGANIZATIONS AND TERI UNIVERSITY**

## **INTERNATIONAL EXPERT WORKSHOP ON EMERGING ISSUES IN CLIMATE CHANGE**

**State of Tropospheric Temperature, Pollution, Melting  
Glaciers and their Potential Impact on Monsoon and High  
Altitude Vegetation in the Himalayas-Tibetan Plateau**

**Dec 28-29, 2009, New Delhi. India**

### **SUMMARY REPORT**

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**Background:**

Climate change is affecting the temperatures, amount of snow and ice in the Himalayan region as well as rainfall patterns in the densely populated downstream regions of Asia which would have enormous significance for livelihood and well being of the people of the region. There is a need to prepare the people, institutions and countries of the region to anticipate the consequences of climate change and evolve suitable and cost-effective adaptation responses. However, there is inadequate availability of information on these processes of change making it both difficult to plan appropriate responses and create public opinion in favour of drastic actions that are needed to address the issues

In order to assess the state of scientific knowledge an extensive literature review was undertaken and an international expert consultation workshop was organised to begin an expert consultation process and assess the current state of scientific knowledge on climate change over the Himalayas, atmospheric and surface temperature trends and the effect of warming on the glaciers and the monsoons, role of aerosols in both moderating and accentuating warming under differing circumstances and the response of high altitude vegetation to climate change. Additionally, the workshop was also expected to recommend steps to encourage more national and international research initiatives in this direction and broaden access to databases, strengthen national capacities in research, monitoring and data sharing for sustainable development in the region and also to create sufficient awareness among public for wider legislative and financial support for necessary action.

The workshop was attended by a total of 75 scientists, subject matter experts, academics from universities and specialised institutions from a number of countries, senior government functionaries and representatives of international organizations. The workshop was inaugurated by Dr P J Dilip Kumar, Special Secretary in the Ministry of Environment and Forest, Government of India. A total of 28 presentations were made by the participants on the trends in changes in temperature and precipitation over the Himalayas, contribution of aerosols to these trends, glacier melt and observed and simulated changes in monsoonal patterns. Towards the end of the workshop group discussions were held on four central issues and this summary report is based on the consensus developed during the workshop as reflected in the outcome of the Group discussions as well as discussions during the technical sessions.

## **The state of melting glaciers**

There was no consensus on the changes in nature of ice cover in the Himalayas (including the Tibetan plateau). The main glacial parameters are length, area, volume, mass and thickness and *the glacier length alone can not be taken as the only parameter that signifies mass balance changes*. In general, the majority of Himalayan glaciers are shrinking in area and thickness and the extent and nature of shrinkage has not changed significantly over the last 100 years. The nature of changes in glaciers are varied and complex with some glaciers exhibiting changes in length in an observational relationship to area and mass while some have changed in length with little change in mass and yet others show changes in thickness but not length. Glacier behaviour varies across the region with higher retreat rates in the east. Possibly, glaciers in the northwest pick up snow precipitation due to the Elevated Heat Pump (EHP) and other climatic mechanisms, thus partly offsetting the melting of glaciers. Glaciers in the eastern Himalaya may be more sensitive to EHP heating and are, therefore, melting more quickly.

Prof. Murari Lal, one of the authors of the Intergovernmental Panel on Climate Change (IPCC) report, said that the IPCC statement that the Himalayan glaciers are likely to melt by 2035 had been made on the basis of a report of the World Wide Fund for the Nature (WWF) 2005 that had quoted Prof Syed Hussnain. He noted that it was wrong to assume, as has been done in sections of media, that the year 2035 had crept in the report by mistake. But Prof. Syed Hussnain, who was also present on the occasion, stated that he had never mentioned any such date in his scientific papers purportedly quoted in the WWF report. The workshop participants are of the opinion that the IPCC conclusion that the Himalayan glaciers could melt by 2035 may have to be revised as our understanding of the phenomena has matured since the period of data collection and synthesis for the Fourth Assessment Report of IPCC. The participants, however, wanted to emphasize that this does not, in any way, reduce the need for mitigation of, and adaptation to, climate change that has been initiated by the international community.

## **Impact of Dust, Black Carbon and Chemical Pollution on Himalayan Glaciers**

Causes for climate change over the Himalayas include black carbon, dust, deforestation, human-induced pollution and many other activities besides the greenhouse gases. The black carbon deposition in Tibetan Himalayas is higher than other places in the northern

hemisphere and has been a cause of significant albedo reduction in central Tibetan plateau. Studies in USA indicate dust-induced albedo decrease could cause early snow melts by as much as 30 days and increased evapotranspiration due to early melt-out may decrease basin runoff by 5%. Similar effects are possible in Himalayas too but there is severe lack of data that precludes drawing of any conclusions on dust and black carbon induced melting of snows. There is little scientific work done yet on the source identification of atmospheric chemical pollutants, their composition and deposition in the Himalayas-Tibetan Plateau. Also, the role of aerosol deposition was realized to be a complex one as its impact on the albedo varies greatly with the type of glaciers. In order to systematically prepare realistic models of all the above sources causing the environmental degradation, there is a need of equipping some of the observatories with devices for collecting related ground and atmospheric observations.

