Climate Change and Hindu Kush-Himalayan Waters – knowledge gaps and priorities in adaptation

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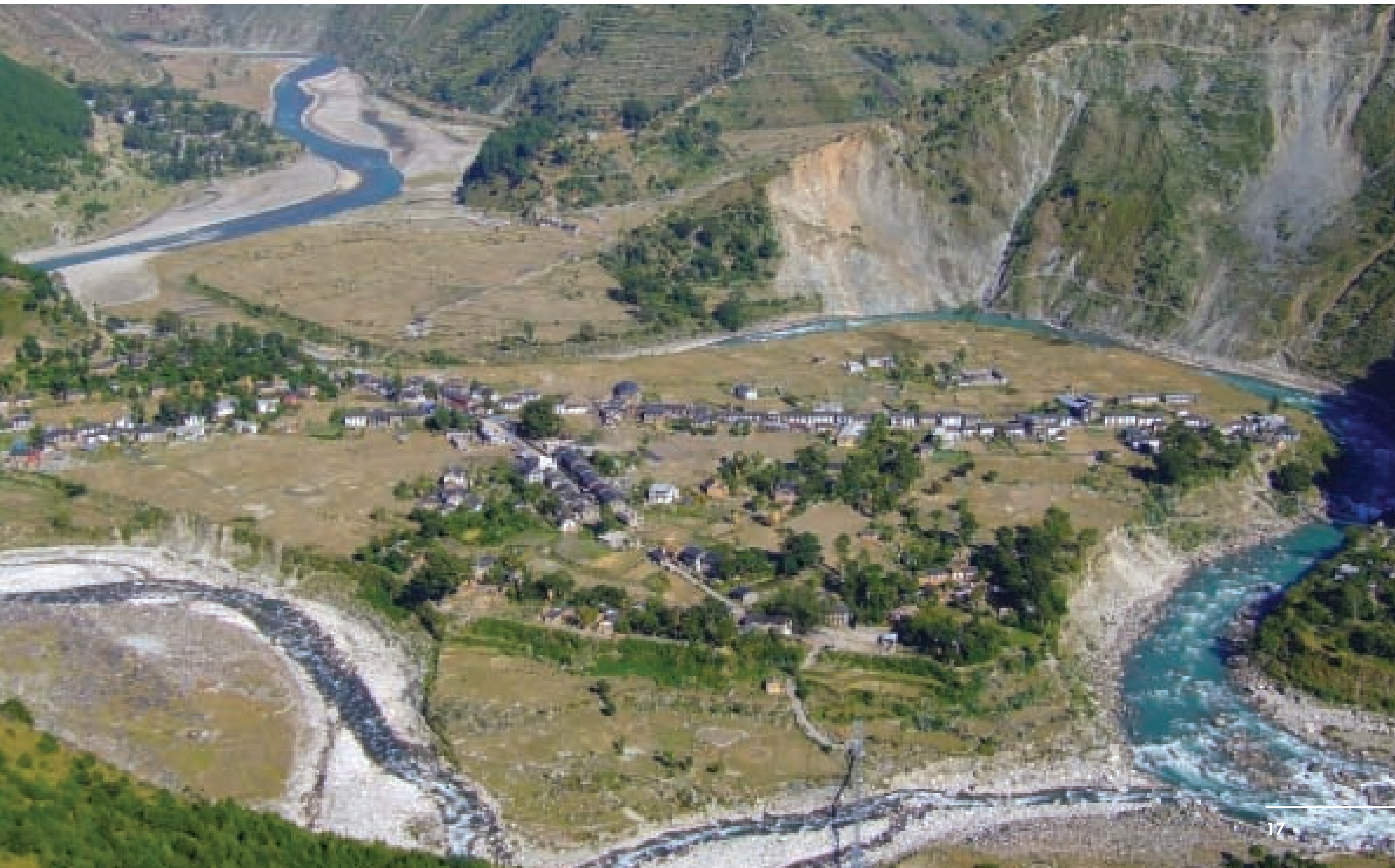
Mountains are often called the 'water towers' of the world as they provide a large part of the water used by humanity (Bandyopadhyay 1996). The rivers emanating from the Hindu Kush-Himalayas (HKH) in Asia carry a very large amount of water and sediment to areas from the east coast of China to the southwest coast of Pakistan and from the Indo-Gangetic plains in South Asia, to the Tarim basin in northwestern China, through river basins serving some1.3 billion people.

