

Long-term Monitoring using Transect and Landscape Approaches within the Hindu Kush-Himalayas

*Nakul Chettri, Eklabya Sharma and Rajesh Thapa

International Centre for Integrated Mountain Development
GPO Box 3226, Kathmandu, Nepal
Email: nchettri@icimod.org

Executive summary

The Hindu Kush-Himalayas (HKH), stretched over more than four million square kilometres, is one of the most significant regions in the world. The region is endowed with rich biodiversity, culture and freshwater resources that serve more than 200 million people living in the region and 1.3 billion people get its services living in the river basins. Therefore, the geographical coverage of the HKH is massive and diverse. Being signatory to the global conservation conventions, the regional member countries of the HKH have set aside considerable biodiversity rich areas into the different forms of protection. However, the prevailing global climate change scenario reveals that the HKH region is a 'white spot' with scattered and limited data. Considering the significance of the HKH at the local, regional and global levels, it is imperative to fill in the gaps of knowledge of this biodiversity rich area to meet the challenges arising from the consequences of climate change. However, to do so, some consorted efforts in representative area through partnership are necessary. ICIMOD conceptualized transect and transboundary approaches, and proposes the regional and global players to collaborate towards this effort in future. This deals on the rationale of 'transects' and 'transboundary landscapes' with an appeal to the regional member countries of the HKH and global actors to join hands in using this long-term monitoring concepts for filling data gaps. Such an effort will help on the effective conservation, in meeting the challenges of climate change and in enhancing the ecosystem services arising from this region.

Introduction

The HKH, the working area of the International Centre for Integrated Mountain Development (ICIMOD), is one of the most significant mountain regions in the world. Endowed with a rich variety of gene pools and species, and ecosystems of global importance, the region hosts parts of the four Global Biodiversity Hotspots: namely Himalaya, Indo-Burma, Mountains of South-West China, and Mountains of Central Asia (Mittermeier et al. 2004). The region, with its varied landscapes and soil formation, and diverse vegetation types and climatic conditions, is well known for its unique flora and fauna, and has a high level of endemism (Myers et al. 2000). Approximately 39% of the HKH is comprised of grassland, 20% forest, 15% shrub land, and 5% agricultural land. The remaining 21% other types of land cover such as barren land, rock outcrops, built-up areas, snow cover, and water bodies. Elevation zones across the HKH extend from tropical (<500m) to alpine ice-snow (>6000m), with a principal vertical vegetation regime comprised of tropical and subtropical rainforest, temperate broadleaf deciduous or mixed forest, and temperate coniferous forest, including high-altitude cold shrub or steppe and cold desert (Pei 1995; Guangwei 2002). Within this varied landscape, the cultural diversity is equally significant. The region has more than a thousand living languages with diverse ethnicity,

traditions and cultures (Turin 2005). In addition, the HKH region is also known as 'Water Tower of Asia'. The Himalayas alone have nearly 4000 sq.km of snow and ice, truly constituting a 'third pole' of the earth and a formidable global ecological buffer. This ecosystem provides services and directly forms the basis for livelihoods for a population of around 200 million people; indirectly, the river basins supply water and other ecosystem services to 1.3 billion people, a fifth of the world's population.

The geographic term 'Hindu Kush-Himalayas' is not very precise. Stretched over more than four million square kilometres, the HKH includes Bhutan and Nepal in their entirety and parts of six other countries: Afghanistan, Bangladesh, China, India, Myanmar, and Pakistan. In other words, ICIMOD's target area includes the Karakorum, the Pamir and other neighbouring ranges. Some of the analyses encompass impact areas that include the river basins of the ten major rivers originating in these ranges, namely Amu Darya, Indus, Ganges, Brahmaputra, Irrawaddy, Salween, Mekong, Yangtze, Yellow and Tarim. Therefore, the geographical coverage of the Hindu Kush Himalayas is massive and diverse.

All eight HKH regional member countries, being signatories to the Convention on Biological Diversity (CBD), are committed to conservation and, as a measure towards the immediate protection of globally significant landscapes, have set aside more than 39% of their most biologically rich land terrain with a total number of 488 protected areas (Chettri *et al.* 2008). In addition, the region also hosts 27 Ramsar sites, 13 UNESCO Heritage sites and 330 Important Bird Area (Birdlife International 2007; IUCN, UNEP, WCMC 2005). Therefore, it is apparent that the HKH region has a global significance in terms of conservation of biodiversity as well as sustainable development of the people living in the region.

