Biodiversity and Climate Change

in the Himalayas

ICIMOD

FOR MOUNTAINS AND PEOPLE

SUSTAINABLE MOUNTAIN DEVELOPMENT

NO. 55 SPRING 2009

BIODIVERSITY AND CLIMATE CHANGE

Biodiversity, Environmental Change and Regional Cooperation in the Hindu Kush-Himalayas

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Acknowledging the Contribution of Mountain Communities...

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Cover photo – Rhododendron in flower at 4500 masl with a snow-clad mountain backdrop in Yunnan, PR China, *Yi Shaoling*

Dear Friends of ICIMOD,

The present issue of our periodical Sustainable Mountain Development is devoted to two events in our institutional life: we celebrated 25 years of ICIMOD in December 2008 and as part of this we organised a regional conference with impressive regional and global participation on Mountain Biodiversity.

A 25th anniversary is often used to review what has been achieved over a quarter of a century. Having done this five years previously, we preferred to emphasise the new challenges emerging globally and regionally, and to look ahead and plan to fulfil the mandate handed to us a quarter of a century ago. We are convinced that climate change and its influence on biodiversity will have a significant impact not only on the lives of mountain people in the Himalayas but also on the role and perception of the Himalayas in the region and the world. Not only are the Himalayas a source of freshwater and provider of ecosystem services for close to one fifth of the world's population living in the downstream river basins; this massive barrier also has a direct influence on regional and global climate, which will become ever more apparent with the increasing change.

The awareness among the scientific community about the growing importance of the Himalayas needs to be made clear to decision makers and opinion leaders; thus we have to develop active communication and information policies among all stakeholders. For regional organisations it will be essential to have access to relevant information; to governments it must be made evident that the ecosystem services of the Himalayas are an important backbone of sustainable development; and to the global community we have to make it clear that what is happening in the Himalayas in terms of climate change, and the potential ecological, economic, and cultural consequences, is of serious concern to us all. Communication is essential to make all this possible. I am, therefore, happy to present you in this issue with the results of two events that took place during our anniversary year. The first is the development of a new brand look for ICIMOD, which provides a basis for the change in our communications approach. The second provides the theme for this issue.

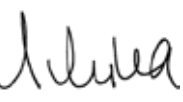
In November ICIMOD, together with global and regional partners, addressed one aspect of these issues by bringing together scientists and planners from across the region and around the world to an International Mountain Biodiversity Conference (IMBC), with pre-conference workshops on Mountain Transboundary Protected Areas and Linking Geodata with Biodiversity Information, and a post-conference workshop on Research Strategy on Global Change in Mountain Biosphere Reserves. Participants discussed ways to fill the gaps in our knowledge and tackle the conservation of biodiversity in the HKH, especially in the light of climate change and its associated impacts. These fora provided a venue in which experts and representatives of global programmes could discuss selected issues with representatives from the countries of the Himalayan region. During the conference and workshops, there were intensive discussions on how climate change is affecting mountain biodiversity, how biodiversity can best be managed for supplies of economic goods and ecosystem services from the mountains, and

how to achieve long-term continuity in mountain research programmes. What would a common future strategy for mountain biodiversity conservation look like and how would it work? The Himalayas are too big for any group to study the whole area. So how can we coordinate the diverse contributions and provide information relevant to the varied aspects of this mountain system?

Professor Bruno Messerli, together with the team at ICIMOD made a tangible proposal for the long-term preservation of Himalayan genetic heritage: to select four representative 'transects' or north-south 'corridors' at different locations from east to west across the HKH and encourage everyone to focus their efforts on these sites. This would increase the pertinence of coordinated, comparative, and collocated information and provide a basis for analysis, understanding and planning. The transect concept was enthusiastically received and both representatives of global programmes and regional experts agreed that by coordinating efforts all the information produced could be made available not only for regional decision making and planning but also for the worldwide study of climate change.

This workshop provides the theme for this issue of Sustainable Mountain Development: Biodiversity and Climate Change in the Himalayas. We are pleased to present here a series of short articles contributed by many of the same biodiversity, climate change, and conservation experts who made the journey to Kathmandu to present their scientific papers at the IMBC. We would like to thank them for taking the time to prepare these short articles for this newsletter so that their valuable knowledge can be disseminated to a wider audience.

Sincerely,



Andreas Schild,
March 2009

Biodiversity, Environmental Change and Regional Cooperation in the Hindu Kush-Himalayas

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It was exciting to be part of ICIMOD's 'International Mountain Biodiversity Conference' and to have a chance to exchange views with representatives from UN organisations, governments, global mountain programmes, universities, non-government organisations, development agencies, conservation specialists, and others, under the umbrella of biodiversity.

The discussions covered a wide range of topics on biodiversity, environmental change and regional cooperation in the Hindu Kush-Himalayas (HKH) and ranged from 'Land Use and Biodiversity' to 'Protected Areas and Transboundary Parks'. The whole world is living through a period of ongoing climate and environmental change and nowhere are the impacts more visible than here in the HKH. Natural and human driving forces are having impacts on biodiversity, ecosystems, and water resources in the mountains and, in the near future, they will, most probably have ramifications for the livelihoods and living standards of mountain communities as well.

The HKH is a huge mountain system. It contains all or parts of eight countries, 10 immense river systems, and about 200 million people in the mountains alone, and impacts on perhaps more than 1.3 billion people in the surrounding lowlands. What does biodiversity mean in such a vast context? The HKH extends from west to east over a distance of about 3,500 km, the variability – from arid mountains with less than 400 mm (0.4 m) of annual precipitation in the west to mountains with more than 10 m of rain the east (in Cherapunjee in the Meghalaya Hills) – is overwhelming and is superimposed upon by south north differences ranging from summer monsoon precipitation regimes to a boreal winter circulation regime over Tibet and the northern mountain chains. These dimensions have created a wide-ranging diversity of genetic resources and species' diversity. A whole kaleidoscope of mountain ecosystems emanating from this variability determines natural and cultural landscapes. But what does this all mean to us? It is only a brief description and without solid knowledge about climate and water as basic elements for soil formation and vegetation growth, for land use and land cover, and especially for biodiversity, we cannot begin to predict the potential impacts of climate change and extreme events. Much less do we have concrete answers in the context of mitigation and adaptation mechanisms.

> "We need basic and comparative data taken over a long period of time and in reliable series throughout this mountain system"

We need basic and comparable data taken over a long period of time and in reliable series throughout this mountain system, but these are lacking. In the light of such a dearth of data how can we begin to tackle biodiversity conservation and management in such an immense mountain range? At this point in time, there is an urgent need to address the lacunae in our knowledge about biodiversity and the so-called 'biodiversity hot spots' in order to preserve mountain resources for the benefit of highland and lowland people now and in the future.

A proposal for a regional-scale concept

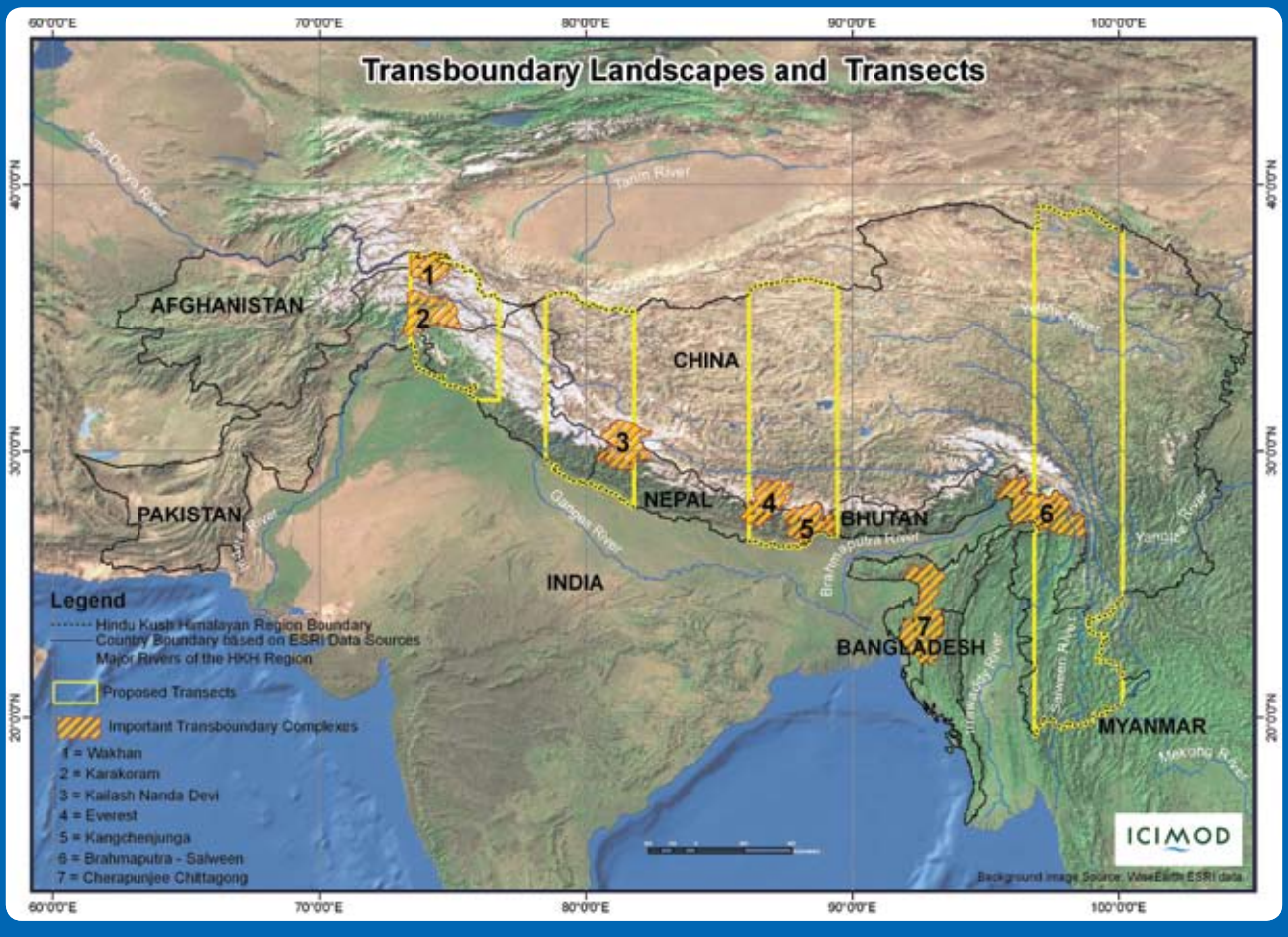
The map of the HKH in Figure 1 marks out several north-south transects from west to east. By selecting test sites from among them and focusing our research upon these, we could add an enormous amount to our current knowledge.

A team of professionals from ICIMOD have already begun to carry out some interesting research in selected places where valuable knowledge about the ecosystems and the environment can be found, e.g., in protected areas (International Union for the Conservation of Nature [IUCN] categories I – VI), in so-called biodiversity 'hot spots', in world heritage sites, in mountain biosphere reserves, in important bird areas, in Ramsar sites, and others. The map shown in Figure 1 is a first draft; it depicts four well-selected transects in colour; and, in addition, there are seven very interesting transboundary landscapes which are quite open towards the north. With the collaboration of Chinese researchers, northernmost test sites could be selected so that a comprehensive understanding and thorough documentation of the changes from the monsoon regime in the south to the climate in Tibet could be achieved.

At the test sites, thorough knowledge and long-term monitoring of every aspect of the different altitudinal belts are essential. To achieve such thoroughness, data about climate, water, biodiversity, and ecosystem services are essential. The knowledge gained will be invaluable for planning conservation and development strategies. It will also be invaluable for integrating these stations into the Global Climate Observing System (GCOS) network, so that the HKH region receives more attention than it has received in the past in climate change projections. Hopefully then the next report of the Intergovernmental Panel on Climate Change (IPCC) will be more attentive to the Himalayas. In the panel's 2007 report the Himalayas were barely mentioned.

Maps of Asia show the changes in temperature and precipitation from South Asia to the Polar Sea, but it is difficult to identify the great barrier of the Himalayas. The HKH region is often considered to be a 'white spot', meaning that the existing data are insufficient for climate modelling or for making any meaningful predictions about the future. The consequences are very clear: if the HKH countries do not improve their efforts towards transboundary cooperation, then they will miss out on integration into the

Figure 1: **Map of the Hindu Kush-Himalayan region – proposal for four north-south transects and seven transboundary landscapes from the arid mountains in the west to the humid mountains in the east (for an explanation see the text)**



global science community which is carrying out research into global and regional climate change.