The monsoon is the dominating factor shaping the climate in Asia, thus the distribution of precipitation is very uneven over space and time and large parts of the continent are water-stressed for many months of the year. The upland catchments provide a crucial ecosystem service in moderating this imbalance by retaining the snow and ice in glaciers and high altitude wetlands and delaying the meltwater flows until the dry pre-monsoon months, thus providing much needed base flows to the rivers.

Vulnerable Chainpur, Nepal (see credits p 61)



The perception of the downstream majority is of the mountains as a dependable source of water supply for the plains. But the Himalayan waters are also the lifeblood of human settlements scattered in the mountains themselves, whose people rely on the annual snowfall and the water in small springs and streams for survival and economic activities.

Hydrological 'Black Boxes'

In spite of their tremendous importance as sources of freshwater for all other physiographic regions in basins, knowledge of the eco-hydrology of the mountain areas is much more limited, less reliable, and less precise than for the plains. The mountains are characterised by great climatic variability, with climatic conditions varying considerably within small spatial distances. Micro-climatic conditions vary extensively based on aspect, altitude, direction of moisture-bearing winds, hours of exposure to sunlight, and other factors, thus the WMO has recommended a much denser network of observatories for mountain areas to obtain representative hydro-meteorological data. The climatic diversity, compounded by other characteristics such as inaccessibility and structural fragility, has made the systematic collection of hydro-meteorological information

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with minimal spatial density very difficult, hazard-prone, and expensive. Thus, development of eco-hydrological knowledge about the waters of the mountains has been very slow, or in some cases non-existent. This gap in the scientific knowledge of the mountains has led to them being described as the "blackest of black boxes in the global hydrological cycle" (Bandyopadhyay et al. 1997:131).

The Hindu Kush-Himalayas represent a significant barrier to atmospheric circulation and exert a strong influence on the spatial distribution of precipitation over the continent. Mawsinram in the state of Meghalaya in North East India, receives a staggering average annual rainfall of about 11,600 mm; while parts of the Tibetan Plateau, across the crest line of the Himalayas, may get as little as 150 mm. The precipitation in the Hindu Kush and the western Himalayas is caused by the westerlies; they do not receive much of the summer monsoon precipitation. At higher altitudes, precipitation is in the form of snow and ice. According to some estimates, the flow in large monsoon-fed rivers in the east, such as the Yangtse, Brahmaputra, and Ganges carries only 18%, 12%, and 9% of glacier melt respectively. In comparison, the Indus in the Hindu Kush and western Himalayas carries about 50% glacier melt (Eriksson et al. 2009).

Although the water that emerges from the Himalayas is critical for meeting the needs of a very large population, scientific knowledge on it is not good. Information is further complicated by the practice, common in many parts of the region, of keeping river flow data confidential. The lack of data is a great obstacle to research on the eco-hydrology of the HKH rivers, and on subsequent policy analysis to guide their informed use. Suggestions for bridging the knowledge gap as quickly as possible have been made repeatedly by mountain scholars (Messerli 2009) but very little progress has been made.

Global warming, climate justice and the mountains

The impacts of global warming and climate change on the mountains of the world have been reported and predicted in the Fourth Assessment Report (AR4) of the IPCC (2007). The people of the Himalayas have very little responsibility for the historical accumulation of greenhouse gases (GHGs) in the atmosphere that is causing anthropogenic global warming. However, they are facing the enormous negative impact of such changes, which poses a challenge to climate justice at the global level. In addition, predictions of the impacts of global warming and related climate change are based on a series of modelling exercises that have inbuilt uncertainties. The stages of modelling that connect possible scenarios of GHG emission with those of precipitation and run-off need refining, especially for application in the mountains. There are very large gaps in the knowledge needed to link scientific uncertainties with the practical identification of risks and generation of adaptation strategies.

The case of the mountain regions for compensation and the provision of financial support for early adaptation measures should be part of the debate around global climate justice. The negative impacts the mountains are facing has not been voiced in a significant way, when compared to the highly visible global campaign in Kyoto and Bali by the group of small island states. As Posner and Sunstein (2009) have stressed, "Climate change raises difficult issues of justice, particularly with respect to the distribution of burdens and benefits among poor and wealthy nations". The case of the mountains, as some of the most vulnerable regions of the world, exemplifies such injustice.

This makes the case for drawing special attention to the mountains in COP 15 with respect to adaptation to the impacts of global warming and climate change. Unfortunately, as we approach COP 15 in Copenhagen with the prospect of moving towards a post-Kyoto international climate protocol, the marginality of the mountains in global negotiations is once again clearly visible. There is a case for another organised intervention on behalf of the mountains, as was made by the Mountain Agenda collectively in the drawing up of Agenda 21 for UNCED (Bandyopadhyay and Perveen 2004).