Conservation and developmental challenges

Many factors contribute to the loss of biodiversity such as habitat loss and fragmentation, species introduction, overexploitation, pollution, nutrient loading and global climate change. The direct drivers of environmental change include climate change, change in land use/cover and species introduction/removal; while indirect drivers are demographic, economic and socio-political changes (MA 2005). In the HKH region, the impact of human on natural environments in terms of over extraction of resources, habitat degradation and species lost are growing everyday, being multiplied by increasing human population and their pressure on the biological resources (Chettri and Sharma 2006). Many of these pressures have influence on the biodiversity conservation and ecosystem services, and more often the impact is negative on people's well-being (Xu *et al.* 2007).

Global communities including conservationists are alarmed by the recent series of reports by the Intergovernmental Panel on Climate Change (IPCC) that reflects that the Earth's climate has become warmer and precipitation regimes substantially changed in the last 100 years (IPCC 2007). However, the prevailing climate change scenario in the HKH region is somewhat incomplete and scattered; and the IPCC report revealed that the region is a 'white spot' in terms of data and information (IPCC 2007). Some anecdotal evidences from the region are bringing alarming signals to the fate of Himalayan biodiversity and its services (Liu and Chen 2000; Shrestha *et al.* 2000). Though the global communities are trying to understand the biodiversity and climate change nexus, there is a huge information and research gap in the HKH region.

ICIMOD, an intergovernmental regional centre is serving as knowledge, learning and enabling centre for the past two and a half decades. It is a centre where information and knowledge are developed and exchanged, and where innovation, technology transfer, and effective communications are used to empower its regional member countries and their people. In the recent years, ICIMOD has been advocating biodiversity conservation and sustainable development through 'mountain perspective framework', characterised by understanding the imperatives of mountain conditions such as fragility, inaccessibility, marginality, diversity, specific niche opportunities and the human adaptation practices. ICIMOD has been also active in facilitating its regional member countries through various conservation and development approaches such as participatory natural resources management, regional cooperation in applied research on conservation and management with 'Ecosystem approach' considering transboundary landscapes including the crosscutting criteria of policy, governance, equity and gender, and mainstreaming information and knowledge management principles. This paper bring forward a concept of an integrated conservation and development approach through 'transects' and 'transboundary landscapes' approaches to rationalise the needs of filling up the data gaps reported by IPCC (2007) and enhance ecosystem services through consorted efforts from regional and global players.

Rationale for transect and landscape approaches

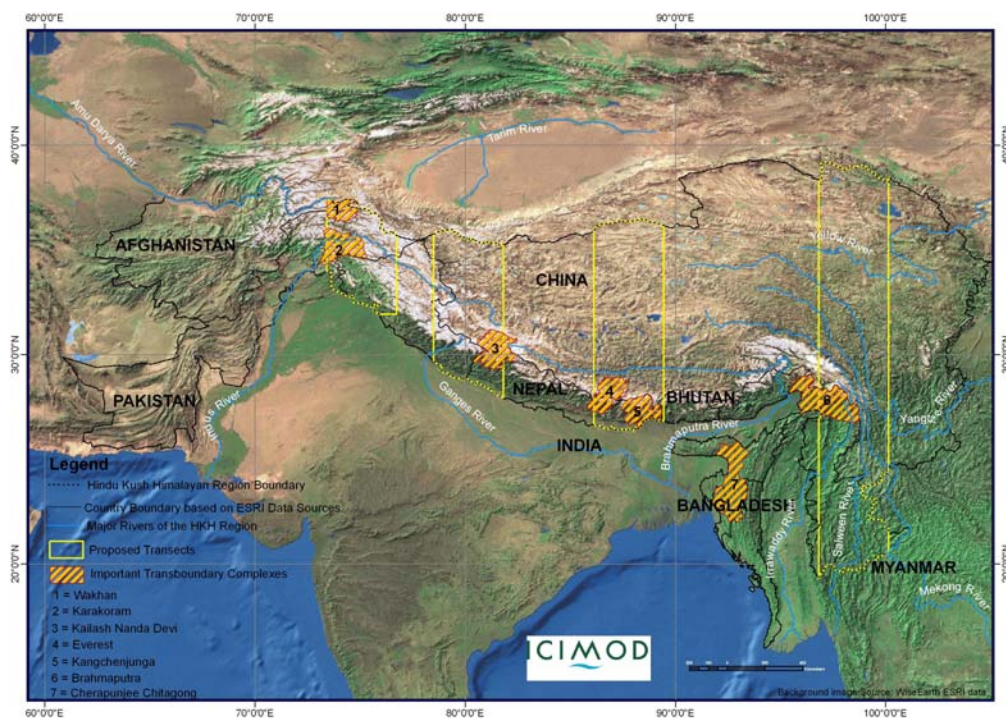
In the recent past, various conservation approaches and strategies have evolved to address the alarming global loss of biodiversity. The Himalayas were also in the spotlight in many conservation prioritisation approaches such as Crises Ecoregion, Endemic Bird Areas; Mega Diversity Countries and Global 200 Ecoregions (see Brooks et al. 2006). However, these approaches mainly focussed on identification of biodiversity rich area for establishment of protected areas assuming species distributions change relatively slowly, unless they are directly affected by human activities. With the recent evidences of global climate change, there is a growing consensus that these conservation strategies must anticipate the prevalent impacts of climate change to make conservation efforts more effective (Araujo and Rahbek 2006; IPCC 2007). Though, the consequences of biodiversity loss are often the strongest on the poor and marginalized people, who depend mostly on the immediate natural resources, there are ample global evidences to show that climate will modify their distributions and abundances; both in terms of altitudinal (Bakkenes et al. 2002; Grabherr et al. 1994; Parmesan 2006) and latitudinal gradients (Parmesan et al. 1999; Hickling et al. 2006). However, the interactions among global changes in itself and in relation to biodiversity, and their impacts on services to human beings are complex and poorly understood in the HKH region and elsewhere. This is mainly due to lack of comprehensiveness and holistic approach in conservation planning and lack of adequate data (Margules and Pressey 2000; Sarkar 2007).