In examining Figure 1, one obvious question is what can be done about the big gaps between different transects? Exhaustive coverage with field stations and field studies throughout the whole of the Hindu Kush-Himalayas is not possible at this point. Nevertheless, if well-equipped test sites are established and thorough research on them is carried out, remote-sensing methods and techniques can be used to apply what is learned at these test sites to the spaces in between, and the results can be calibrated with the knowledge gained about the test sites. This approach will need transboundary cooperation and the involvement of all the countries bordering the seven transboundary landscapes and four transects. In the case of the Wakhan, the countries involved are China, Afghanistan, Pakistan, and partially Tajikistan; for the Karakoram the countries are Pakistan and China; for Nanda Devi-Kailash the countries are India, China, and Nepal; for Everest the countries are Nepal and China; for Kangchenjunga the countries are Nepal, India, China, and Bhutan; for Brahmaputra-Salween the countries are India, China, and Myanmar and, for Cherrapunjee and Chittagong, the countries are India and Bangladesh.

A proposal for a local-scale concept

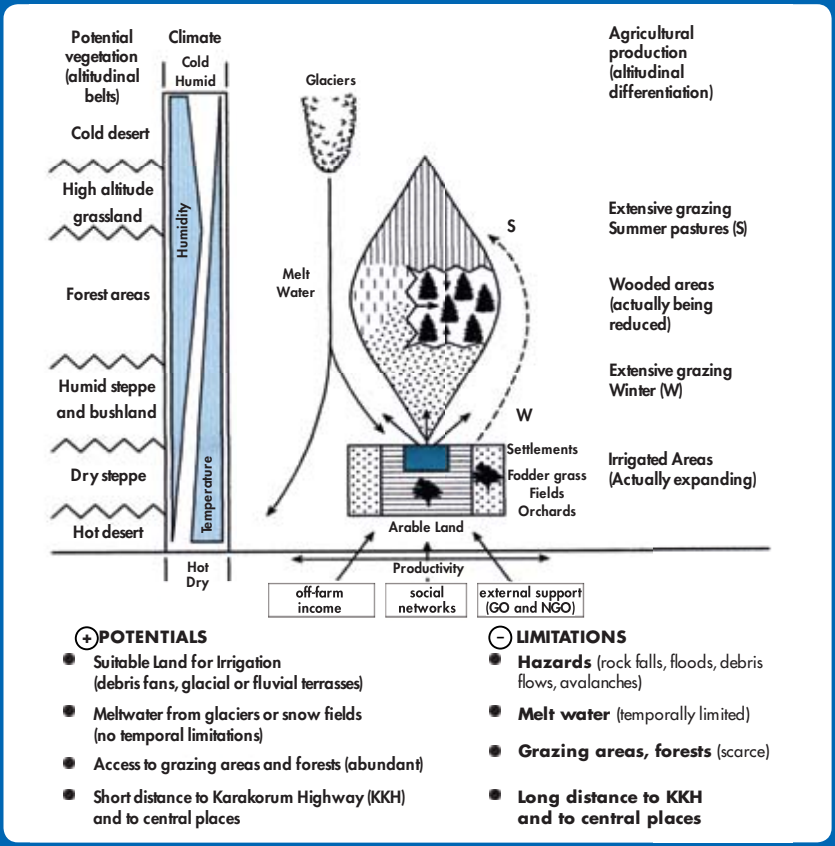
Global and regional climate change projections are very generalised, and it is difficult to downscale the results to the level of a valley or village, especially in mountain areas. We can assume, however, that there will be further increases in temperature and in extreme events. If we want to examine the impacts these changes will have on a certain place or village and its inhabitants, it will be essential to understand the relationship between the natural environment and the human system. One interesting example was developed for the village of Bagrot in the Karakoram in 2003 (see Figure 2). The researchers, Winiger and Börst, studied climate and hydrology, irrigated and non-irrigated land-use systems, and the altitudinal belts where summer and winter grazing took place. Summer grazing is limited at higher altitudes by increasing freezing conditions and at lower altitudes by increasing arid conditions. Based on the knowledge acquired, the potentials and limitations could be evaluated, and certain changes in the natural and human systems could be integrated and used for projection into the future, for example, what are the consequences of melting glaciers, shorter periods of snow cover, and changing precipitation and runoff; and what are the impacts on vegetation and biodiversity? These would make useful indicators and guidelines for test sites as this kind of information if brought from regional knowledge centres can be reflected on a local scale and then observations on a local scale can be transmitted back to regional institutions. This is extremely important in light of the big gaps between the different transects. Observations from local places outside a test site can be calibrated and advice given back to the local communities outside based on an analysis of these observations.

Global support to regional and local initiatives

GCOS is a common undertaking of the World Meteorological Organisation (WMO), the United Nations Educational, Scientific, and Cultural Organisation (UNESCO), the United Nations Environment Programme (UNEP), and the International Council for Science (ICSU). It has already commenced work and gauging stations have also been designated by the countries of the HKH region; and this is gratifying to note. Six countries have stations above 1,000 masl; China has a total of 33 stations of which 10 are above 1,000 masl (some above 3,000 masl); India has 21 stations with 4 above 1,000 masl (some above 2,000 masl); Myanmar has 3 stations but none above 1,000 masl; Nepal has one station at 1,000 masl; and Pakistan has 6 stations, 2 of which are above 1,000 masl. The precise locations are not given, but it can be assumed that several of these stations are planned for the HKH region.

In the agreement between GCOS, the World Meteorological Organisation (WMO), the Intergovernmental Oceanographic Commission of UNESCO (IOC), UNEP and the International Council for Science (ICSU), it was decided that the essential climate variables would be for the atmosphere: temperature, precipitation, air pressure, surface radiation budget, wind speed and direction, and water vapour. The composition of the air in terms of carbon dioxide, methane, ozone and aerosols will be measured. The terrestrial variables will include: river discharge, water use, ground water, lake levels, snow cover, glaciers, permafrost, land cover, fraction of absorbed photosynthetically active radiation, biomass, soil moisture, and fire disturbance. If all of these different variables could be measured, it would mean that a substantial amount of basic data on land use and biodiversity could become available, even across political borders. This would herald a new era in research for development in the HKH region. Realistically, however, this will be a long process.

Figure 2: **Conceptual analysis of the village of Bagrot in the Karakoram, Pakistan – Vertical arrangement of natural vegetation and agricultural productivity**



This basic knowledge is an important tool for observing and measuring future environmental changes (slow trends and extreme events) in order to understand and disentangle natural and human driving forces and to prepare the necessary adaptation measures in time. For further explanation see Winiger and Börst (2003).

Difficult political decisions have to be made, these stations will be very expensive, and their satisfactory functioning will depend on highly-qualified staff. Therefore, it is extremely important that, initially, the measuring programme introduced for developing countries is kept within realistic limits. By concentrating our focus, reliable and comparable climatic data can be derived from these mountain systems which are of utmost importance for their natural resources (especially water resources). Currently 13 countries have selected a coordinator and a certain amount of progress has been made in planning their national networks: China is one of these countries. To date 142 countries have nominated focal points, i.e., institutions or personalities responsible for cooperating with the global programme.

Of special interest is the planned cooperation between GCOS and the Global Earth Observation System of Systems (GEOSS) to intensify the continuous observation of the surface processes of the Earth. This could open up new possibilities for surveying the big open spaces between the transects and test sites: let us keep in mind that both programmes, GCOS and GEOSS, particularly emphasise the application of their results to weather, agriculture, water, energy, biodiversity, and climate change. Needless to say biodiversity is also included.

Interaction and cooperation in the HKH region is both a challenge and an opportunity. Interaction means participating in global and regional programmes (macro level) and undertaking the responsibility for downscaling observations and experiences to lower levels (meso and micro levels) to the greatest extent possible. On the other hand, the leading persons or institutions at the local level will be responsible for scaling up their observations and experiences to higher levels. Cooperation means the exchange of data and experts across borders, because mountains and their adjacent lowlands are units that cannot be separated. This is the way forward – a way that will help to avoid serious conflicts in future and to reap benefits of mutual collaboration.

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Climate Change in the Mountains – Who Wins and Who Loses?

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Species diversity per unit land area in mountains is often greater than in the lowlands. This is quite amazing considering the limited amount of land area they appear to cover. Topographic richness and steep elevational gradients are the key: climate zones are compressed across elevational gradients over short distances.

As one ascends, one passes through humid jungles in the foothills, and montane cloud forests and alpine heaths, eventually reaching the regions of permafrost and snow where a nival flora can be seen that at low elevation is usually found 8,000 km closer to the poles. The high degree of species richness is also a result of gravity-driven fragmentation of the land surface, yielding a high 'geo-diversity' or habitat diversity offering a multitude of ecological niches. Mountains are 'islands in the sky', but also islands of biodiversity.

Alpine plant diversity in Jigme Dorji National Park in Bhutan

Why conserve mountain biodiversity?

One ever valid foundation of biodiversity conservation is ethics: every species has a right to exist and flourish. This is an argument that receives broad public support and does not need a scientific justification. Human beings also create biodiversity by domesticating plants and animals, adding a 'cultural' element to biological richness. Genetic or species diversity also makes a lot of sense economically, because diverse crop and husbandry systems are less likely to run into complete failure. The state of a region's biodiversity is key to a number of ecosystem processes from which people are drawing benefits. Science is able to identify and quantify these benefits (e.g., certain ecosystem goods and processes).

Mountain biodiversity in a warmer world - where to go?

Mountain organisms were long thought to be seriously constrained by the influence of low temperatures. Today, the same experts are worried that climatic warming will threaten those high elevation biota. It is a paradox that an 'improvement' in conditions which were thought of as 'harsh' before, is suddenly considered dangerous.

This dilemma reflects a basic misconception of 'stress' in nature. A given assemblage of species is nature's response to the local environmental conditions, provided there has been sufficient time for evolutionary processes (selection) and migration to take place. What might seem harsh to the human observer is not harsh for those species that have been selected for the specific local life conditions. Thus, the real issue is that the ongoing and expected climatic changes are much faster than what evolution and migration are commonly able to track.

Mountain areas are an excellent laboratory for studying adaptation to changes in temperature because temperatures decrease rapidly as elevations rise. Mountains provide cool 'escape routes' for those species that cannot stand the 'heat', but species already inhabiting summit regions are in a very difficult situation, because they can go nowhere else. Those that move upslope into already occupied terrain face heavy competition, and the inhabitable land area gets more and more restricted as one ascends.

Finally, it is important to recall that habitat diversity in mountains also offers alternative thermal niches at often very short distances (just think of the micro-climatic

Gentiana sp. growing in a rugged alpine habitat in Sikkim

conditions in front of and behind a rock). Thus, there should be fewer 'hopeless' refugees in mountain areas than anywhere else. On the other hand, the spatial compression of climatic belts allows ongoing biological changes to be tracked more easily, the reason why mountains have been considered early warning systems for climatic change. However, notwithstanding the fact that many plants might adapt or migrate without too much trouble, the increasingly limited land area with elevation will threaten the survival of large territorial animals.

Winners and losers

When environmental conditions change, organismic populations either have to adapt, escape, or become extinct. Competitive exclusion favours species that compete successfully for basic resources such as light, water, space, prey, window of time, and so forth. Physiological limitations are not so much of an issue in the case of climate warming because most organisms can cope with a few degrees of extra heat. What is meant by 'adaptation' can in fact involve rather different processes: organisms can adapt either by acclimatisation or, in the case of animals, by changing their behaviour. Such adaptations differ from evolutionary adaptation which takes place over a very long period of time. Large populations with diverse habitats are more likely to host genotypes that can replace others if environmental conditions change. Over the expected short period it will take for the climate to warm significantly, many species will be unable to evolve new genotypes. Thus, local species that lack genotypic adjustment or acclimative potential will be replaced by species from elsewhere which will then assemble into new 'adapted' communities.

"Local species that lack genotypic adjustment or acclimative potential will be replaced by species from elsewhere"

Spatial fragmentation and diverse habitats commonly result in a high degree of genetic diversity among alpine organisms. Species accustomed to changing conditions from week to week and season to season may be more likely acclimatise to new conditions. When species cannot acclimatise or change their behaviour, and when no selections from the local gene pool match the new conditions, escape or decline are inevitable.

Likely losers	Likely winners
Large territorial animals	Small, highly mobile organisms
Late successional plant species	Ruderal species (species growing on wasteland, weeds)
Species with small, restricted populations	Widespread species with large populations
Species confined to summits or the plains	Mid-slope species

What may happen to organisms that cannot adapt rapidly enough? One example is the European edelweiss (*Leontopodium alpinum*): this charismatic species once populated the cold glacial steppes stretching from central Europe into central Asia (where its relatives still thrive at high elevation). When a 'sudden' arrival of interglacial warmth reached Western Europe the edelweiss took refuge in the colder environment of the nearby Alps and escaped extinction – it is now the flagship plant species of the Alps.

Which species will be lost if change takes place as rapidly as we fear? There is no simple answer, but a few general characteristics may serve as a guideline.

