Paper II.4

Climate Resilience and Adaptation in the Himalayan Region

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The Himalayan region features a great diversity of climates, hydrological and ecological systems, as well as a diversity of cultures and communities. Despite their variety, all of these natural and social systems depend on the region's glaciers, snowpack, rivers, soils, and monsoons. The Himalayan region is the source of Asia's nine largest rivers whose basins are home to 1.3 billion people.[i] Within the region, these rivers, including the Indus and Ganga in India, provide immense freshwater and hydroelectricity resources, and their mountain sources generate valuable tourism revenue and hold great spiritual value. Globally, as well, the Himalayas play an important role in atmospheric circulation, biological and cultural diversity, and in the global hydrological cycle.[ii] The Himalayan region emerged as a gap in the latest Intergovernmental Panel on Climate Change (IPCC) review of climate change science, and the impacts of accelerated glacier melt are already being felt.

1. Problem: Observed Climatic Changes and Drivers

Atmospheric warming of 1°C observed in the Himalayas over the past thirty years has led to a considerable reduction in glacier area. The IPCC reported in 2007 that glaciers in the Himalaya are receding faster than in any other part of the world.[iii] Kulkani et al. (2007)[iv] have found that 466 glaciers in Chenab, Parbati and Baspa basins have lost 21% of their area from 1962 to 2001/2004. Alongside the loss of glaciers, impacts on agriculture, pests, water resources, infrastructure, and health are also emerging. For example, erosion and increasing siltation of rivers have significant costs to downstream hydroelectricity generation and ecosystems. The length of the growing season (daily temperature greater than 10°C) has increased by close to fifteen days over the past thirty years.[v] Climate change impacts need not be all bad news, but farmers and agriculture policies will have to keep pace with dynamic conditions.

The causes of change in the Himalayan region include rising temperatures related to global climate change, the drivers of which are well known, as well as regional atmospheric brown clouds. Brown clouds are composed of ash, black carbon, acids, and aerosols emitted primarily through biomass burning (accountable for two-thirds) and fossil fuel combustion (one-third).[vi] Rainfall causes black precipitate to fall on the surface of glaciers, which absorbs more sunlight, and accelerates melting. Also, due to the effects of brown clouds on cloud formation and precipitation, monsoons have been weakening, with the number of days of rainfall decreasing, but the number of high intensity rainfall days increasing.[vii]

2. Projections

Continued glacial melt is expected to lead to increased river flow and floods over the next few decades, followed by reduced flows. Seasonal variation in runoff will likely be affected, causing water shortages during dry summer months. Based on anticipated temperature and precipitation changes, some perennial rivers could become seasonal drainages. Working Group II of the IPCC in 2007 has stated that "if current warming rates are maintained, glaciers located over Tibetan Plateau are likely to shrink at very rapid rates, from 500,000 km^2 in 1995 to 100,000 km^2 by the 2030s."[viii] Non-gradual consequences are also projected; in Sikkim, 14 lakes have been identified as potentially dangerous for outburst flooding by the Asia-Pacific Network for Global Change Research. Further impacts may include altered disease transmission risks, increased incidence of pests, losses of assets and infrastructure due to flooding and landslides, conflict over resources and migration.

Institutions responsible for science, planning, governance, delivery of public sector programmes and community empowerment need to prepare to adapt to impacts in sectors including:

a) Water supply, flood control, wastewater management, and sewerage
b) Industry, especially water-intensive industries
c) Agriculture, especially policies and programmes that relate to crop selection
d) Forest management for erosion mitigation and biodiversity conservation