The recent evidence suggests that co-occurring global changes can confound results from single factor studies and need interdisciplinary approach (Root et al. 2003). Thus, in the HKH region, there is an urgent need to untie these complexities and understand its practical implications through an innovative approach. However, this is not an easy task. Reasons are the massive geographical coverage with inaccessible terrain and diverse ecological conditions of the HKH region. These cause practical limitations for any comprehensive research by taking the whole area. In addition, due to the geo-political and socio-economic differences among the regional member countries, there are variations in the level of research capacities, consistencies in data quality and poor data sharing mechanism with irregular monitoring systems practiced by the regional member countries. Moreover, majority of the conservation

prioritisation approaches in the HKH region are focussed on altitudinal gradients, critical ecological zones and biodiversity rich areas mainly concentrating on east-west direction leaving out the fact that climate change aspect on biodiversity needs to consider the latitudinal dimensions as well i.e. south-north aspects. The latitudinal dimension has a special risk factor for highland species found in the arid and semi arid areas of Tibetan plateau, Hindu Kush, Karakoram and Pamir range that are sensitive to climate change and more likely to be at risk of extinction. Globally, there are many numerical evidences for the shift of species towards north latitude (Graberr et al. 1994; Hickling et al. 2006) or higher elevation (Peterson 2003; Wilson et al. 2007), especially for species in the transition zone between sub-alpine and alpine, which are more vulnerable to climate change as they have limited scopes to move further (Carpenter 2005). However, such analyses for the HKH region is few, limited to certain pockets of area.

ICIMOD has been instrumental in introducing the concept of 'transboundary landscapes' and 'conservation corridors' by identifying seven critical transboundary landscapes along the HKH region covering complexes from east to west, wet to dry and low to high altitude situations (Figure 1). ICIMOD along with partners such as The Mountain Institute (TMI), World Wildlife Fund for Nature (WWF) and International Union for Conservation of Nature (IUCN) have been developing comprehensive conservation and development strategies for a few of the complexes at the national and regional levels (see Choden et al. 2008; GoN/MFSC 2006; Sharma et al. 2007). However, these initiatives in some of the landscapes such as Everest and Kangchenjunga are focussing on biodiversity status and management aspects while not including the climate change and the latitudinal perspectives. With this realisation, ICIMOD proposes to include more transboundary landscape covering east-to-west and altitudes and the 'transect' approaches.

Figure 1. Map showing seven transboundary landscapes and four transects in the HKH region.