Looking at the possible combinations, small, mobile, widespread ruderals (species growing on wasteland, weeds, and so forth) are likely survivors, and large, slowly-reproducing organisms with small populations will risk extinction. Recent advances of plant species into higher elevations have indeed been observed for the group of 'weedy' plants that are favourably equipped to take advantage of the new situation. Nevertheless, some other plant species are so resilient and adaptive that they have hardly been affected by past climate changes over several thousand years (e.g., clonal plant taxa). Research has shown that some of these species haven't changed position by more than a few metres over the last millennium. There are still other species that overcome climate changes by utilising diverse mosaics of high-elevation micro-habitats. Given the natural inertia of most high-elevation plant species, a few degrees of warming might not bring about much change in alpine vegetation in the short term, but more pronounced warming might. Species respond individualistically, and the formation of new communities is more likely than the migration of communities as a whole. Initially, these movements may only be noticed by experts who are used to examining small changes. Unless some charismatic species are affected, the slow pace of change may escape public notice. Experts may become alarmed, but the public at large will remain insouciant, so there is a communication challenge.

Climate Change in the Himalayas: the Vulnerability of Biodiversity

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The Hindu Kush-Himalayan (HKH) range of mountain chains is astounding, not only from an aesthetic point of view but also in terms of the abundance of natural resources sheltered within the huge folds of rugged mountain valleys.

It is here that rare and endangered flora and fauna exist: global biodiversity hotspots. The HKH includes all or part of four Global Biodiversity Hotspots, 330 Important Bird Areas, two Mega-Diversity Countries (India and China), and 60 eco-regions of which 12 are Global 200 Eco-regions. A total of 488 protected areas cover 39% of the total area. The region directly provides essential ecosystem services to more than 200 million mountain people, and indirectly provides services to 1.3 billion people living downstream. The river basins are an important source of food and energy.

Anxiety about global climate change, the impacts it could have in mountain regions, the implications in terms of the vulnerability of mountain biodiversity, and the paucity of human adaptation mechanisms to cope with the prospective changes have brought mountain regions into the spotlight. This article discusses these issues as well as people's perceptions of climate change, its variability, and the vulnerability of mountain biodiversity to the change.

Mountain biodiversity in a global context

About 25% of the Global Biodiversity Hotspots and 40% of the Global 200 Eco-regions in the HKH region are part of protected area networks. The Indo-Burma Hotspot alone has 7,000 endemic plants and possesses 1.9% of the global endemic vertebrates. More than 7,000 species of plants, 175 species of mammals, and over 500 species of birds have been recorded in the Eastern Himalayas (Chettri et al. 2008). These statistics highlight the fact that the services provided by biodiversity in the HKH must be substantial; they are now threatened by the changing trends in climate, with similar implications for mountain ecosystems everywhere.

Climate change variability

The Fourth Assessment Report of the Inter-Governmental Panel on Climate Change (IPCC) concluded that changes in the atmosphere, oceans, glaciers and ice caps demonstrate that the planet is warming.The data available for the Eastern Himalayas show that there is a definite warming trend at higher altitudes and that areas at altitudes above 4,000m seem to be experiencing the greatest warming trend. The warming trend observed ranges from 0.01 to 0.06^{0}C/yr and the annual mean temperature is expected to increase by 2.9^{0}C by the middle of the century. The Eastern Himalayas are predicted to experience milder winters with increases in precipitation. While some observational data are available for the Eastern Himalayas (Figure 1), knowledge about climatic characteristics for the HKH region is limited by both paucity of observation and insufficient theoretical attention. In order to determine the degree and rate of climatic trends, long-term data sets are needed. ICIMOD is proposing to rectify this paucity of data by developing and implementing 'transects and landscapes' for long-term monitoring.

Local perceptions of climate change

People in the Eastern Himalayas perceive climate change as a threat. They believe it to be caused by excessive human extraction of and impacts on natural resources and, to a lesser extent, part of natural climatic variability. Most people from the region who responded to our research associated climate change with an increased risk of floods and landslides and an

increase in temperature, land degradation, drying up of water sources, outbreaks of pests, and food shortages. Respondents recollected personal experiences of changing climate conditions and were of the opinion that farmers would be the hardest hit. Many others reported phenological changes in trees (times of budding, flowering, leaf fall, and so forth) which they thought to be good indicators of climate change in the region (Table 1). Local communities are reported to be changing their cropping patterns.

The vulnerability of biodiversity

Biodiversity hotspots in the HKH are vulnerable to climate change because they are rich in endemic species with restricted distribution. Threats to biodiversity include the possible loss of genetic resources and species, possible loss of habitats, and, concomitantly, a decrease in ecosystem services.

Not all of the possible threats are to the natural environment. Human systems also could suffer. A recent study in the Eastern Himalayas found that its subsistence economy, dependent as it is on ecosystem services, would be challenged to adapt in the event of significant changes in climate. Agricultural practices would have to change and, although rangelands in high-altitude areas might benefit in some ways, alpine shrubs and meadows as well as the habitats of endangered, restricted range species and Trans-Himalayan migratory birds might come under threat. There would also be impacts on water and wetland resources (Table 1). Community vulnerabilities to stresses caused by water scarcity, food insecurity, water-borne diseases, glacial lake outburst floods, and flash floods would all be exacerbated by climate change. Fragmentation and loss of habitats threaten species' survival – high-altitude species found in the transition zone between sub-alpine and alpine and high-altitude wetland species will be vulnerable to climate change.

> "Biodiversity hotspots are vulnerable to climate change because they are rich in endemic species with restricted distribution"

People living in the Eastern Himalayas are likely to be less resilient to climate change because they are extremely poor. Population growth rates are high and infrastructure is weak. The main occupation is subsistence farming. Although there is hydropower potential, this potential could also be severely impacted by climate change. Empirical research is essential, but at the moment it is almost non-existent. Plans are being formulated to rectify the research situation, however.

Table 1: **Overview of climate change trends, peoples' perception, impacts, and vulnerable entities in the Eastern Himalayas**

Preliminary Results

Climatic Trends/Projections	Potential Impacts	Vulnerable Entities	Peoples' Perception
• There is increased magnitude of warming with elevation, with areas >4000m experiencing the highest warming • Observed warming is 0.01 to 0.06°C/yr • Annual mean temperature is expected to increase by 2.9°C by the middle of the century • The Hadley Centre regional climate model- HadRM2 gives projection of milder winter with enhanced precipitation	• Climate change impact in the Eastern Himalayas to be more pronounced than global average • Hydrological changes to impact functions and services of wetlands • Successional shift from wetlands to terrestrial ecosystem • Increased degradation of peat land, bog, swamp and marshland • Change in ecotone and microenvironmental endemism • Vertical species migration and extinction • Dominance of invasive and xeric species • Reduced productivity of alpine and cryospheric ecosystems • Reduced agrobiodiversity and their production, decline of genetic diversity	• Region's economy less resilient to current climatic variability • Stresses due to water scarcity, food security, water-borne diseases, GLOFs, and flash floods to increase communities vulnerability • Isolated protected areas with little or no habitat connectivity • Brahmaputra and Ganges river basin • Riverine islands, ephemeral and cloud forest ecosystems, Alpine shrubs and meadows • Agroecosystems in high altitudes of eastern Nepal, Sikkim, Bhutan, Arunachal Pradesh and TAR • High altitude rangelands • Endangered, restricted range species(endemic) and trans-Himalayan migratory birds	• Perceived as a consequence of diverse human activities causing pressure on resources • Associated in context to warming weather condition, hazards, outbreak of pests, food and water shortage • Adaptation towards change in cropping pattern • Better farmland productivity at high altitude, less at lowlands • Changes in phenology

Rhododendron dominated forest in the subalpine and alpine ecotone showing rhododendron (inset) as keystone species; Shangrila, PR China

Adaptation strategies

In the past, natural ecosystems adapted autonomously without much interference on the part of those who stood to benefit from their services. Traditionally, communities depending on these ecosystems and their resources have had informal institutions and customary regulations in place to ensure that external perturbations did not exceed natural resilience. In recent times climate and other global changes have accelerated to such an extent that the need for planned adaptation is now acute. At present the rate at which demographic and sociopolitical changes are taking place in response to global changes is outstripping the ability of traditional approaches and coping mechanisms to respond. Formal adaptation measures will have to supplement traditional approaches in order to address these new threats to biodiversity.

Recently, there has been a shift from contemporary conservation approaches to a new paradigm of landscape-level interconnectivity between protected area systems. This concept advocates a shift from the species-habitat focus to an inclusive focus – expanding the biogeographic range so that natural adjustments to climate change can proceed without being restrictive. The benefit of translating the concept into action, however, has yet to be realised.

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Mountain Biosphere Reserves – A People Centred Approach that also Links Global Knowledge

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UNESCO's Programme on Man and the Biosphere (MAB) has established biosphere reserves to combine biodiversity conservation with sustainable development at local and community levels. To date 531 biosphere reserves have been established in 105 countries. Each biosphere reserve provides a living laboratory for scientific studies of the ecosystem and interactions between humans and their environment. These will eventually help us understand the mechanics of global climate change.

Biosphere reserves – a people-centred model of sustainability

Economic development, social development, and environmental protection are the three mutually facilitating pillars of the MAB biosphere reserves. They together form the keystone of sustainable development. Biodiversity conservation is combined with local and community-based development in the reserves and these are reinforced by scientific studies on human-environment interactions and ecosystem studies.

Holistic economic and environmental management plans that protect natural resources also allow for sustainable economic activities for the local population. In this way there are fewer land-use conflicts, and sustainable land management practices can be determined jointly by local stakeholders, scientists, and government officials based upon scientific spatial analysis.

Mountain biodiversity around the world – a people-centred approach

Forty per cent of all biosphere reserves are in mountain areas. Spectacular scenery, the many rare and endangered plant and animal species, rich cultural diversity, and local handicrafts help to make mountain areas key destination sites for tourism. When local communities benefit from the income generated by tourists who respect the environment, biodiversity conservation and community livelihoods can be mutually reinforcing, resulting in win-win situations.

The following examples of biosphere reserves from around the world show that biodiversity conservation and sustainable development can work hand-in-hand to improve community livelihoods. All that is needed is a holistic, integrated approach and acknowledgement of the need for environmental conservation and community livelihoods.

> "Economic development, social development, and environmental protection are the mutually facilitating pillars of the MAB biosphere reserves"

Ecotourism activities in the Issyk-Kul Biosphere Reserve in Kyrgyzstan include demonstrations of eagle hunting as well as the production and marketing of felt carpets using traditional designs.

The Dana Biosphere Reserve in Jordan uses the slogan 'caring for nature, caring for people'. It uses an inter-related ecotourism approach and organic farming

Katunsky Biosphere Reserve landscape, Russia

schemes for the local population so that organic fruits and vegetables can be sold to upscale hotels in the capital.

The Bia Biosphere Reserve in Ghana has quite an original income-generating scheme. Three local villages have been granted licences to collect the African giant snail *(Acatina acatina)* which is found in abundance in the reserve. Some of the money collected is used to protect the area and the rest is returned to the villages for community-based projects (e.g., for water pumps or improving school buildings).

The Entlebuch Biosphere Reserve in Switzerland is home to 17,000 people; and they are engaged in promotion of 'Entlebuch Biosphere Products' such as cheese, ham, and spirits as well as cultivating natural resources and developing ecotourism. Local establishments use 'Entlebuch Biosphere' labels for high quality products.

The Mount Arrowsmith Biosphere Reserve, on the east coast of Vancouver Island in British Columbia (Canada), has introduced its own currency – the Oceanside Dollar. Tourists can buy them (at an exchange rate of 1 to 1 with the Canadian Dollar) to pay hotel bills and buy other items. The idea behind this scheme is that some tourists, if not all, will take the Oceanside Dollar home as a collector's item, adding to the net inflow of cash to the reserve.

For the long term – mountains as fragile indicators of change

The sensitivity of mountains to climate change and other changes taking place globally makes them ideal places for research into the impacts of such changes. Zonal vegetation belts vary with altitude and are likely to shift upwards with global warming, making them good indicators. Similarly, changing precipitation patterns will alter water runoff and water storage in the surrounding

"The sensitivity of mountains to climate change makes them ideal places for research into the impacts"

lowlands. The socioeconomic well-being of people in the mountains will also be affected as the climate changes.

No systematic studies of the impacts of global change on mountain environments have been carried out so far. This situation is changing and biosphere reserves are helping in this process. Recognition of the importance of mountain environments first came in 1992 at the United Nations Conference on Environment and Development in Rio de Janeiro. Mountains were identified as 'fragile ecosystems'. Important as this was, a coherent and coordinated approach to studying the principal mountain ranges of the world was still needed. Managers of mountain biosphere reserves and scientists came to a consensus about collaboration on global change issues in the mountains at the Perth Declaration in October 2005. That same year they promoted the Global Change in Mountain Regions (GLOCHAMORE) Research Strategy as a blueprint for research into the impacts of global change in the mountains: this was intended to guide managers of mountain biosphere reserves and scientists. The GLOCHAMORE Research Strategy facilitates the distribution of information through a harmonised methodology.

The UNESCO Man and the Biosphere (MAB) Programme contributed to the GLOCHAMORE Project by mobilising site managers of mountain biosphere reserves. Biosphere reserves have collected climate data and species' lists over the long term so that they can be monitored over time to analyse impacts on them from global warming. Moreover, people live and make a living in biosphere reserves; hence the repercussions of global warming on local mountain economies and standards of living can be assessed.

