MEETING REPORT

Impact of climate change in the rural landscape of Central Himalaya*

A workshop was held recently on the ethnic communities and their traditional knowledge system (TKS) regarding climate change adaptation, particularly in the rural landscape of Central Himalaya. It is well known that until recently, indigenous local knowledge (ILK) or TKS based on centuries-long natural experiments has helped local communities adapt and mitigate the impact of natural disasters, climate change and the sustainable management of natural resources to a large extent. The workshop offered a platform for sharing experiences regarding climate change and its impact in diverse sectors of the rural ecosystem, such as agriculture, livestock, forest and water resources, and how traditional communities inhabiting this region are adapting and building resilience to meet the challenges of climate change using their ILK/TKS.

The workshop had 90 participants comprising postgraduate and Ph.D. students from life sciences, agricultural sciences, earth sciences, social sciences and humanities, academicians/scientists, NGOs and other stakeholders with a deep understanding, knowledge and experience regarding the rural ecosystem and rural landscape management.

The first technical session dealt with applying TKS/ILK in relation to climate change adaptation in agriculture and covered other sectors relevant to the rural landscape.

R. K. Maikhuri (Department of Environmental Sciences, HNBGU), while welcoming the dignitaries and participants, highlighted the major issues, concerns and challenges of the rural landscape concerning climate change and its adverse impact on local livelihood, food, health and nutritional security. He mentioned that though the magnitude of erosion in traditional agrobiodiversity, health care system and eco-cultural zones, no system appeared immune to erosion in the local knowledge base. He emphasized that the significance of ILK/TLK is now being incorporated into development protocols. Only recently have many state governments in the region begun tapping into ILK/TLK to address some of the current concerns related to climate-induced changes in the rural landscape, particularly in the cropping pattern and for adapting to extreme weather conditions. Institutionalizing indigenous knowledge can be critical for inter-generational resource enrichment and transfer. Therefore, there is a need for an integrated approach to climate change monitoring/observations, vulnerability assessment and adaptation strategies based on the livelihood of the vulnerable sectors and communities.

Annapurna Nautiyal (HNBGU, Srinagar Garhwal) explained that in the Himalayan region, several local weather-adaptive practices have emerged in response to fluctuations in the weather for centuries, which the local communities have used with varying degrees of success. However, in Uttarakhand, for example, traditional knowledge and practices like maintaining genetic and species diversity in agriculture, including those of livestock, fragmented landholdings and different agroforestry practices and cultural networks may help local communities under abnormal weather conditions in a limited manner, as many of the traditional practices and institutions are eroding fast under the influence of modernity. She mentioned that the rural people of the region had developed several indigenous and traditional methods of farming to conserve crop diversity and which is deeply associated with cultural and spiritual values of the farming communities. They are not only the custodians but also managers of crop diversity and maintain dynamic processes of crop evolution and adaptation, the key elements of sustainable agricultural productions, Nautiyal added. The situation calls for a thorough understanding of the changing ground realities in the region, so that effective strategies can be formulated to respond to such real but unpredictable and unforeseen challenges.

R. C. Sundriyal (Department of Forestry and Natural Resources, HNBGU) highlighted the role of the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol (1997) in reducing the overall cost of meeting emissions targets and the Paris Agreement (2015–16), that strives to keep global temperature well below 2°C and ideally at 1.5°C. He also mentioned that at the national level, there is a National Action Plan on Climate Change (NAPCC 2008) that not only promotes an understanding of climate change, adaptation, mitigation, energy efficiency and natural resources conservation but also pursues economic and developmental objectives of the country along with fulfiling global commitments like greenhouse gases (GHGs) emissions. He added that India has set up the highly ambitious Intended Nationally Determined Contribution (INDC) targets that envisages reducing the country's emissions intensity of its GDP by 33–35% compared to 2005 levels by 2030, which is 75% higher than the target set earlier and highlighted that India is keen to opt environment friendly lifestyle, adopt a climate resilient technology and undertake a low carbon emissions conduit and intensity.

H. C. Nainwal (Department of Geology, HNBGU) highlighted that the Himalayan glaciers form a huge reservoir of water that sustains the lives of millions of people downstream in the Indian sub-continent. About 17% of the total area of the Indian Himalayan Region (IHR) is under permanent cover of ice and snow (~32,000 km^2). Over 9000 Himalayan glaciers form a unique reservoir storing about 1200 km^3 of freshwater. The melting of ice and snow forms new glacial lakes and increases the volume of the existing ones, which has increased the threat of glacial lake outburst floods. However, since continuous glacier recession is becoming a distinct possibility in the context of global warming, spatio-temporal monitoring of its mass and dynamics has become important. In the future, water scarcity due to changing snow and ice covers could seriously impact the livelihoods and economy of the people inhabited in the uplands and lowlands. In a wider context, the possible impact on the operational efficiency of downstream hydropower and irrigation projects would have to be proactively assessed, Nainwal added.

He further mentioned that the availability of large volumes of water, along great

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height differentials, offers tremendous potential for hydropower generation, but this has to be harnessed in the form of small run-off river projects instead of mega hydropower projects in the Himalayas, which pose many challenges. The small run-off the river projects are ecologically and economically viable and will provide a potential source of energy, minimize the traditional fuel dependency and help tackle the climate change impact.

