

# Summary

This policy summary looks at reported and possible, future consequences of climate change in the greater Himalayan region. The main emphasis is on responses in high mountain cryogenic phenomena such as glaciers, permafrost, and avalanches; the implications for water supply, ecosystems, and hazards; and how these threaten regional populations. The assessment points to a serious need to improve relevant knowledge in the region concerning key policy areas and strategies to improve the adaptive capacities of communities at risk.

The greater Himalayan region is taken to include the inner and south Asian mountains and high plateaux. It contains the most extensive and rugged high altitude areas on Earth, and the largest areas covered by glaciers and permafrost outside high latitudes. The ecosystems and human cultures in this region are exceptionally diverse. Global climate change is predicted to lead to major shifts in the strength and timing of the main climate systems affecting the region: the Asian monsoon, inner Asian high pressure systems, and Westerlies. Moreover, climate change is expected to intensify in mountain areas, especially high relief, sub-tropical areas. Already of major concern is the rapid reduction of glaciers in much of the region. This, in itself, is significant and has implications for regional water resources, as well as being an indicator of the scale of climate change. Some major hazards, from debris flows to glacial lake outburst floods (GLOFs), are becoming more frequent and severe (Beniston 2003). In fact, all aspects of the Himalayan cryosphere are affected by climate change. They include vast areas of permafrost and areas subject to snow avalanches or freeze-thaw and are affected by the changing balance between snow and rainfall. Complexities arise, especially from interactions among different cold climate elements. The most rapid and varied interactions occur through the vertical 'cascade' of moisture and sediment between different topoclimates. Large and rapid downslope, down-glacier, or downstream cascades also exaggerate the scale and difficulty of predicting hazards such as debris flows and flash floods. The varied ability of mountain species to respond as temperature warms, glaciers retreat, and weather extremes become more common threatens extinction for some and is a threat to biodiversity in general.

An important theme is the enormous diversity within the region in climates and topoclimates, hydrology and ecology, and, above all, in human cultures and the ways in which their activities are complexly interwoven with elements of the cryosphere and alpine ecosystem. The complex regional differentiation magnifies the significance of two major problems: the widespread absence of basic scientific investigations into cryogenic processes and limited knowledge of the human cultures and ongoing developments in them. This leads to the theme of 'uncertainty on a Himalayan scale', referring more to problems of limited knowledge than inherent physical and social uncertainties.

The impacts of climate change are not evenly distributed in intensity within the region, nor among different communities and sectors of society. However, the poorer, more marginalised, people of the high mountains are likely to suffer the earliest and the most. Given the evidence that many risks already threaten women disproportionately; and also the elderly, disabled, and indigenous groups, especially their poorer members; identifying changes in the cryosphere and alpine ecosystem most likely to affect them is of utmost importance. In addition, there are broader regional questions of which the more severe highland-to-lowland dangers relate to rapid melting events, floods caused by natural dam bursts, increased sedimentation, and droughts caused by reduced or changed flow patterns.

Of course, mountain people have lived with and survived great hazards for thousands of years, but current rates of climate change are among the most rapid known and they are superimposed on severe and, equally, uncertain socioeconomic pressures. A range of issues and policy areas are identified, from the regional to local community levels, through which these problems might be addressed. They involve land use, water management, disaster management, energy consumption, and human health. It is argued that community-led adaptive strategies and capacities, as well as substantial efforts to reverse the human drivers of climate change, are needed. An important practical and ethical requirement is for all levels of government, research, non-government organisations, and professions to engage with mountain communities in combined efforts to increase their adaptive capacities to climate change.