Participatory planning gives mutual learning opportunities

Looking ahead – understanding climate change by linking global knowledge

UNESCO-MAB is promoting a project on 'Global Climate Change in Mountain Sites (GLOCHAMOST) which will examine and work out adaptation strategies in biosphere reserves and put the GLOCHAMORE Research Strategy into practice. GLOCHAMOST will foster collaboration and communication in both industrialised and developing countries around the world as well as facilitating collaboration among researchers, managers of mountain biosphere reserves, and mountain communities affected by global change. Mountain scholars, scientists carrying out research into global change, and managers of mountain biosphere reserves will bring together the knowledge available and carry out research to improve the overall understanding of change in mountain regions. This way, GLOCHAMOST is poised to carry out research in mountain areas in the collaborative spirit of the Perth Declaration.

"More efforts are needed to increase the number of these reserves in the region"

The Nanda Devi Biosphere Reserve is the only UNESCO network biosphere reserve in the Hindu Kush-Himalayas; more efforts are needed to increase the number of these reserves in the region. There are many national efforts in line with the UNESCO Biosphere Reserve Programme in the region where the same principles, concepts, and management of biosphere reserves are followed, without the sites being nominated as UNESCO sites. For example, India has established many biosphere reserves on their own initiative. We expect more UNESCO Mountain Biosphere Reserve sites will be evident in the Hindu Kush-Himalayas in the near future.

Linking Traditional Ecological Knowledge Systems with Modern Approaches

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A combination of modern and traditional methods is often the best approach, to conserve and manage mountain biodiversity for the benefit of both mountain people and others in the plains below. Often development interventions have been alien to the value systems of local people – the traditional forest guardians – and hence have not met with much success. Traditional ecological knowledge is a tool that can link cultural diversity with biological diversity and thus make modern methods acceptable to local populations. In turn modern approaches will help bring about the needed changes by making use of knowledge from global sources.

The intangibles

Because mountain people live close to the natural resources that form the basis of their subsistence, they have a holistic view of 'nature and culture'. Their perspective is one that sees cultural and biological diversity as mutually supportive. The link between the two is traditional ecological knowledge. Intangible dimensions are expressed in music, dance, poetry, and religious rituals, and in artefacts such as sculpture, architecture, and so forth: they vary according to the local culture, each society identifying itself with a specific 'natural cultural landscape.' This is the driving force behind the relationship humans have with nature and the natural resources around them: their 'ecocultural landscape'.

Other dimensions are embedded in the concept of 'natural cultural landscapes' as they relate to biodiversity, for example, 'sacred groves' and 'sacred species'. The following are examples of 'living' ecocultural landscapes in the mountains of the world.

- The ancient rice terraces of the Ifugaos in the Philippines
- The Ziro Valley area of the Apatanis of Arunachal Pradesh, India, where traditional wet-rice cultivation is part of a community forest and includes the surrounding socio-ecological hill systems. A range of religious festivals and rituals link a number of ethnic groups in the area and contribute to their harmonious coexistence.
- The diffuse cultural landscape around the River Ganges, which covers an extensive area of hills and plains in India. Millions of people visit the religious heritage sites along the river and the myths and stories woven around this diffuse cultural landscape are a sacred heritage for millions of Hindus.
- The Himalayan land of Sikkim has many sacred landscapes and groves: Sikkim itself was known in ancient times as Beyul Demojong, the 'Hidden Fruitful Valley.'

Tangible values emerging from the 'intangibles'

Traditional ecological knowledge connects intangible values with the tangible benefits derived from them. But traditional knowledge alone is no longer sufficient; it needs to be integrated with formal knowledge and modern methods to bring about ecological conservation and sustainable development. The importance of formal knowledge cannot be underestimated: when it is linked with traditional knowledge appropriate 'hybrid' technologies and institutional arrangements can evolve.

Some classifications of the tangible dimensions of traditional ecological knowledge derived from the 'intangibles' are listed below.

- Economic: traditional ethnobiology (lesser-known plants and animals harvested from the wild and used for food and medicine)

Jhum landscape in North East India

- Socioecological: the ways in which traditional societies conserve and use biodiversity to manage soil fertility, nutrient cycling, and soil moisture regimes.
- Sociocultural: the cultural, spiritual, and religious belief systems of mountain people which are centred around 'sacred species', 'sacred groves', and 'sacred landscapes'.

Managing agrobiodiversity for food security

Agroforestry systems in forested landscapes can be grouped roughly along a gradient to provide a framework for discussion. At one extreme are the casually-managed systems such as shifting cultivation (northeastern Himalayan region). At the other extreme are the intensely managed cropping or plantation systems (e.g., mountain areas of the Western Ghats). All other systems fall between these two. Managing agroforestry systems at middle levels of intensity seems to be the most beneficial. In terms of agriculture, there are two alternative pathways: (a) improving traditional agriculture through incremental change and (b) a contour pathway where development models are adjusted to the ecological contours of the landscape. These pathways are explained in the following examples.

The incremental pathway

Casually-managed systems, such as shifting cultivation, can be developed using gradual inputs of traditional ecological knowledge with a minimum of formal knowledge. The redevelopment initiative known as the 'Nagaland Environmental Protection and Development' is a good example of this. An attempt at sustainable tree fallow management was made: selection of tree species was based on community perceptions, and socially-valued trees with ecological keystone value. This approach ensured community participation in fallow management and helped prevent land degradation. Over 35 ethnic groups living in Nagaland were involved, so it was essential to integrate traditional institutional arrangements with modern institution building through elective processes. The result was that the community participated to the fullest extent possible.

The contour pathway

The contour pathway emphasises adaptive management of agricultural systems through models suited to the given ecological contours. Some sedentary agroforestry and alley cropping systems fall into this category. More

Traditional transport system used by indigenous people of North-East India

inputs based on formal knowledge are used than in the incremental pathway, and traditional ecological knowledge supplements these as required. Sloping agricultural land technology (SALT), developed for mountain agriculture in the Philippines, is a case in point. Terraces are planted with annual and perennial crops between rows of nitrogen-fixing perennial shrubs. Initially rejected, SALT finally gained acceptance in the Himalayan region when socially-valued tree species were used for nitrogen fixation.

Modern agriculture

Modern agriculture stands apart as an artificial entity of monoculture plantations boosted by chemical fertilisers in a landscape devoid of much tree cover. Since this approach has proven detrimental to soil health, attempts are being made to restore tree cover by introducing organic residue. For example, the steps taken towards sustainable management of soil health through use of organic residue management resulted in a technology package on sustainable soil fertility management. The use of fertiliser consequently decreased by 30-50% in the tea gardens of the Western Ghats of southern India, resulting in increased productivity and improvement in the quality of tea.

Sustainable forestry in mountain landscapes

Concerns about sustainability have led to a movement towards community approaches to forest management. The integration of traditional ecological knowledge acceptable to the community has helped to reintroduce ecological keystone species that sustain soil fertility and nutrient cycling processes. This approach was further reinforced by designing cheap community-participatory water harvesting systems and/or through the revival of traditional water harvesting technologies where they existed. Traditional knowledge formed the basis for tree-based agroforestry management using early successional fast-growing species valued by the community and/or enabled a 'condensed forest succession' in the landscape. These efforts led to land restoration through a compatible mix of socially-valued, early-successional tree species along with late-successional species.

Acknowledging the Contribution of Mountain Communities – Investing in the Future

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The resources of biodiversity benefit people in numerous ways. They provide basic subsistence needs, such as traditional medicines, food crops, and non-timber forest products. Although this applies to people in general throughout the world, for mountain communities these resources are particularly important as contributions to their subsistence, their welfare, and to the improvement of their livelihoods.

Less evident benefits include a range of ecosystem services, such as clean water, slope stability, or the long-term disease resistance and food security provided by crop genetic diversity. There are benefits also that cannot be seen, benefits which are aesthetic and religious. Traditionally there is a wide variety of culturally significant resources; for example, rudraksh seeds, bodhi trees, lotus blossoms, and sacred groves. A diverse collection of flora and fauna, such as multipurpose trees and medicinal plants, plays an important role in mountain economies throughout the Hindu Kush-Himalayas (HKH). Many important food crops and other plant and livestock species have originated from within mountains landscapes. Landraces and wild relatives of many agricultural species and cultivars either have their origins in mountain areas or are conserved within them. There they are actively maintained and selected by mountain farmers using their traditional knowledge, adding to the richness of mountain and global biodiversity, especially in the HKH and other remote mountain areas where market penetration has been limited by the topography and heterogeneity of the landscape. Mountains are refuges on a grand scale for the conservation of genetic resources in situ, upon which advanced plant breeding and crop production rely, rendering their contribution to global food security invaluable. Closer to home, mountain communities rely on this rich biodiversity to maintain subsistence livelihoods and resilient farming systems under some of the most difficult conditions on earth.

Mountain communities benefit from the biodiversity and play an important role in maintaining and enhancing it. Maintenance of sacred groves and culturally significant plants; selection of useful species, varieties, and cultivars; and knowledge of crop traits are all among the resources protected by mountain communities. In many cases, mountain farmers are the stewards of regional agrobiodiversity and local genetic heritage, as well as the globally important genetic resources upon which our food security depends. This important role of mountain communities and mountain cultures in maintaining biodiversity has been recognised explicitly by the Convention on Biological Diversity (CBD) in its Mountain Biodiversity Programme of Work.

Payment for ecosystem services (PES)

The value of, and benefits from, ecosystem services are gaining increasing recognition locally, regionally, and globally. Several international and scientific forums, most notably the Convention on Biological Diversity (CBD), the UN Framework Convention on Climate Change (UNFCCC), and the Intergovernmental Panel on Climate Change (IPCC), recognise the global values of ecosystem services. Efforts are being made to identify mechanisms that will support and compensate, among others, mountain communities that maintain or improve upon these services. Various approaches, such as watershed management, biodiversity conservation in situ, or carbon sequestration, are being tried to support

Community forest in Sankhuwasabha, Nepal

the maintenance of ecosystem services through a variety of payment mechanisms generally referred to as 'payments for ecosystem services' (PES). To date, these have focused to a great extent on watershed services and water resources, the rationale given being in terms of upstream-downstream linkages. An example of these approaches is the Grain for Green (Green Hills, Clean Rivers) programme in China through which farmers have converted sloping agricultural land to tree or grass cover, for which they are provided with grain subsidies.

Carbon sinks and biodiversity

Climate change has brought the important role of carbon storage as a globally important ecosystem service into the limelight. Forests and trees are important components of the global carbon cycle, fixing and storing large quantities of carbon in vegetation and soils. Forests act as both sources of and sinks for atmospheric CO_2. They release carbon into the atmosphere when disturbed by natural or human impacts, and they absorb atmospheric CO_2 when vegetation and soil carbon accumulate after afforestation, reforestation, or natural re-vegetation. The global impact of deforestation, driven by agricultural expansion, is a major factor in ongoing global environmental change and contributes significantly to atmospheric greenhouse gas emissions and climate change. Land-use change and unsustainable land management accounts for approximately one-fifth of annual global greenhouse gas emissions: there has been a 40% increase in emissions from land use and land-use change since 1970. About one third of greenhouse gas emissions come from developing countries, with South and Southeast Asia being among the regions with the highest predicted rates of forest loss. Deforestation and ecosystem degradation likewise, contribute substantially to the loss of biodiversity, as well as to greenhouse gas emissions. Carbon finance mechanisms that conserve forests and promote sustainable land use could have a significant impact on biodiversity conservation within the HKH region; but only if the need to support both conservation and sustainable forest management is recognised.

Afforestation and reforestation projects could make substantial contributions to biodiversity conservation in the HKH. In particular, growing trees on farms in diverse agroforestry production systems could reduce pressure

on forest resources. The important aspects of biodiversity conservation in growing trees outside of forests should not be underestimated. Most people agree that forests and wildlife habitats should be conserved, but the growing demand for wood products places increasing pressure on remaining forests. Growing economies and burgeoning populations in South Asia will continue to drive the demand for forest resources. Growing trees on farms directly reduces pressure on forests, wildlife, and biodiversity, and carbon from the atmosphere is sequestered into wood and soils.

Reduced emissions from deforestation and degradation (REDD)

Maintaining the existing forests and promoting improved forest and land management to avoid emissions associated with deforestation and degradation of forests are key elements of any future international climate framework. The programme on 'Reduced Emissions from Deforestation and Forest Degradation' (REDD) has become a central component of the global climate protection regime currently being negotiated to replace the Kyoto Protocol which comes to an end in 2012. The possibility of significant amounts of funding becoming available under a post-Kyoto agreement to finance REDD has attracted the attention of policy makers and the public in the HKH region. Previous experiences have shown, however, that benefits for developing countries which have limited capacities to implement and participate in complex international agreements have been elusive. Significant inputs into capacity building at regional and national level will be required to ensure that the proposed implementation of REDD within the region contributes meaningfully to the goals of sustainable development, biodiversity conservation, and improved livelihoods for the poor. Creation of governance structures that address the needs of forest users and local communities, ensure that carbon benefits are distributed equitably, compensate livelihood losses, and promote sustainable development and environmental conservation goals is essential. Again, past experience has shown that neglecting the role and needs of local communities has led to failed resource management policies.