Transects, landscapes and their significance

Transect is defined as a strip line drawn for the purpose of systematic studies. ICIMOD proposes four north-south transects covering a total area of 1,378,199 sq km (40%) of the HKH region where significant representation of Global 200 ecoregion, protected areas, Important Bird Areas, Ramsar sites and World Heritage sites are present (Table 1, Figure 1). The four transects also covers six out of seven critical transboundary landscapes namely i) Wakhan, ii) Karakoram, iii) Kailash-Nanda Devi iv), Everest, v) Kangchenjunga, and vi) Brahmaputra (Figure 1) with substantial representation of cryosphere, wetlands and biodiversity. In addition, these transect also covers more than 100 potential GLOFs found in the Himalayas. The only one transboundary landscape that does not fall within the four transects is the 'Cherapunjee-Chitagong' landscape; and inclusion of this landscape helps in brining in elements that would be interesting in the context of climate change in the critical landscapes towards the down-streams and more of sub-tropical ecological zone. A combination of transboundary landscapes and transects in the monitoring bring in the following three attributes:

1. Includes most of the bio-physical and socio-cultural dimension pockets, altitudinal (foot-hills to alpine), latitudinal (north-south) and longitudinal (east-west) coverage, dry and wet situations and all major types of farming systems.
2. Includes, cryosphere covered areas, wetlands, potential GLOFs, and biodiversity rich areas.
3. Includes all the eight countries of the HKH providing opportunity for cooperation.

Table 1. Conservation significance of the proposed transects of the HKH region [* signifies information on area in sq km (number) and ** total ecoregions and (the Global 200 Ecoregions)]

Variables	Transect 1	Transect 2	Transect 3	Transect 4
Total area (km ²)	144978	239980	340155	653086
Ramsar sites*	36287 (4)	76345 (2)	17543 (2)	138455 (5)
Heritage sites*		630 (1)	1148 (1)	16984 (2)
Biodiversity Hotspots*	22044 (2)	98764 (1)	80592 (1)	375155 (3)
Ecoregions**	8 (3)	12 (3)	12 (4)	20 (8)
Important Bird Areas*	1959 (31)	2071 (19)	5217 (30)	8509 (29)
Protected areas (IUCN I-VI)*	13471 (52)	18983 (16)	143683 (25)	585561 (82)

ICIMOD's role

Being regional knowledge, learning and enabling centre and its strong partnership in the HKH, ICIMOD could take a lead role in coordinating the efforts from global partners and regional member countries in strengthening the monitoring systems on long-term basis. It could take the regional cooperation components in both transect and transboundary landscape approaches implementation. In partnership with strategic institutions from the north and the region the capacities of the institutions could be strengthened and global know-how could be customized. ICIMOD wishes to inventoried on the information and institutions already present in the proposed transects and landscapes, following which a strategy on cooperation for long-term monitoring will be developed.

References

- Araujo, M.B.; Rahbek, C. (2006) 'How does climate change affect biodiversity?' In *Science*, 313:1396-1397
- Bakkenes, M.; Alkemade, R.M.; Ihle, F.; Leemans, R.; Latour, J.B. (2002) 'Assessing effects of forecasted climate change on the diversity and distribution of European higher plants for 2050.' In *Global Change Biology*, 8:390–407
- Birdlife International (2007). Important Bird Area data provided by BirdLife International, taken from World Bird Database (accessed 19 June 2007)
- Brooks, T.M.; Mittermeier, R.A.; da Fonseca, G.A.B.; Gerlach, J.; Hoffmann, M.; Lamoreux, J.F.; Mittermeier, C.G.; Pilgrim, J.D.; Rodrigues, A.S.L. (2006) 'Global Biodiversity Conservation Priorities.' In *Science*, 313:58-61
- Carpenter, C. (2005) 'The environmental control of plant species density on a Himalayan elevation gradient'. In *Journal of Biogeography*, 32: 999–1018
- Chettri, N.; Sharma, E. (2006) 'Assessment of natural resources use patterns: A case study along a trekking corridor of Sikkim Himalaya.' In *Resources, Energy and Development*, 3(2): 21-34
- Chettri, N.; Shakya, B.; Thapa, R.; Sharma, E. (2008) 'Status of protected area system in the Hindu Kush Himalaya: an analysis of PA coverage.' In *International Journal of Biodiversity Science and Management*, 4(3): 164–178
- Choden, S.; Shakya, B.; Chettri, N. (2008). *Biological Corridor Strategic Plan (2008-2013) Toorsa Strict Nature Reserve – Jigme Dorji National Park Western Bhutan*, Nature Conservation Division, Department of Forest, Ministry of Agriculture, Thimpu, Bhutan
- GoN/MoFSC (2006) *Sacred Himalayan Landscape - Nepal Strategic Plan (2006-2016)* Broad Strategy Document. Kathmandu: Ministry of Forests and Soil Conservation, Government of Nepal
- Grabherr, G.; Gottfried, M.; Pauli, H. (1994) 'Climate effects on mountain plants' In *Nature*, 369: 448
- Guangwei, C. (2002) *Biodiversity in the Eastern Himalayas: Conservation through Dialogue. Summary reports of the workshops on Biodiversity Conservation in the Hindu Kush-Himalayan Ecoregion*. ICIMOD, Kathmandu, Nepal
- Hickling, R.; Roy, D.B.; Hill, J.K.; Fox, R.; Thomas, C.D. (2006) 'The distributions of a wide range of taxonomic groups are expanding polewards' In *Global Change Biology*, 12: 450-455
- IPCC (2007) *IPCC Summary for Policymakers: Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability*. IPCC WGII Fourth Assessment Report
- IUCN; UNEP; WCMC (2005) *World Database on Protected Areas (WDPA)*. CD ROM
- Liu, X.; Chen, B. (2000) 'Climatic warming in Tibetan plateau during recent decades' In *International Journal of Climatology*, 20:1729-1742
- MA (2005) *Millennium Ecosystem Assessment: Ecosystems and Human Well-Being: Synthesis*. Island Press, Washington

