

# **HIGH MOUNTAIN GLACIERS AND CHALLENGES CAUSED BY CLIMATE CHANGE**

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The United Nations General Assembly, in a resolution in 2008 on sustainable development of mountainous regions, acknowledged “that mountains provide early indications of global climate change”. Vulnerability to climate change of ecosystems, other than mountain ecosystems, is well known to the public. However, it appears less well known to the public that changes in alpine glaciers, in high altitude lakes, along the upper tree line, or of the mountain vegetation in general, can provide early indications of climate change. For this reason, the UN General Assembly resolution also requested the scientific community, national governments and inter-governmental organizations to collaborate with mountain communities to jointly study and address the negative effects of global climate change on mountain environments.

While making my way here to Tromsø, I have been reading about these impacts and indicators in the Proceedings of the international conference on the subject of “Mountains as Early Indicators for Climate Change” that was held at the University of Padua in Italy in April 2008. The objective of that Conference was to discuss the role of mountains as early indicators for climate change and the impact of global warming on mountain ecosystems. The state of scientific research, and the gaps in data and information, were presented for different mountain regions around the world. UNEP was one of the organizing partners and copies of the proceedings are available.

## **Implications for Water Supplies**

1. It is clear from that Conference that **mountainous areas of the world are among the most vulnerable ecosystems, and that climate change impacts are expected to be strongest there.** What is less well documented at this moment, it seems to me, are the consequences for human populations of climate change impacts on mountains.

**2. The challenge of future water supplies and availability flows through almost every conclusion of the IPCC’s Fourth Assessment Report.** An estimated four billion people, or two thirds of the current world population, are likely to be affected from the impacts that are now known. Mountains contribute close to 30 per cent of global run off, supplying water for domestic purposes, for agriculture, industry and power generation. What happens to mountain ecosystems will have great significance for many people downstream.

For example, the IPCC has stressed that the information and monitoring network in the Himalayas is probably among the weakest in the world, while the region is perhaps the most important in terms of the ecosystems delivering water to the production of near one quarter of the world's cereal supply. This is also as important for other parts of the world, for example the Andes, where the prospects for agriculture and living for the downstream communities are as seriously affected.

### **Glaciers as Indicators**

**3.** It is clear that glaciers are among the most important indicators of changing climatic conditions, as climate change in terms of temperature increases takes place up to several times more rapidly at high altitudes. **Glaciers are also a key component of the hydrology in major mountain ranges.** For these reasons, it is important for us to expand and consolidate arrangements for assessment and monitoring of the impacts of the shrinking of glaciers on water resources and dependent communities. Information gaps must be filled using innovative approaches based on both field data and modeling, so that the information is urgently made available for policy makers, given the severe risks at hand.

### **The Role of UNEP**

**4.** UNEP has been pleased to contribute along with other partners to bringing together much of the related research that exists. Examples of such collaboration are the following relevant products: *The Global Outlook for Ice and Snow*, *The global Desert Outlook* and the *Fall of the Water* – all reveal how crucial glaciers are to livelihoods worldwide, and particularly as a water resource to drylands in South-America, Central, East and South Asia. Another report on “*The environmental food crisis*” demonstrated how crucial these water resources are not only to the people downstream, but also to global and regional food security and food prices. GRID Arendal, a collaborating centre of UNEP, played a lead role in all of these reports, with valuable input from ICIMOD in Nepal, CICERO in Norway and many other scientific organizations. UNEP also supports the publication of the series “*Fluctuations of Glaciers*” compiled by the World Glaciers Monitoring Service.

### **The Need to Go Beyond Research**

**5.** As you know better than other people, many of the glaciers are already melting. I have read that for Africa 80% is gone, and in the Himalayas over 15% has been lost, and likely accelerating. The changes in hydrology due to shrinking of glaciers, given the downstream impacts on dependent communities as well as far reaching impacts on global food supply, **call for close and urgent attention to adaptation measures.** This will require development of programmes and research focused on adaptation, identifying practical real-life solutions and best practices, using a mixture of innovation and traditional knowledge. More than ever, moving to a green economy will become increasingly vital within an adaptation package of measures. Land use practices, including reforestation of watersheds, reducing erosion and implementing flood dikes and

water efficiency that can help reduce or mitigate impacts of climate change, are thus among key components of future sustainability in these regions.

**6. Further, melting of glaciers can cause natural hazards.** Adapting to hazard management and mitigating impacts of floods, typically impacting the most impoverished settling in high-risk locations, assumes new urgency. We therefore encourage the continued monitoring of Glacial Lake Outburst Flood (GLOF) and the collaboration which has begun on this across the Hindu Kush Himalayas region, leading to another very useful product - the Inventory of Glaciers, Glacial Lakes and the Identification of Potential Glacial Lake Outburst Flood (GLOF) affected by Global Warming in the Himalayan Region. It is also essential that focus is given to mechanisms, strategies and implementation of policies that will reduce risks of populations to hazards associated with climate change in high mountains.

### **The Role Norway has been Playing**

7. The Government of Norway has been instrumental in financing and supporting much of the work that I have cited in bringing together the results of ongoing research in ways that can be policy relevant. In addition, it is supporting the on-going pilot study of the Hindu Kush-Himalayas climate change assessment, with ICIMOD, Pakistan, India, China, Nepal, Bhutan and Bangladesh. This focuses on adaptation strategies to a changing climate that is already felt in the region. UNEP strongly encourages the continued development of a program built in this manner from within the region with the experts of the region, to which Norwegian organizations GRID Arendal and CICERO also contribute. Appropriate and adequate responses for adaptation or to cope with hazards caused by melting glaciers will require the necessary capacity to be built in affected countries and communities.

Much of UNEP's own participation in these activities is made possible through Norway's support. We have built up some experience on mountain sustainable development and in particular its interrelation with climate change. Through its office in Vienna, UNEP serves as the Environmental Reference Centre of the Mountain Partnership. That office also provides the Secretariat of the Carpathian Convention, facilitates the cooperation process among the countries of the Caucasus and assists countries of the Balkans for the conservation of biological diversity and establishment of transboundary protected areas.

In the near future UNEP, as the Environmental Reference Centre of the Mountain Partnership, will promote the establishment of a Global Network of High Altitude Monitoring Stations in order to better support the scientific community in its work of better understanding the phenomena related to climate change and mountains. While UNEP does not undertake such research, it does serve as a convening organization; it contributes to information and analysis; it formulates and presents policy options; and it helps build capacities and popular understanding of these issues. Outreach and communication we can do!

*Final as checked against delivery*

We thank the Government of Norway for supporting and facilitating research and monitoring efforts relating to mountains and glaciers, and for bringing scientists together in this meeting on high mountain glaciers and challenges caused by climate change so that we might elevate these ecosystems in the climate change discourse.

Be assured that UNEP will add its voice to your own in this regards.

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