Developing a mechanism to conserve carbon within existing forests; that is, slowing down the rate of deforestation and degradation in the HKH, will not be easy. Mountain forests within the HKH region have unique and difficult conditions which will require carbon finance mechanisms appropriate for the environment. The diverse biophysical, socioeconomic, and institutional conditions pertaining in the mountains, particularly in the HKH, need to be recognised by the post-Kyoto international climate agreement. Likewise, any REDD agreement must also recognise and promote the conservation of the immensely important, and globally significant biodiversity found within the HKH region.

Tree planting in Nagaland, India

Changing Lifestyles of Mountain Communities – New Uses for Ancient Landscapes

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The patterns created by land cover and conversion of large areas of land for human uses define the spectacle of our planet from above. Changes in mountain ecosystems are perhaps not so easily detected, taking place as they do in the varied, rugged topographies of chains of peaks: peaks that are crowned with cascades of permanent snow and ice.

Climate change and human responses to over population, and decreasing fertility of agricultural land by expansion of subsistence production onto marginal lands, are, however, taking an inevitable toll on mountain ecosystems and biodiversity. This is especially true in the Hindu Kush-Himalayan region: a region that supports 1.3 billion people living in ten river basins. The water tower of the Himalayas is vulnerable not only to climatic but also to economic and sociopolitical impacts. The principal drivers behind changes on the ground are forest transition and rangeland degradation.

Land-use and land-cover changes in the Himalayas

Altitudinal gradients, latitudinal variation, and the local political economy determine land use in the Himalayas: over 80% of the population are either full- or part-time subsistence farmers who mainly grow grain. Knowledge about the interlinkages of land-use systems along elevational gradients, their relationship to social and ecological systems, and their connections to and impacts from changes taking place locally and in the environment at large, is vital to our understanding of the changes taking place. The picture is not the same across the Himalayas, there are differences between east and west. Large areas of forest have been lost in general, but less so in Southeast than in South Asia where agricultural crops have replaced forests. The map shows the land-use situation in the Himalayan highlands, and here the picture is different (Figure 1).

Rangeland degradation in the highlands

One aspect that is often neglected is that rangeland covers more than half of the land in the Himalayas. Climate change impacts and unsustainable management practices have now driven approximately ten million pastoralists in this area into poverty. Over the past 50 years, the minimum reported winter temperatures have increased and snowfall has decreased. The warming trend might have benefited vegetation growth in arid steppe and cold desert areas, but if it continues as predicted it will certainly not benefit the most productive

> "The principal drivers behind changes on the ground are forest transition and rangeland degradation"

highland grasslands where productivity depends largely upon precipitation. In recent times, many nomadic herders have converted to a sedentary lifestyle. Contrary to popular belief, restricted herd mobility and increasing livestock populations are linked to overgrazing and degradation. Cattle on the move could be more beneficial to rangelands than cattle in the stall. Herders themselves suffer from a sedentary lifestyle and are prone to diseases they previously did not encounter.

Forest transition in the uplands

Forests in the mountains are a treasure trove: they provide fodder, firewood, timber, and non-timber forest resources; and all of these are essential for survival among the highest mountains on earth. After decades of forest destruction, in the 1980s countries in the Himalayas engaged in afforestation through approaches such as joint forest management (India), forest user groups for community forest management (Nepal), forest tenure reform (China), and forestry and biodiversity conservation (Bhutan). In the middle hills of the Himalayas, protected areas were either established or extended, accompanied by tree plantation; in turn, these approaches facilitated natural regeneration. Governments reinforced the rights of the people to forest tenure and this, together with market incentives, meant that farmers planted more trees and managed more forestlands than ever before. The treeline appears to have shifted northwards to higher altitudes with climate change and along with it forest plant species and many vertebrates and invertebrates.

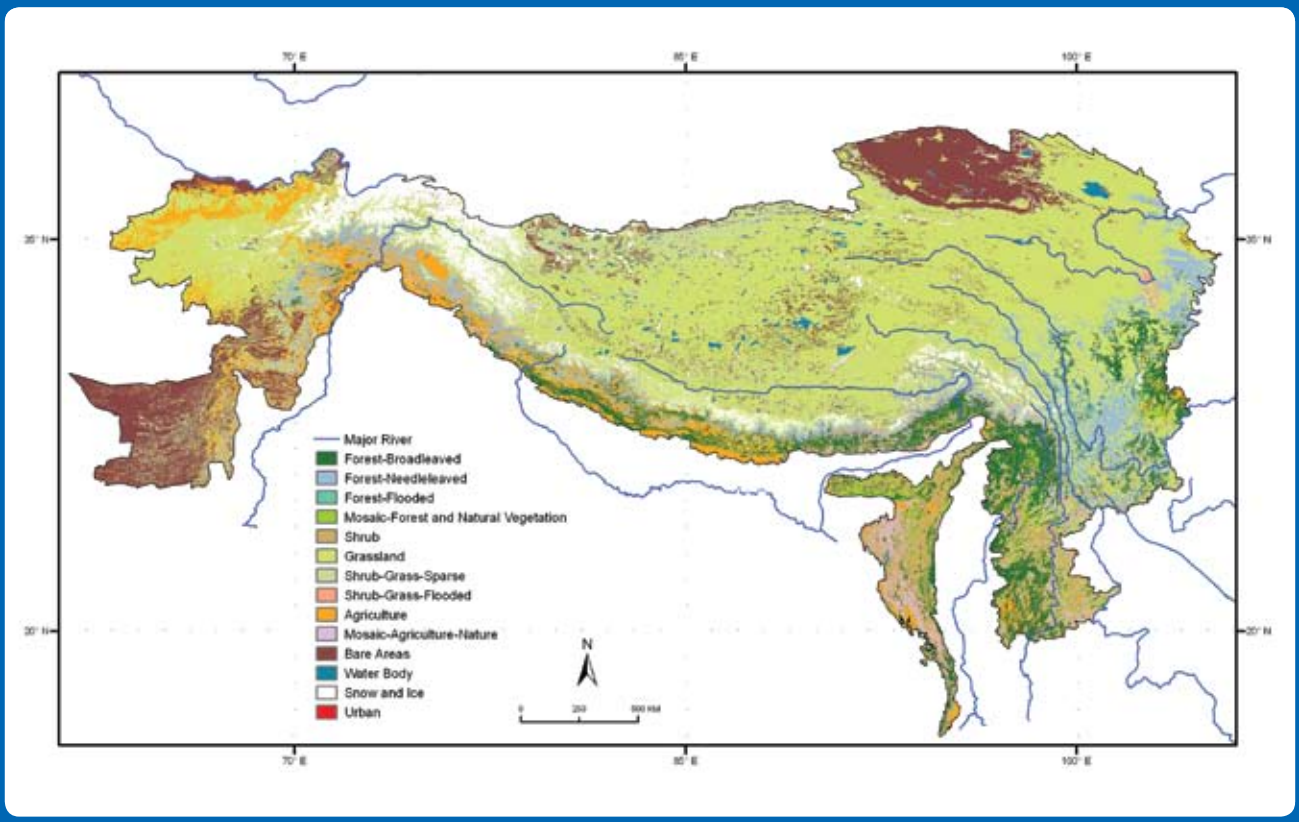
Agricultural intensification

Land has become scarce as a result of overpopulation and subsistence crops have been replaced by high-value products such as fruit, flowers, and vegetables. This trend dates back to the mid-1960s when smallholder farmers began to plant high-yielding varieties of rice and wheat. Agricultural intensification becomes untenable when appropriate changes in inputs or management don't take place concomitantly. Intensified crop production is vulnerable to markets, to changes in ecosystems, and to changes in government and development policies. Many traditional Himalayan farming systems, such as shifting cultivation, have been transformed into either monocultures of modern food or cash crops and much agrobiodiversity has been lost forever.

Deforestation and plantation in the tropics

Deforestation has occurred mostly in the tropical foothills. The most visible transformation is the creation of monoculture plantations producing rubber, tea, tropical fruits, and bananas. Poverty and the desire for profit are the two main drivers. Poverty is often associated with shifting cultivation, subsistence farming, land reclamation, and/or colonisation. Mountain farmers often have insecure land ownership and only quasi-open access to forest resources. Local user groups are not empowered. Market failures and market growth and commercialisation also contribute to poverty-driven deforestation. Large-scale

Figure 1: **Land-use and land-cover map of ICIMOD defined working areas in the Himalayas**



Use of modern technology in managing the landscape, Jhikhu Khola, Nepal

monoculture plantations as a pathway to modernity and poverty alleviation are subject to supply and demand mechanisms beyond local control, and when demand weakens poverty re-emerges.

Urbanisation

The built-up or paved-over areas are the urban forests of our world. In the Himalayas less than 0.1% of the land surface is urban. Nevertheless, urbanisation affects land change elsewhere through transformation of urban-rural linkages. As urban dwellers increase in number, the demand for mountain ecosystem services, such as fresh water and food, grows. The economic boom in China and India and the remittance economy in Pakistan and Nepal have accelerated urbanisation and rural-urban migration. Lifestyles and expectations change and the production-consumption relationships well understood by rural inhabitants are alien to their urban counterparts. They do not recognise the importance of Himalayan forests and grasslands in fulfilling their urban demands.

Payment for ecosystem services

Reliable flows of fresh water, productive soil, and carbon sequestration are important ecosystem services. Today, there is a growing trend to pay for ecosystem services: payment is either voluntary or mandated by policy and is related to carbon, water, and even biodiversity. One example in the Himalayas is the 'Grain for Green' programme in China where the government paid large amounts of compensation to upland farmers to plant trees on agricultural land in upper watersheds for conservation purposes.

Agroforestry landscape

Planting trees along with agricultural crops is an excellent strategy for fulfilling increased food demands and the need for biomass resources. By doing so agricultural landscapes can provide critical ecosystem services such as water, biodiversity, and carbon sequestration. Two trends seem almost universal in the Himalayas: the number of trees in forests is declining, and the number of trees on farms is increasing.

By and large, the changes that always seem so distant from the Himalayan region and out of synchronisation with its traditional lifestyles and agricultural systems are having an impact on the landscape. Conversely, the changing landscapes of the Himalayas are having impacts not only downstream in the region, but also on a much wider area beyond. Our changing lifestyles are altering not only the patterns of land cover, but also the rich mosaic of biodiversity in the Hindu Kush-Himalayas.

Changing Water Regimes and Biodiversity in High-Altitude Wetlands

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For the 250 million people living on the valley floors and plateau areas of the Himalayas, wetlands are central to their livelihoods. Lakes, floodplains, and peat lands support agriculture and industry in these areas. Rice cultivation, grazing, fish farming, collecting fuel and building materials, and tourism, together with local spiritual and religious activities are vital to the region's poorest communities.

The one and a half billion people in lowland regions depend on services provided by high-altitude wetlands. The wetlands maintain water quality, regulate water flow (floods and droughts), and, in the case of high-altitude peat lands, regulate the global climate (storage of greenhouse gases in peat). They also support both regional and global biodiversity. Many species depend on the wetlands for their survival; in particular the migratory species for which the wetlands provide important stopping points for refueling and rest en route.

Wetlands in the Himalayan region are rapidly becoming degraded: in some areas as many as 30% of the lakes and marshes have disappeared because of overexploitation of wetland resources and climate change during the past few decades. The consequent loss of ecosystem services and biodiversity is hampering sustainable development. Many species dependent on the wetlands are in decline and there is a rise in the number of issues related to degraded wetland services: diminishing drinking water supplies, loss of local livelihoods related to wetland produce, and increased flooding downstream.

The close correlation between poverty and wetland degradation commences when wetlands are not accounted for in development planning. Poor planning leads to the degradation of wetland services and increases the vulnerability of local livelihoods. Unsustainable practices lead to an increase in siltation and lakes cease to regulate hydrological regimes properly. Increasing populations and economic development also pose distinct challenges to the maintenance of wetlands, ecological characteristics, and livelihoods.

Wetlands are part of the water cycle. Sustainably managed, their services are important tools for water management. Integrated water resource management

"Wetlands in the Himalayan region are rapidly becoming degraded: in some areas as many as 30% of the lakes and marshes have disappeared"

is the key to balancing the competing uses and exploitation of wetlands and to ensuring that wetland services and values are considered when constructing infrastructure and regulating rivers. Within the region, however, the capacity for assessing how intersectoral linkages can be integrated into water resource planning and management is poor, and this is limiting the harmonisation of these sectors. Another limitation is the poor understanding of the relationship between high-altitude wetlands and basin hydrology. Until recently, high-altitude peat lands were regarded as grazing lands

High altitude wetland in Shangrila, PR China

without much realisation of their role in water regulation. Recent work shows that wetlands are, in fact, peat systems that store and release water; and, since they are located at the head of some of the region's major rivers, they play an important role in river regulation.