- Margules, C.R.; Pressey, R.L. (2000) 'Systematic Conservation Planning.' In *Nature*, 405: 243-253.
- Mittermeier, R.A.; Gils, P.R.; Hoffman M.; Pilgrim, J.; Brooks, T.; Mittermeier, C.G.; Lamoreaux, J.; da Fonseca G.A.B. (eds.) (2004) *Hotspots Revisited. Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions*. CEMEX. USA
- Myers, N.; Mittermeier, R.A.; Mittermeier, C.G.; da Foseca, G.A.B.; Kent, J. (2000) 'Biodiversity hotspots for conservation priorities.' In *Nature*, 403(24): 853-858
- Parmesan, C. (2006) 'Ecological and evolutionary responses to recent climate change'. In *Annual Reviews of Ecology, Evolution, and Systematic* 37:637–669
- Parmesan, C.; Ryrholm, N.; Stefanescu, C.; Hill, J.K.; Thomas, C.D.; Descimon, H.; Huntley, B.; Kaila, L.; Kullberg, J.; Tammaru, T.; Tennent, W.J.; Thomas J.A.; Warren, M. (1999) 'Poleward shifts in geographical ranges of butterfly species associated with regional warming.' In *Nature*, 399:579–583
- Pei, S. (1995) *Banking on Biodiversity. Report on the Regional Consultations on Biodiversity Assessment in the Hindu Kush-Himalaya*. Kathmandu: ICIMOD
- Peterson, A.T. (2003) 'Projected climate change effects on Rocky Mountain and Great Plains birds: generalities of biodiversity consequences'. In *Global Change Biology*, 9: 647-655
- Root, T.L.; Price, J.T.; Hall, K.R.; Schneider, S.H.; Rosenzweig, S.H.; Pounds, J.A. (2003) 'Fingerprints of global warming on wild animals and plants'. In *Nature*, 421: 57-60
- Sarkar, S. (2007) 'An open access database for Himalayan environmental management'. In *Himalayan Journal of Sciences*, 4(6):7-8
- Sharma, E.; Chettri, N.; Gurung, J.; Shakya, B. (2007) *Landscape approach in biodiversity conservation: A regional cooperation framework for implementation of the Convention on Biological Diversity in Kangchenjunga Landscape*. ICIMOD, Kathmandu, Nepal
- Shrestha, A.B.; Wake, C.P.; Dibb, J.E.; Mayewski, P.A. (2000) 'Precipitation fluctuations in the Nepal Himalaya and its vicinity and relationship with some large scale climatological parameters'. In *International Journal of Climatology*, 20:317-327
- Turin, M. (2005) 'Language endangerment and linguistic rights in the Himalayas: A case study from Nepal.' In *Mountain Research and Development*, 25 (1): 4–9
- Wilson, R.J.; Gutierrez, D.; Gutierrez, J.; Monserrat, V.J. (2007) 'An elevational shift in butterfly species richness and composition accompanying recent climate change'. In *Global Change Biology*, 13:1873-1887
- Xu, J.; Shrestha, A.B.; Vaidya, R.; Eriksson, M.; Hewitt, K. (2007) *The Melting Himalayas: Regional Challenges and Local Impacts of Climate Change on Mountain Ecosystems and Livelihood*. ICIMOD, Kathmandu, Nepal.