### **Temperature trends**

Ground observations of air temperature measurements show strong spatial and seasonal gradients across the Himalayas-Tibetan Plateau. The atmosphere over the western Himalayas, which contain major glaciers and are headwater to major rivers including the Indus and the Ganges, shows enhanced warming trends over the past three decades with the effect being most discernible in the snow accumulation period of the winters and the snow melt periods of the pre-monsoons.

### **Potential impact on Monsoon**

One of the major issue for deliberation before the Workshop was the likely effect of the changing climate on the monsoons as it would have enormous socio-economic consequences for the Himalayan region and the downstream plains. Clearly more research on the monsoon variability in the changing climate over the South Asian region is needed both over the downstream Plains as well as over the slopes and valley regions of the Himalayas. The all India average monsoon rainfall in the past half century was associated with a neutral-weak negative trend while the early summer monsoon rainfall was showed to be on the rise in the recent past decades.

## **Data Inadequacy and Access**

Lack of sufficient meteorological data from Himalayas has been a major handicap in drawing conclusions on the impact of climate change on the glaciers and snow cover. Multisensoral satellite coverage of entire Himalayas is essential for a detailed examination of the glacier dynamics and associated phenomena like Glacier Lake Outburst Floods (GLOFs) and this data has to be validated by means of statistically valid field measurements to ensure a complete understanding. Participants felt that it was necessary to have an adequate network of Automatic Weather Stations (AWS) for meteorological data and stated that the costs of setting up and maintaining these AWSs would be manageable if the data generated are made accessible to its many users on a differentiated price basis. The workshop recommended detailed studies on a few representative benchmark glaciers in the four 'glacier zones' of the Himalaya (Afghanistan, NW Himalaya and Karakorum, Central Himalaya including SW Tibet, and Eastern Himalaya including SE Tibet) over a longer period encompassing both field observations and remote sensing.

Since the Himalayas are spread over eight countries with different technological strengths, financial capabilities and socio-economic objectives a long term program of this nature would need to be coordinated by an international organisation with participation of the government organisations from the concerned. This will require a huge effort since the data will have to be collected from ground as well as remote sensing and proxy data may have to be used. This process would also need significant efforts towards developing guidelines and standardisation of measurements.

The Workshop Participants felt that there was an urgent need to have adequate data quality control and data dissemination in order to fill the gaps between various data sources and develop deeper understanding of the magnitude of the temperature and precipitation trends. Proxy data in the form of tree ring and ice core isotope analysis can also be used to characterize the seasonal trends.

The Workshop expressed its deep concern that there is very little data in the public domain on this most important of issues and recommended that this aspect of the Southwest and East Asian monsoon variability response to climate changes with likely differential responses in summer as well as winter precipitations should be studied in a holistic manner.

## **Impact on River discharge**

On the question of changes in river discharges there is some evidence that the precipitation and river discharge over the north western Himalayas is decreasing while increasing over the central Himalayas but lack of adequate scientific data prevented the Workshop from arriving at a conclusion in this regard. The Workshop felt that this issue needs a detailed research.

## **Impact on High Altitude Vegetation**

At present the knowledge available on the impact of climate change on the high altitude vegetation is very limited. However, the likely changes on the basis of existing information are altitudinal and latitudinal shifting of the species due to change in the hydrology and temperature, changes in the floral and faunal species composition and forest types variations in phenological behaviour of species the extension or shortening of vegetation cycles and in biogeochemical cycles, structural and morphological changes affecting the biomass production, alteration in the processes of speciation and extinction and increased rates of biodiversity loss and shifts in genetic corridors. The degree of such changes may vary in an area due to topography, soil and geographic location and biotic factors may aggravate the process of change.

The main challenges are collection of statistically sound and reliable data on long term basis, capacity building and standardization of techniques and tools, lack of suitable techniques and protocols for detecting effects of climate change on vegetation such as bio-markers and molecular indicators and developing the requisite international cooperation among the Himalayan countries. The Workshop recommended well coordinated research in important aspects of the impact of climate change on vegetation.

## **Institutional Issues and mechanism**

### **Networking for enhancing capacities and utilizing resources**

Recognizing the commonality of the issues but differential human and technological capacities of the relevant institutions across the eight countries of the Himalayan region the Workshop recommended creation of a network of existing institutions for enhancing their capacities and efficient utilization of available resources that are likely to flow to the countries of the region under the UNFCCC Adaptation Fund. Such a network could be called

Himalayan Climate Adaptation Network. This could be easily created with international support from adaptation funds and the task of coordinating its activities could be assigned to an existing international institution.

The Workshop felt that water is one of the most precious commodities for this heavily populated region and it could be under threat in the changing climate and yet there are constraints in sharing information on this across the region **on account of considerations of national security**. In addition there is a general lack of observation stations and of systematically collected and aggregated data. A regional network and a data sharing mechanism are of urgent need.

### **Some activities specifically recommended were**

#### *1. Enhanced cooperation for early warning*

Accurate mapping of glacial lakes for managing outburst floods through regulated drainage and sharing of information sharing for development of a suitable early warning system has been recommended by the Workshop.

#### *2. Institutional Strengthening:*

The Workshop recommended that relevant national institutions may be assisted in the task of preparing adaptation plans and plans for social and economically vulnerable groups.

The Workshop recommended that the summary conclusions may be brought to the notice of

- UN Commission for Sustainable Development – for policy recommendation
- Governments in the regions
- International and regional organizations
- IPCC WG2
- World Glacier Monitoring Centre/Global Land and Ice Monitoring System (GLIMS)

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