Wetlands International's role in supporting biodiversity conservation and regional cooperation

Wetlands International works at all levels from global to local to achieve the conservation and wise use of wetlands as a contribution to sustainable development. Its mission is "to sustain and restore wetlands, their resources, and biodiversity for future generations". Wetlands International is working in partnership with ICIMOD and WWF and other local NGOs to support governments in the region to establish the 'Himalayan Initiative' within the framework of regional cooperation under the Ramsar Convention on Wetlands. The initiative is aimed at establishing a regional forum for integrated wetland conservation and wise use, and at providing a basis for regional cooperation. This cooperation has led to the development of a regional strategy for conservation of wetlands and is the driving force behind development of the capacity-building framework, tools for wetlands, and the wetland information system.

In the HKH region there is limited experience in planning for management of wetlands or of integrating it into wider development planning measures. Management plans based on extensive inventory collection and assessment are needed, but these should also involve stakeholders, particularly local communities, and integration of the traditional local knowledge base. At the same time, restoration measures to rehabilitate and re-establish lost wetlands or lost wetland services need to be carried out. An example of measures being undertaken is the innovative approach promoted by Wetlands International for local-level restoration of peat lands on the Tibetan plateau. This work has been carried out with local materials and communities to block gullies and drainage ditches as a means of preserving rangelands and biodiversity. In India, Wetlands International has developed integrated management plans for the restoration of Wular Lake Rudrasagar Lake, and Loktak Lake.

The Central Asian Flyway experiences many issues in relation to threats to wetlands and their biodiversity, including threats to migratory water birds. International collaboration to address this and to work towards maintaining interconnected and healthy wetlands in the flyway is currently poor, and this undermines the effectiveness of conservation efforts undertaken by individual countries and stakeholders. The region will need technical and strategic support for the conservation and sustainable use of wetlands and their biodiversity resources, including migratory water birds. Wetlands International has been at the forefront in providing this much-needed expertise: furthermore, as a leading member of the Task Force on avian Influenza and Wild Birds, it will coordinate the activities on avian influenza for the region.

> "In the HKH region there is limited experience in planning for management of wetlands or of integrating it into wider development planning measures."

Scientists and experts on climate change are still debating exactly how climate change will impact Himalayan wetlands; however, since climate change cuts across all aspects of ecosystem services and biodiversity, wetlands will not be immune to it. Wetlands International is now focusing on how to improve wetland resilience to climate change as a means to both biodiversity conservation and to safeguarding the wetland services that are important assets for the resilience of local people's subsistence systems, health, and safety.

Effective use and management of wetland in promoting ecotourism, Shangrila, PRChina

Managing Landscapes Using Conservation Corridors

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Fragmentation of habitats threatens species' survival and causes loss of biological diversity. Spatial configuration of habitats plays a crucial role in conservation of biodiversity. A good patch connected to neighbouring patches by corridors and stepping stones lowers the risk of extinction among its populations.

Hence, fragmentation could be the greatest challenge to conservation of biodiversity. In heavily fragmented landscapes, species' survival is only likely within a network of patches that are sufficiently connected (Bennett 2003). Conservation biology has demonstrated the necessity of protecting large areas of habitat and maintaining connectivity between natural habitats and across altitudinal gradients, especially in the prevailing conditions brought about by climate change. Connectivity is especially important for wide-ranging and migratory species – such as elephants, large herbivores, and migratory birds – and for the large carnivores at the top of the food chain. Connectivity is also a recognised human response to fragmentation. Historically, whole human populations have migrated across thousands of miles when conditions became unfavourable. Currently, climate change makes it essential to maintain the flow and movement of organisms across the landscape in order to maintain the valuable biodiversity resources of the planet (Williams et al. 2005).

Research into climate change demonstrates how a substantial amount of carbon released into the environment comes from carbon stored in the forests which escapes as a result of deforestation, changes in land use, and soil disturbance. Strengthening vast wildernesses by connecting natural habitats can be useful in a number of ways: it can help store carbon, enhance ecosystem resilience and services, and facilitate conservation of threatened species. Maintaining connectivity between natural habitats and along altitudinal gradients in mountain regions, therefore, is an important strategy in promoting the adaptation of plant and animal species to climate change.

Box 1: **What is connectivity?**

The concept of connectivity has a structural component which is related to the spatial arrangement of habitats or other elements in the landscape; and it has a functional (or behavioural) component that relates to the behavioural responses of individuals, species, or ecological processes to the physical structure of the landscape.

The four types of connectivity are:

1. Landscape connectivity (a human view of the connectedness of patterns of vegetation cover for a landscape);
2. Habitat connectivity (the connectedness between patches of habitat suitable for a particular species, e.g., through a conservation corridor);
3. Ecological connectivity (the connectedness of ecological processes across many scales, including processes relating to trophic relationships, disturbance processes, and hydroecological flows); and
4. Evolutionary process connectivity (referring to the natural evolutionary processes, including genetic differentiation and evolutionary diversification of populations, which need suitable habitats on a large scale and connectivity to permit gene flow and range expansion. Ultimately, evolutionary processes require the movement of species over long distances).

Landscapes and conservation corridors: an evolving concept

Biodiversity conservation and concomitant promotion of sustainable development is an important challenge for conservation and development communities. Biodiversity conservation requires a comprehensive approach that makes use of both reserve and non-reserve areas. Whole communities often depend for their livelihoods on areas that are deemed 'protected', and these areas cannot exist in isolation. It is necessary to bridge these areas across both natural and national borders in order to meet the needs of the people who inhabit them and the lands surrounding them (the matrix). Today, many conservationists, including parties to the Convention on Biological Diversity (CBD), advocate an 'ecosystem approach' to conservation and to management of the broader landscape matrix: a concept that is still evolving.

Himalayan initiatives

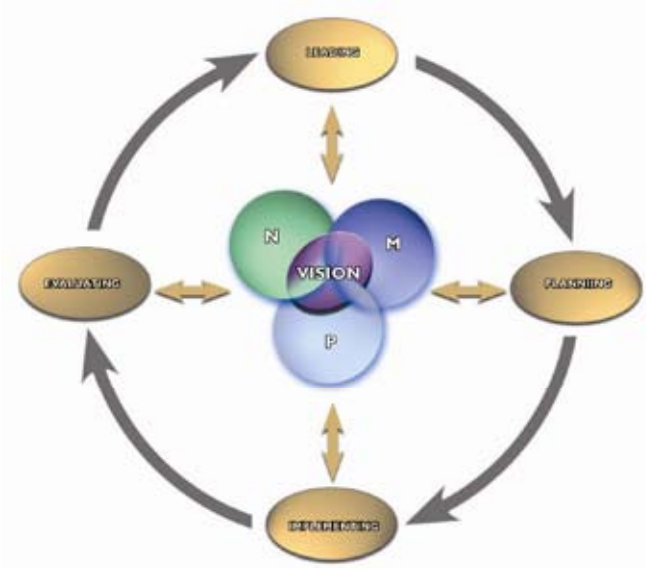
ICIMOD, The Mountain Institute (TMI), the World Wide Fund for Nature (WWF), and the International Union for Conservation of Nature (IUCN), as well as other partners, have been instrumental in introducing the concept of 'transboundary landscapes' and 'conservation corridors' for the HKH region. These complexes stretch from east to west, wet to dry, and low to high-altitude areas and are part of a series of experimental transboundary (mountain) landscapes such as the Mount Everest complex and the Kanchenjunga landscape. ICIMOD is promoting the idea of five additional transboundary landscapes and four transects. These will improve connectivity across Himalayan ecosystems and encourage cross-border research that can lead to an improved understanding of the impacts of climate change in the region. This initiative is part of a comprehensive approach to 'Connectivity Conservation' (see Box 1). Researchers worldwide have shared their findings to formulate a global connectivity conservation framework (Worboyes et al. 2009 in preparation). This framework includes protection, retention, and rehabilitation of natural connections among habitats and within ecosystems at the landscape level. The three main functions will be (1) conserving habitats for movement of species and maintenance of viable populations; (2) conserving and enhancing ecosystem services; and (3) promoting and enhancing local welfare by conserving and using natural resources.

> "Five additional transboundary landscapes and four transects will improve connectivity across Himalayan ecosystems and encourage cross-border research"

The framework takes into consideration that connectivity conservation areas will need active management to deal with more frequent, extreme, and human-induced threats such as climate change (see Figure 1).

Conservation corridor between Toorsa Strict Nature Reserve and Jigme Dorji National Park in Bhutan, showing villages along the fringes

Figure 1: **A conceptual framework for connectivity conservation management (N = nature context; P = people context; M = management context)**



Box 2: **Suggested measures for meeting climate change**

Managers' strategies for promoting resilience in protected Areas

1. Inventory–taxa surveys to know what you have. Be alert for unusual sites / communities, refugia
2. Sustain the slow variables (e.g., soil resources and the species' pool) that accumulate slowly and provide buffers
3. Sustain both ecological legacies (e.g., old forest growth, woody debris) and cultural legacies (e.g. people's connection to land)
4. Relieve the stresses that drive adverse change (e.g., pests, invasive species, pollution)
5. Increase the effective size of the protected area where and when possible (e.g., enlarged core protection zone and buffer zone with nature-friendly land use)
6. Protect altitudinal gradients
7. Restore or facilitate recovery of missing keystone species (e.g., wolf, beaver)
8. Build linkages across multiple scales from hedgerows to landscape-scale connectivity corridors (stepping-stones may also be valuable)
9. In connection with connectivity, think big, think bio-regionally, think even on a continental scale
10. Cooperate to develop common approaches with adjacent or nearby protected areas. Transborder cooperation is especially important
11. Increase interchange with and education of stakeholders about interventions planned
12. Develop flexibility and ability to move in new directions as scenarios change, employ adaptive management, treat crises as opportunities for constructive change
13. Think outside the box

Source: Lawrence S. Hamilton, provided at the IMBC, October 2008

Innovative, integrated responses across landscapes by land management authorities and property owners (see Box 2 for suggested measures) will be essential. The connectivity conservation strategy envisages a different kind of land stewardship that can be financed by a carbon economy and from payments for water. This concept has captured the imagination of many who see the direct national (and possibly international) benefits of individual, local conservation responses. Connectivity conservation could facilitate national responses to climate change and contribute to provision of clean air and clean water which will benefit local communities and help conserve many valuable species.

Conclusion

The conservation of large areas of natural lands that interconnect protected areas is critical for the survival of threatened species and those needing a wide habitat range so that they can survive and adapt to climate change: it is especially critical for species threatened with extinction. Climate change causes biomes to shift: connectivity conservation can help to maintain functioning, resilient, ecosystems; to enhance natural catchments; and to promote clean water supplies. In its entirety, connectivity conservation will result in improved air quality and lead to reduced emission of greenhouse gases by sequestering carbon from the atmosphere. This means that food production, economic security, and environmental integrity will be strengthened.

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Regional Research on Biodiversity: Improved Knowledge as a Basis for Better Livelihoods

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Biodiversity is the key to life on earth: human existence – with food, medicines, fibres, fuel, building materials, and many other facets of what we know as civilisation – was only able to evolve because of biodiversity related ecosystem services.

Starting perhaps with primitive organisms and eventually, through a series of changes or evolutionary stepping stones, plants, animals, insects, and the whole fabric, both animate and inanimate, of this dynamic planet developed into the rich variety of life forms we see today. Human beings used all this biodiversity to build

Mountain landscape comprising rangelands, forests, and water resources – precious ecosystem services provided by the Hindu Kush-Himalayas

Agroforestry innovations in Khonoma, Nagaland, India

their civilisations and their wonders of science and art, but used it to such an extent, and heedlessly, that today global change in general, and climate change in particular, is threatening the very foundations of human existence.

Now that the effects of climate change and the loss of biodiversity are becoming a priority issue, the Hindu Kush-Himalaya (HKH) region wants to join other nations worldwide to help preserve our global genetic heritage and make it available as a source for the improvement of livelihoods. At this juncture, however, it is evident that the cornerstone on which sound policies and efficient strategies depend is missing. There is a lack of reliable data derived from scientific observation and of trained manpower to carry out the research – both of which are needed for environmental assessment and sound decisions on development issues and global assessments.

Long-term regional data – a regional need with global implications

Attentive observers can quickly see changes; but, as Professor Körner so aptly reminds us, plausibility is not proof. The IPCC and other agencies have often signalled the serious dearth of data from this region. When compared to other parts of the world, this region is lacking data in many disciplines because it is understudied or the data generated are not accessible. One particularly poignant and telling example that illustrates the situation vividly comes from the IPCC Assessment Report No. 4 which points out that 28,115 significant, observed biological changes were reported for Europe but, during the same period, only 8 were reported for the whole of Asia!