Anoop Dobriyal (Department of Zoology, HNBGU) mentioned that in the face of climate change, most ecosystems will be by species composition, productivity and biodiversity changes. Therefore, the magnitude of the potential response of the climate-sensitive Himalayas needs to be better understood. He stated how climate change is impacting our biodiversity on the basis of personal experiences and research on fish diversity for the last 40 years. The species have been reduced from 70 to roughly 50 during the 40-yr period. Also, the catch has considerably reduced for common indigenous species. Dobriyal suggested various conservation measures for fishes and other aquatic life forms in the Upper Ganga Basin. He also emphasized that among the fish fauna unique to the Himalayan hotspot (IUCN 2004), the genus *Schizothorax* (common snow trout) represented by at least six endemic species were commonly found in the mountain lakes and streams and now facing the threat of extinction from the region.

The second technical session focused on traditional local knowledge and experiences of farmers/local people and scientific studies on rural and forest ecosystems. R. K. Maikhuri (Department of Environmental Sciences, HNBGU) mentioned that the most significant piece of evidence of climate change impact is the decrease in water resources used by livestock, particularly in alpine pastures, forests and grazing areas for 15–20 years, as experienced by the pastoralist community of high-altitude villages in Niti and Mana valleys, Chamoli district, and Chaudas, Drama and Byans valleys, Pithoragarh district, Uttarakhand. The gradual increase in temperature and consequent drying up of water bodies in alpine meadows has forced the local people to reduce the livestock population and switch to medicinal plant collection, particularly kerra jari (*Cordycepsis sinsensis*) from the alpine region. Transformation in different aspects of the farming system and a decline in productivity have been observed in most of the high-altitude villages due to the impact of climate variability, according to Maikhuri.

J. S. Chauhan (Department of Seed Science, HNBGU) mentioned that crop variability in the Central Himalayan region and in other gene centres results from an interaction between environment and culture. The environmental factor is the basis for natural adaptation to the many isolated and highly diverse agro-ecological zones in Central Himalaya. He stressed that at the local level, traditional agro-diversity loss threatens the sustenance of local communities, as biodiversity provides food, fibre, medicine and other products that ensure subsistence and income. However, many traditional crop varieties have been considered by scientists as climate-proof/climate-resilient crops. In most traditional communities, the care of seeds has been traditionally done by women, who develop a broad spectrum of well-adapted crop varieties. The vital role of women in selection and plant breeding in traditional systems has given them a position of influence, power and respect. However, the modernization of agriculture and growing emphasis on market-based transactions are responsible for the gradual loss of local knowledge systems, which need to be conserved and documented before they are completely lost from the region.

Vijay Kant Purohit (High Altitude Plant Physiology Research Center, HNBGU) mentioned that local inhabitants in almost all the elevations reported early flowering, leafing and fruiting (20–25 days before the timing of their phenophases) in medicinal plants (*Allium stracheyi*, *Berginia ligulata*) and wild edibles (*Rhododendron arboreum*, *Prunus cerasoides*, *Bombax cieba*, *Bauhinia variegata*). Flowering in *R. arboreun* has also been seen in January, while the normal flowering time is February–March. Change in flowering and fruiting time earlier than 15–20 days was also observed in *Myrica esculenta*, an important wild edible fruit that plays an important role in the seasonal livelihood in Champawat, Pithoragarh and Pauri districts of Uttarakhand. Similarly, there was a decline in the yield and availability of wild edible fruits (*Myrica esculenta*, *Juglans regia*, *Viburnum mullaha*, *Ficus* spp.) and vegetables (*Diplazium esculentum*, *Morchella esculenta*, *Paeonia emodi*, *Megacarpaea polyandra*). The increase in population density of invasive and colonizing species, like *Verbascum thapsus*, *Rumex nepalensis*, *Polygonum polystachyum*, *Convolvos arvensis* in the alpine ecosystem of Western Himalaya could be negatively impacting forest regeneration, taxonomic composition of forests and biodiversity.

C. M. Sharma (Department of Botany, HNBGU) explained that seasonal availability and quantity of nontimber forest products, fuelwood, fodder and green grass have been reduced, as observed in the recent past, which are known to be basic services for the functioning of the rural ecosystem to supplement the daily chores of locals. The availability of medicinal plants and wild edibles has declined due to overexploitation and is further accelerated by climatic variations resulting in habitat destruction, shift in species towards high altitudes and species extinction. The timberline ecotone has been reported to advance the higher altitudes with increasing global temperature. The Western Himalaya has recorded an upward shift of its timberline by 19 and 14 m over ten years on the south and north slopes respectively[1].

In his concluding remarks, Maikhuri mentioned that TKS and IKS play a crucial role in climate adaptation and coping strategies since they are directly linked to the local communities. For effective use of traditional knowledge, there is a need of blending of traditional knowledge with modern scientific knowledge so as to strengthen the communities' capacity in climate change adaptation and resilience building. It is therefore highly imperative to collect, compile and systematize the diverse range of indigenous knowledge with respect to climate change adaptation before it disappears. By accepting indigenous approaches, collaborating ethically and respectfully with these communities, require enabling policy environment in the field of climate change adaptation and mitigation.

1. Dubey, B., Yadav, R. R., Singh, J. and Chaturvedi, R., *Curr. Sci.*, 2003, **85**(8), 1135–1136.

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