Global warming and the waters of the HKH

Within the levels of accuracy of available modelling tools, the IPCC (2007) has outlined the possible impacts of global warming and climate change on the HKH region. These indicate that warming will be quite significant for South Asia and the Tibetan Plateau. The rates of retreat of the glaciers of the Himalayas have also been linked to the rapid increase in human settlements, industrial and urban pollution, and deforestation near the glaciers. Eriksson et al. (2009) have summarised these predicted impacts and indicative scenarios. At the macro-level, accelerated retreat of the glaciers would alter the contribution of glacier melt and affect high altitude wetlands. This would change the base flow in the HKH rivers, first by increasing base flow over the next three or four decades, and subsequently, by reducing it to a new equilibrium level, much lower than at present. This will seriously affect the very large Asian irrigation systems in China and South Asia that depend on HKH waters. According to Stern (2007), the accelerated melting of glaciers would seriously affect about half a billion people in the Hindu Kush-Himalayan region and a quarter of a billion in China. A recent statement from the Asian Development Bank says that about 1.6 billion people would be affected by the impacts on the HKH.

Another vital aspect is the impact of climate change on the precipitation pattern within the mountains which affects the availability of drinking water in springs, irrigation from small streams, and the snow needed to renew soil moisture on farmlands. These are more significant for mountain communities than glacier recession. Drying up of springs, dehydration of soil, reduced flow of local streams, and lack of winter snowfall are increasingly affecting the region. It is here that the knowledge gaps in the eco-hydrology of the HKH region stand as a serious obstacle to predictions of future climate patterns. Not only is the climate-modelling inaccurate, the identification of risks is difficult and needed adaptation strategies unclear. The problems of global warming and climate change underscore the need for the HKH region to strengthen hydro-meteorological observations to the standards suggested by the WMO for mountain areas. With water at a premium, eco-hydrological data on the rivers of the HKH becomes knowledge that can create immediate economic possibilities.

Adaptation for the HKH: water as the main product of land

Mitigation of GHG emissions remains the first priority for industrialised countries. However, adaptation strategies are in the short- and long-term interest of the whole world. In the case of the HKH region, adaptation must go ahead with whatever little knowledge is available. The objective of adaptation will be two-fold. Firstly, the

Densely-wooded slopes support storage in Bhutan

evolution of measures for minimising water stress in the densely populated plains that depend on water supplies from the HKH rivers; secondly, measures for mountain communities to adapt to the changing climate and water endowment. For coastal countries, adaptation needs are more related to sea level rise and monsoon inundations. It will be important to ensure the mutual consistencies of the diverse adaptation measures suitable for the various Asian countries.

A considerable amount of thinking has gone into adaptation strategies for mountain communities. Notwithstanding the lack of data, efforts based on smaller parameters and sensitivity analyses can identify the adaptation processes in small, but effective, directions. At the macro level, the design of adaptation measures to protect the water towers of Asia offers some revolutionary options for reorienting land and water management. For centuries, land and water use has been decided first in the interests of local agri-pastoral economies, and then, in some parts, for the optimal

"Adaptation includes promoting water storage and conservation"

extraction of timber. The time may now have come to re-think land and water management in the HKH in terms of provisioning to the agri-industrial economies in the surrounding plains based on the principle of rewards and compensation for upstream environmental service providers. This should be the main adaptation strategy for addressing future water stress.

Adaptation includes promoting water storage and conservation. Land management offers a very cost-effective measure for this; but a robust payment system needs to be put in place for mountain land being used for the production and storage of water rather than wood, crops, and others. Areas in the HKH with heavy precipitation need to be covered with vegetation that maximises conservation and storage of water. This will require that water is accepted by all concerned as the main product of the land, and that the owners of land are willing to change their traditional management practices. New land use zoning dependent on the hydrological utility of the slopes for water conservation will have to be put in place. Payment for watershed services could provide the mechanism on the institutional front, (Aylward et al. 2006). A review compiled in 2002 identified 63 examples from around the world of the application of market-based approaches to the provisioning of watershed services (Landall-Mills and Porras 2002). This needs not only a revolutionary scientific and technological approach, but also a very informed and able political leadership to initiate the practice of the concept in smaller areas (to start with) with rich monsoon precipitation. Political vision, eco-hydrological wisdom, and diplomatic expertise of the highest order are required for such an innovative arrangement to be put in place.

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