Only rigorous long-term observation will make it possible to acquire the amount and quality of data needed for this region. This is a tall order since the HKH region comprises some of the most difficult topography in the world. Research conditions are difficult, altitudes are daunting, and long periods of isolation have to be accepted as a sine qua non for serious Himalayan researchers. Another problem is that there is only a weak tradition of collecting and sharing data and often no resources to do so either. ICIMOD looks on this 'dearth of data' as an enormous challenge but not as one that cannot be addressed. The acquisition of long-term scientific data is possible if regional members are

willing to 'Hold hands across the Himalayas'. Professor Messerli reminds us that regional collaboration is the key to success in our endeavours. Global programmes with decades of experience are willing to help with technical backstopping. These programmes have the expertise and are motivated to work with us in the HKH because the data that could be shared would benefit not only the HKH but also the whole world by contributing to improved climate change models, preserved genetic heritage, and so forth.

Sharing global knowledge and making the most of regional experience

The governments in the HKH region are often painfully aware that they do not have the information either to respond to their local communities or to fulfil their commitments to international agreements. With limited capacity how can this work begin? Global agencies, which have the know-how in natural sciences, can help with technical solutions, but so far these efforts have been bilateral and the approach has been fragmented. Since neighbouring member countries in the HKH share the same challenging mountain terrain, biological diversity, and climactic conditions, every one of them would gain by sharing data collected in selected, representative locations. This is the approach suggested by Professor Messerli and the ICIMOD team. A concrete proposal for long-term studies in the HKH by using sample sites in 'transects' or north-south 'corridors' from east to west across the HKH, has been made. The proposal is still in the initial stages and many of the practical details have to be worked out in connection with the regional member countries. At the 'International Mountain Biodiversity Conference', which was held late last year at ICIMOD, it was reassuring to see that the transect concept was appreciated by the countries of the region and by global programmes who are ready and willing to provide technical knowhow.

Reaping maximum benefit from long-term research

Change is not a new phenomenon by any means. It is an inevitable process for all life on earth. But change has never been experienced at such a rapid rate in living memory. Historical records indicate that such rapid changes have not taken place previously. The 20th century was overwhelmingly a century of science and technology. Mountain communities who were not part of this scientific revolution were left behind and played only a rather marginal role. Climate change and the awareness of changing biodiversity and the need for sustainable ecosystem services make the mountain communities guardians of a global heritage, of regionally essential goods, and of a local basis for sustainable livelihoods. Mountain communities need to be empowered to make the most of this and to see a future in their changed environment.

Both global and regional institutions can make this happen by working together. While ICIMOD's regional member countries (RMCs) – the countries of the Himalayas – have agreed in principle to work together for long-term monitoring, national institutions and governments now need to buy in to all of these endeavours and plan a course of action to implement the plans proposed. The Himalayan countries need to take ownership of activities in their environments and need to assume responsibility for mobilising resources and managing the day-to-day practicalities that monitoring entails. For those who have very little experience in collecting primary data, the task may seem daunting – ICIMOD is ready and willing to help them by sharing methodologies and in linking to global programmes which can provide technical backstopping. For member countries which are already well on their way with data collection, ICIMOD can help by providing long-term vision, a platform for sharing data, and linkages to global programmes as needed.

> "Regional collaboration is the key to success in our endeavours"

Collecting data by using Trans-Himalayan transects is a viable way of overcoming the deficit in basic data, but these data alone are not sufficient. The work does not stop with collection: data need processing, analysing, and sharing to be useful contributions to policy formulation and for use by decision makers. Only then will data collection help reduce poverty at the community level. ICIMOD can play a role in making data relevant at different levels of complexity – with elementary techniques for integration of data and visualisation to extensive and complex tools and methods of modelling, simulation, and decision making. ICIMOD can also help by incorporating shared community-based knowledge and indigenous experience. Here the scientific data observed can be combined with traditional ecological knowledge to produce tangible outcomes for work in reducing risks of water-induced disasters, improving agriculture by better management of ecosystems, and many others. These will facilitate reduction of poverty by making livelihoods more secure and lands better yielding

and more profitable than is currently the case. On a more global level, this hard data will help communities to benefit fully from the 'access and benefit sharing' of biodiversity resources and 'payment for ecosystem services' schemes intended for them. Here ICIMOD can provide a platform for sharing and accessing the tools to facilitate both the preliminary, geo-referenced visualisation of the data all the way up to and including the extensive and sophisticated processes for modelling, simulation, and decision-support systems.

Opportunities for enhancing livelihoods through use of non-timber forest products, North East India

What is the relevance for local livelihoods?

Collecting basic data on biodiversity in the HKH might seem irrelevant in terms of local livelihoods, and of interest only to scientists. While this is one aspect to be considered, data also provide essential knowledge for a much wider range of endeavours, all of which aim to improve the lives and livelihoods of communities in remote mountain areas. Changes in biodiversity are important indicators that something fundamental is affecting the ecosystem and that it can have ramifications for animal husbandry and agricultural production. Changes in biodiversity also affect the ecosystem and the services it provides: slope stabilisation, for example, is hampered and erosion processes exacerbated by the disappearance of traditional autochthonous species.

ICIMOD sees biodiversity as a source of wealth which can be harnessed. Medicinal and aromatic herbs, non-timber forest products, honey and milk, and horticultural produce are all examples of mountain-specific products which are increasingly in demand. Organic products from remote mountain areas have special characteristics and part of their appeal is the fact that they originate in far-flung areas – this has proven to be a potential source of branding and pricing for these products. Conserving and managing biodiversity, therefore, is an essential element of sustainable development strategies in mountain areas.

What role can ICIMOD play?

Although ICIMOD's primary concern is to create an environment conducive to knowledge exchange and sharing, it also supports attributes of knowledge for development. It facilitates sharing and exchange between and among regional research institutes, universities, and think tanks; and helps them collect and share social, economic, and environmental data on and in the HKH region. ICIMOD, as a knowledge, learning, and enabling centre, can really play an instrumental role as a platform for exchange between its RMCs. The Centre has a transboundary 'regional' vision; but, having said that, it can also be instrumental in bringing on board global programmes and helping to customise their knowhow for adaptation to the Hindu Kush-Himalayan region. ICIMOD is a facilitator – RMCs need to 'buy in'and and take on their share of the responsibility. In addition, through its involvement in the proposed Himalayan University Consortium (HUC), ICIMOD can be engaged in developing the capacities of regional partners and propagating global approaches to problems on a Himalayan scale.

ICIMOD's expectations

ICIMOD will work hard to reduce the scientific uncertainty about climate change in the HKH region and secure increased regional ownership and active participation: this will include coordinating biodiversity research. The data will serve the purpose of both scientists and researchers who are looking for ways to use biodiversity as an effective instrument in poverty reduction: this is very pertinent to development methods. Trans-Himalayan transects are a practical solution to the unwieldy problem of how to coordinate data collection over such a vast area. ICIMOD will promote the development of research and knowledge and, in future, help in the training of well-qualified people from the region who will then take up the responsibility of long-term monitoring. From the vision to reality can take a long time, but with cooperation from all parties concerned, perhaps the future is not as far away as it seems!

Global Initiatives

Global Observation Research Initiative in Alpine Environments (GLORIA)

GLORIA is a worldwide, long-term observation network in alpine environments – it collects data on vegetation and temperature which yield information used to assess and predict losses in biodiversity and other threats related to climate change. To date, it is comprised of a network of more than 50 working groups in 61 target regions on 5 continents. www.gloria.ac.at

The focus on summit areas

A key advantage that high mountain areas have over lowlands is that, with increasing altitude, ecosystems become less complex and factors related to temperature become more important. Another advantage is that that they are less prone to direct human impact– the higher the elevation the less likely that the effects of warming can be confused with those created by human intervention. For these reasons high mountain ecosystems are particularly suitable as global indicators of global warming.

Mountain biodiversity provides information about the integrity of the entire mountain ecosystem. GLORIA studies vascular plants in particular because they (1) occur over a wide range of high mountain systems (from humid to arid regions), (2) are often specific to a certain elevation belt, (3) are of fundamental importance for ecosystem functioning, (4) can be readily recorded in the field (since they are sessile and macroscopic), and (5) experts are mostly available for study of this organism group. Among climate variables, soil temperature is measured since it is of outstanding ecological importance not only for the temperature regime itself but also for detecting the length of the snow-cover period, and it is relatively easy to measure compared to other variables.

The design and sampling method

Each GLORIA sampling site consists of permanent plots around a summit. Detailed sampling of species' cover within each quadrant provides a baseline for detecting changes in species' composition; repeat measurements at different time intervals are used to detect changes in vegetation patterns.

GLORIA – implementation of the network

GLORIA is a worldwide community of ecologists committed to establishing the foundations of a long-term programme that will yield results for future generations. GLORIA sites are deployed in the alpine zone across every altitude, latitude, and longitude of the planet's major biomes. GLORIA's simple approach has made it possible to establish numerous sites within and across continents. As of November 2008, GLORIA had 30 active target regions in Europe, 14 in North America, 8 in South America (with 11 additional sites planned for 2009) and 3 in Australasia. No sites have been established in Africa but there have been several expressions of interest. GLORIA is still underrepresented in Asia where at present only 6 sites are active. Within the Hindu Kush-Himalayan Region, sites are established in Yunnan and Sichuan (China), and setup of new sites in Nepal, Sikkim (India), and Tibet (China) is planned for 2009 and 2010.

GMBA – Global Mountain Biodiversity Assessment: a DIVERSITAS network

GMBA is a cross-cutting network of DIVERSITAS which actively explores and synthesises findings from research into mountain biodiversity and provides a link between science and policy. GMBA documents and synthesises knowledge on mountain biodiversity and communicates these findings to international policy fora and interested institutions. At present, GMBA is a network of about 400 researchers and policy makers in the field of mountain biodiversity, and 946 subscribed members, in 71 countries.

The Swiss Academy of Sciences and DIVERSITAS played an active role in the creation of GMBA in 2000 in fulfilment of the objectives of Agenda 21. GMBA is a research network that looks at how high elevation biological diversity is responding to global changes. To provide a complete picture, GMBA looks at all 3 dimensions; the horizontal, biogeographic dimension with a zonal emphasis on the global scale; the vertical bioclimatic dimension with elevation transects on a regional scale; and the temporal dimension,

looking at past, present, and future situations by revisiting sites and using modelling.

GMBA attempts to make the most of the data extant and often synthesises hidden and fragmented results of research on mountain biodiversity to bring them to the attention of a widespread audience. By increasing the visibility of mountain biodiversity issues, GMBA helps to shape a global corporate identity for a scattered research community. GMBA advocates studies on how human activities have impacted natural and cultural landscapes in the mountains. GMBA encourages the sustainable development of rural upland areas. It provides data and information in a format usable to policy makers and stakeholders.

Mountain biodiversity data mining

GMBA, in cooperation with the Global Biodiversity Information Facility (GBIF), is encouraging a worldwide effort to mine geo-referenced databases on mountain organisms since accurate geographical coordinates and altitude specifications (georeferences) of observed or collected biological species are the vital link between biological data and other geophysical information. Functional insight and theory will only emerge from large-scale cross-continental comparisons of the upper montane zone, the treelike ecotone and the alpine regions, and elevation transects.

Electronic archives of biological data are a novel way of testing evolutionary and ecological theory throughout the world's mountain ranges. The separation of global from regional environmental conditions along elevation transects provides new perspectives and paves the way for a fresh understanding of how mountain biota adapt. Similarly, information on rock chemistry and mountain topography offers test conditions for soil-related drivers of biodiversity and species' radiation and in an evolutionary context across a suite of geographical scales.

GMBA and GBIF are constructing a thematic Internet portal which will make it possible to search a vast archive for data on mountain biodiversity, and permit GBIF data to be used in a mountain-specific context in which geo-referencing will make it possible to link biological information with other geophysical data.

The Mountain Research Initiative (MRI)

MRI promotes and coordinates research on global change in mountain regions around the world and, through its regional networks, it catalyses the interdisciplinary research needed to fill current knowledge gaps. MRI is not a biodiversity research network per se, but rather seeks to complement such work by facilitating long-term monitoring of environmental change in mountain regions, integrated model-based studies, process studies, and providing advice on sustainable land use and natural resource management through the promotion and coordination of research. In its seven years of existence, it has actively participated in the design of the international research agenda and through its regional networks has catalysed interdisciplinary research.

Actions on the global level: design of an international research agenda

The first major product of MRI was a 700-page compendium on 'Global change in mountain regions – An overview of current knowledge'. This set the groundwork and was followed by the GLOCHAMORE (GLobal CHange in MOuntain Regions) Project that coupled globally with UNESCO's Mountain Biosphere Reserves. The GLOCHAMORE Research Strategy, the Project's final product, is an integrated and implementable research strategy to improve understanding of the causes and consequences of global change in mountain regions around the world.

How can MRI work regionally to fill scientific gaps?

MRI supports the work carried out by regional scientists through its four programme activities.

- Promoting inter- and transdisciplinary research on mountains by enlisting key scientists to work through their own national or multinational research funding agencies
- Helping to create the type of research proposed in the GLOCHAMORE strategy by supporting the formation of new research partnerships and catalysing groups and individuals to develop project proposals
- Focusing the community's attention on some of the most important issues in mountain regions by facilitating the development of peer-reviewed papers on specific key scientific issues, and the transfer of knowledge from scientists to managers

- Creating a more solid sense of community among researchers working on global change in the mountains by distributing relevant information and increasing the flow of information between them.