3. India's Development Objectives for the Himalayan Region

Glacier and hydrologic changes compound existing challenges in the region, and solutions can build on efforts to address these 'baseline' problems. Among the challenges facing agricultural productivity, according to the 11th Five-year Plan, are erosion, flooding, deforestation, low seed replacement rates, poor communication infrastructure, soil acidity and toxicity, lack of electricity, and poor roads.[ix] India's 11th Plan, National Environment Policy, and National Action Plan on Climate Change (NAPCC) each recognize the importance of the Himalayan region and provide a starting point for adaptation. *How can they become channels for climate resilience?*

a) In the 11th Plan, river connectivity and tourism are promoted and low productivity is identified as a barrier to accelerating sustainable development.
b) Under the NEP, the National Committee to Assess the Impacts of Climate Change is evaluating impacts on key development sectors, identifying priority interventions, and monitoring implementation of interventions. NEP-suggested measures for conserving Himalayan ecosystems include improved land use planning, watershed management, reforestation, resilient infrastructure design and sustainable tourism.
c) The first version of the NAPCC's Mission Five: Sustaining the Himalayan Ecosystem emphasises the need to improve the science supporting understanding of the Himalayan system and suggests scientific collaboration and information exchange. The NAPCC supports empowering local communities to manage ecological resources, and building on measures in the NEP for conservation of mountain ecosystems.

4. Gaps: Science, Implementation and Financing

Three major gaps have been identified. First is the widespread absence of scientific evidence about glacier processes and limited knowledge of the human settlements within them. Second is a lack of capacity to take action based on scientific findings through anticipatory measures. Third is leveraging financing for adaptation that is efficient, consistent with the idea of "polluter pays," and that reaches all levels in need – community, state, national, and international.

5. Taking Action: Supporting Science and Applying Good Practices

Efforts to improve scientific knowledge in the region have been initiated by organizations such as the International Centre for Integrated Mountain Development (ICIMOD), the Institute for Social and Environmental Transition (ISET), and others, but the EU can help to scale up these efforts and strengthen the scientific foundations for climate resilience.

While experience with the use of climate change scenarios is limited, good practices are available. Within the Indo-German Cooperation, GTZ, on behalf of the German Ministry for Economic Cooperation (BMZ), is embarking on an initiative to support the safeguarding of rural development from climate change risks in four Indian states. The programme will be implemented by the Ministry of Environment and Forests. Good practices that this programme will employ involve:[x]

a) Assessment of vulnerabilities and the identification of risks to climate variability and change, over appropriate timescales, present and future.
b) Participatory identification of hard (infrastructure) and soft (incentives, regulations) options for reducing negative impacts or taking advantage of beneficial opportunities.

c) Design and implementation of measures to increase resilience, integrate resilience into ongoing programmes, and develop capacity to manage climate information, monitor, evaluate and adjust.
d) Development of sustainable financing models, such as insurance, use of adaptation funds, and integrating climate resilience into existing programme budgets.

What does adaptation look like on the ground? While adaptation is not prescriptive, some outcomes based on the good practices above would include:

a) An understanding of climate risks and adaptation, based on local priorities. A national level assessment is supported by the UNFCCC, but state and regional assessments are essential for taking action on the ground. In the Himalayan region, such an assessment might highlight impacts on and options for water, agriculture, extreme events, and particularly vulnerable communities and industries.
b) Calibration of water, agriculture, rural and urban development, natural resources, and disaster risk management initiatives to present and anticipated climate conditions. In the Himalayan region, this could include increased water storage capacity based on scenarios (e.g. through afforestation and infrastructure), support for climate-appropriate crops based on climate projections (e.g. through policy/financial incentives, etc.), or support for less climate-sensitive livelihoods, among others.
c) Tools, methods, and capacity in place to utilize climate information and recalibrate adaptation over time. For example, projected runoff data can be incorporated into models for hydropower generation or water supply to improve management of the resource and reduce costs in the long term (e.g. due to silt load damage to turbines or lost returns on capital investments due to reduced runoff). Demand scenarios should also account for climate change. Climate information, while imperfect, is an essential ingredient. Projected data may not always be available, but approaches are available to deal with observed data and uncertainty.

6. Adaptation Initiatives in the Region

A number of initiatives are underway, including the following selected examples.

a) ICIMOD has taken a leading role on the scientific aspects of glacial systems, including work to identify "potentially dangerous" lakes in the Hindu Kush-Himalayan region. ICIMOD also manages the *Too much too little water* project, assessing local adaptation strategies to climate-induced water stress and hazards in the greater Himalayan region, for which field studies are underway in Nepal, India, China and Pakistan.[xi]
b) ISET is involved in various activities including assessing the costs and benefits of proactive disaster risk management for vulnerable communities in Pakistan, India, and Nepal.[xii] They are also developing and documenting methods for community risk assessment and adaptation (funded by the ProVention Consortium), and implementing livelihood resilience pilots and research in regions vulnerable to extreme climatic variability and change (funded by IDRC).
c) WWF's *Himalayan Glaciers and Rivers Project* has field-based glacier monitoring and media outreach activities in Gangotri (Uttarakhand) and Chota Sigri (Himachal Pradesh).[xiii]
d) UNDP and the Bhutan Department of Geology and Mines are implementing activities to reduce the risks of glacial lake outburst flooding (GLOF) through the drainage of high risk glacial lakes and the installation of early warning systems in high-risk valley communities, activities prioritized in Bhutan's National Adaptation Programme of Action (NAPA).[xiv]

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[i] Tiempo Climate Newswatch, Climate Change and the Himalayan Glaciers. http://www.cru.uea.ac.uk/tiempo/newswatch/report070714.htm

[ii] Bandyopadhyay and Gyawali (1994): 'Himalayan Water Resources: Ecological and Political Aspects of Management,' in Mountain Research and Development, 14 (1): 1-24.

[iii] IPCC 2007, WG II, Chapter 10, p493.

[iv] Anil V. Kulkarni, I. M. Bahuguna, B. P. Rathore, S. K. Singh, S. S. Randhawa, R. K. Sood, Sunil Dhar (2007): 'Glacial retreat in Himalaya using Indian Remote Sensing satellite data,' in: Current Science, 92 (1): 69-74.

[v] Tiempo Climate Newswatch, Climate Change and the Himalayan Glaciers. http://www.cru.uea.ac.uk/tiempo/newswatch/report070714.htm

[vi] UNEP, 23 January 2009. See: http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=556&ArticleID=6046&l=en&t=long

[vii] UNEP, 13 November 2008. See: http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=550&ArticleID=5978&l=en

[viii] IPCC 2007, WGII Chapter 10, p 493, cites WWF 2005.

[ix] 11th Plan page 9, cites Report of the Working Group of Sub-Committee of National Development Council on Agriculture and Related Issues on Region/Crop Specific Productivity Analysis and Agro-Climatic Zones, Planning Commission, Government of India (February 2007).

[x] Additional adaptation guidance: UNDP Adaptation Policy Frameworks (APF): http://www.undp.org/climatechange/adapt/apf.html, USAID Adaptation Manual: http://www.usaid.gov/our_work/environment/climate/policies_prog/vulnerability.html, the UKCIP Adaptation Wizard: http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=147&Itemid=273, GTZ Climate Check: http://www.gtz.de/en/themen/umwelt-infrastruktur/24205.htm, and the World Bank ADAPT tool: http://sdwebx.worldbank.org/climateportal/home.cfm?Page=map

[xi] See: http://www.mountainforum.org/rs/ec/index.cfm?econfid=16. Funded by SIDA and others.

[xii] Partners include IIASA, ProVention Consortium, ISDR, and the Cooperative Programme on Water and Climate.

[xiii] See: http://www.wwfindia.org/about_wwf/what_we_do/cc_e/ccai/ccrp/ Birla Institute of Scientific Research, Jaipur and scientists from Jawaharlal Nehru University, and glaciologists from IRD, France are also involved.

[xiv] See: www.undp-adaptation.org/project/glof