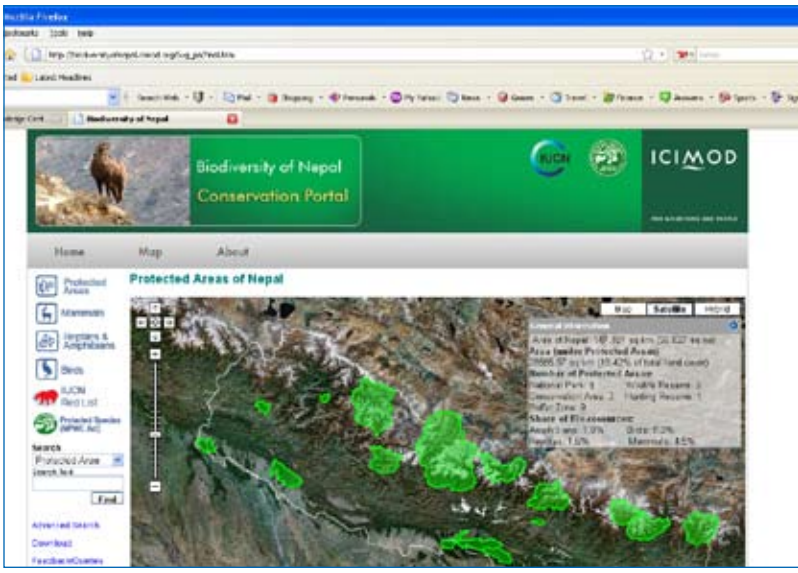
How does MRI foresee its work evolving in the coming years?

The history of MRI is a move from abstract ideas towards concrete activities and real people. Whereas the compilation of the GLOCHAMORE Research Strategy was an intellectual challenge – defining and evaluating globally compelling global change research topics – the challenges now are much more human and entrepreneurial. MRI is headed in this direction.

During the 2007-2010 funding period MRI will continue its activities and continue to work through its three regional networks: MRI Africa, MRI American Cordillera, and MRI Europe and by 2010 MRI foresees expanding these activities to the Asian mountains.

ICIMOD's Biodiversity Portal

ICIMOD has recently developed a 'Biodiversity of Nepal' conservation portal in collaboration with IUCN and the Department of National Parks and Wildlife Conservation, as a means of sharing and providing access to information about natural resources and biodiversity in Nepal. A database and interactive mapping feature provide information on protected areas, mammals, reptiles and amphibians, birds, the IUCN Red List, and protected species.
http://biodiversityofnepal.icimod.org.



A regional approach

It is essential for conservation in the HKH to understand the driving forces behind environmental factors such as changes in the use of land, water, and energy; sensitivity and vulnerability to environmental variations and changes; and responses to and choices for managing environmental resources. However, most of these drivers are regional, multilateral, or at least bilateral, and cannot be studied on a country basis alone. Furthermore, information related to biodiversity, natural resources, and livelihoods in the HKH is sparse, and much of the information that is available is of poor quality and/or difficult to access. Thus in future, we hope to convert the Nepal-specific conservation portal into a Mountain Biodiversity Portal. This decision was taken at the workshop on 'Linking Geodata with Biodiversity Information in the Himalayas' held in November 2008.

The current, geo-referenced information portal will become a regional database for the HKH region using a decentralised and distributed network of national partner institutions from participating member countries. The database will be of international standard and compatible with those of the Global Mountain Biodiversity Assessment (GMBA) and Global Biodiversity Information Facility (GBIF). It will facilitate exchange with other international agencies such as the Global Earth Observation System of Systems (GEOSS), IUCN, Ramsar Sites, Important Bird Areas (IBA), World Wide Fund for Nature (WWF), United Nations Environment Programme (UNEP), Critical Ecosystem Partnership Fund (CEPF), Food and Agriculture Organization (FAO), WESCOM, National Geographic, and others.

At a later stage, we will consider the possibility of using the portal to provide a decision support system (DSS) with combinations of simulation modelling, optimisation techniques, geographical information systems (GIS), and associated databases and user interface components.

Centre News

2008 – Celebrating 25 years for mountains and people!

In 2008 ICIMOD celebrated the completion of 25 years of working for mountains and people. The year-long celebration focused on the themes of resilience and adaptation to global change of the Hindu Kush-Himalayan people, and on promoting sustainable mountain development. On the 1st of January 2008, staff were welcomed with a garlanded banner at the entrance of the building with 'Let us celebrate 25 years of ICIMOD' – setting the tone for the year.

The celebrations started with the Eco Everest Expedition 2008 <www.ecoeverest.net.np>. ICIMOD joined with Asian Trekking and the United Nations Environment Programme (UNEP) to support this unique mountaineering expedition, which brought together climbing, research, and environmental awareness. The climbing expedition, led by Dawa Steven Sherpa of

Asian Trekking, was designed to draw attention to the issue of climate change and the problem of melting glaciers in the Himalayas. A cleanliness campaign was carried out and eco-friendly products and methods field-tested as part of the expedition. The expedition was formally launched on 18 April 2008 at Everest Base Camp. The high point was reached on 26 May when Dawa Steven and his team reached the summit of Mount Everest and displayed an ICIMOD banner. A repeat photography exhibition, *'50 Years of Change – Glaciers, Landscapes, People and Resilience in the Mount Everest Region,* Nepal' was also displayed at Base Camp, and an ICIMOD Information Centre was set up, which together served as an interaction point for visitors, climbers, and local people. An ICIMOD research team led by Basanta Shrestha carried out field studies of the Dig Tsho and Imja Tsho glacial lakes as part of the expedition and held an awareness workshop on GLOFs in Namche Bazaar.

The second major event was the 'Himalaya – Changing Landscapes' photo exhibition, first unveiled in a smaller format at Everest Base Camp in April (see above), and then shown in different formats in Stockholm, Sweden during World Water Week from 17 to 23 August; in Barcelona, Spain from 4 to 15 October, in parallel with the IUCN World Conservation Congress (in partnership with the BBVA Foundation); and finally in Kathmandu at Hanuman Dhoka, Durbar Square from 2 to 8 December (in partnership with the Nepal Tourism Board). The exhibition contains a unique collection of panoramas of mountains, valleys, and glaciers in the Khumbu region of Nepal taken in the 1950s and retaken in the same locations in 2007 by mountain geographer Alton Byers of The Mountain Institute (TMI), together with photos of scientific teams conducting research in the 1950s and portraits of mountain people. The panoramas and historic photos were shared by Dr Byers under the ICIMOD/TMI partnership agreement. The exhibition drew global attention to the impacts of climate change in the Himalayas and has proven to be a powerful tool for raising awareness of global climate change in the Himalayas, as well as for raising the profile of ICIMOD itself.

A Day out in Godavari, a visit to the ICIMOD Demonstration and Training Centre, was organised on Saturday, 3 May 2008 for members of Kathmandu's diplomatic community and development agencies and their families. Some 70 guests enjoyed observing the different technologies, farming activities, and research being undertaken at the Centre and discussing them with ICIMOD staff.

Two international days were celebrated with special events: World Environment Day (5 June) and International Mountain Day (11 December). A Digital Photo Contest on the theme 'For Mountains and People' was held from 25 March to 16 May 2008 and received more than 1100 entries from 365 contributors in 65 countries. The ICIMOD Hindu Kush-Himalayan Prize went to Prem Hang Banem for his photo 'Worshippers going round the sacred lake Gufa-Pokhari' (2007) and the Mountain Forum Global Prize was awarded to Christian Cristoforetti for his photo 'Transhumant sheep return to the alm in Paneveggio Forest after a winter on the plains' (2007). All entries can be viewed online at http://www.icimod.org/photocontest. The top entries were displayed at the World Environment Day (5 June) and International Mountain Day (11 December) events, and during the ICIMOD Open House Day on 6 December. ICIMOD's Asia Pacific Mountain Network also facilitated an E-discussion on 'Building the resilience of mountain communities to climate change' from 30 April to 14 May as part of World Environment Day 2008. A summary of the discussion is available online at http://www.icimod.org/apmn/buildingresilience/.

September also saw the introduction of a new brand look for ICIMOD to meet the challenges of the coming years under the new strategic framework introduced in 2008 (see separate report).

Two international conferences were held in Kathmandu as part of the celebrations: the 10th International Symposium on High Mountain Remote Sensing Cartography (HMRSC-X), held from 8 to 11 September, and the International Conference on Mountain Biodiversity (with three pre and post workshops on Mountain Transboundary Protected Areas; Linking Geodata with Biodiversity Information; and Research Strategy on Global Change in Mountain Biosphere Reserves), held from 6 to 18 November. These conferences provided ICIMOD with an opportunity to bring together many international and regional experts on a common platform and foster regional and international cooperation.

ICIMOD's Director General, Dr Andreas Schild, was awarded the first Sir Edmund Hillary Himalayan Environment Award at the headquarters of the Indian Mountaineering Foundation (IMF) in New Delhi, India, on 14 October. The annual award is given by the Himalayan Environment Trust to an organisation or individual for an outstanding lifetime contribution to the cause of the Himalayan Environment.

The year culminated in a week-long celebration from 1 to 6 December. Members of ICIMOD's Board of Governors and International Support Group were also able to participate as the 39th ICIMOD Board of Governors' meeting was held from 1 to 4 December (see separate report).

On 2 December 2008, 'Himalaya – Changing Landscapes' was inaugurated at Hanuman Dhoka, Durbar Square by Ms Hisila Yami, Minister for Tourism and Civil Aviation. The week-long exhibition was popular among Kathmandu locals and visitors alike, and the panels shown in Nepal are now on permanent display at the International Mountain Museum in Pokhara for all to enjoy and study.

A high-level panel discussion on 'The Role of the Hindu Kush-Himalayan (HKH) Mountain System in the Context of a Changing Climate' was organised on ICIMOD's actual anniversary day, 5 December, at the Soaltee Crowne Plaza, Kathmandu. Seven invited panellists (two of whom had been present at the first inaugural symposium in 1983) discussed with participants key issues and challenges faced by the region and the potential role of ICIMOD in enhancing adaptation and building the resilience of mountain communities. A 25th Anniversary commemorative book 'ICIMOD and the

Himalayan Region: Responding to Emerging Challenges' was launched, and a commemorative souvenir cover was postmarked with a specially designed anniversary cancellation stamp.

In the evening of 5 December ICIMOD held a gala function at the Hyatt Regency for staff and invited guests. The function was graced by the Right Honourable President of Nepal, Dr Ram Baran Yadav, who addressed the audience. Other speeches were delivered by Dr Andreas Schild, Director General of ICIMOD,

eminent scientist Professor Bruno Messerli (keynote speaker), and the incoming ICIMOD Board Chair, Mr Sherub Gyaltshen from Bhutan. The programme included a slide show, musical performances, and a dance-drama on the theme of 'Water'. Seven staff members who had completed 25 years of service with ICIMOD were felicitated.

The week-long celebration finished with an Open House on 6 December at ICIMOD's headquarters in Khumaltar, Lalitpur, which was accompanied by an informative and fun-filled fair. The highlights included guided tours of ICIMOD's programmes and a Climate Change Corner where the glacial melting phenomenon was explained with examples. ICIMOD staff had a rare opportunity to meet the general public and discuss issues and respond to questions on climate change in the Himalayas and global warming. The response from the public was overwhelming; it is estimated that some 2,000 to 2,500 people came to the Open House.

Nira Gurung, ngurung@icimod.org

ICIMOD Board of Governors 2009

Regional Board Members

Eng Ghulam Mostafa Jawad
Deputy Minister of Agriculture
Ministry of Agriculture and Irrigation, Afghanistan

Mr Jamil Osman
Secretary, Ministry of Chittagong Hill Tract Affairs
Bangladesh Secretariat, Bangladesh

Mr Sherub Gyaltshen
Chairperson, ICIMOD Board of Governors
Secretary, Ministry of Agriculture, Bhutan

Prof Dr Ding Zhongli
Vice President, Chinese Academy of Sciences, PR China

Mr Vijai Sharma, IAS
Secretary, Ministry of Environment and Forests, India

U Kyaw Htun
Deputy Director General, University of Forestry, Myanmar

Prof Dr Gunanidhi Sharma
Vice Chairman, National Planning Commission, Nepal

Mr M Zia-ur-Rehman
Secretary, Ministry of Food, Agriculture and Livestock, Pakistan

Independent Board Members

Dr Jacqueline A. Ashby
Chairperson, ICIMOD Programme Advisory Committee (PAC)
Vice Chair, ICIMOD Board of Governors (BoG)
Research Coordinator, Andean Change Program
International Potato Center (CIP), Peru

Dr Elke Förster
GFA Consulting Group GmbH, Representative Office Hanoi/
Senior Consultant, Vietnam

Dr Amir Muhammed
Rector, National University of Computer and Emerging Sciences
Pakistan

Dr Linxiu Zhang
Professor and Deputy Director, Centre for Chinese Agricultural Policy
Chinese Academy of Sciences (CAS), PR China

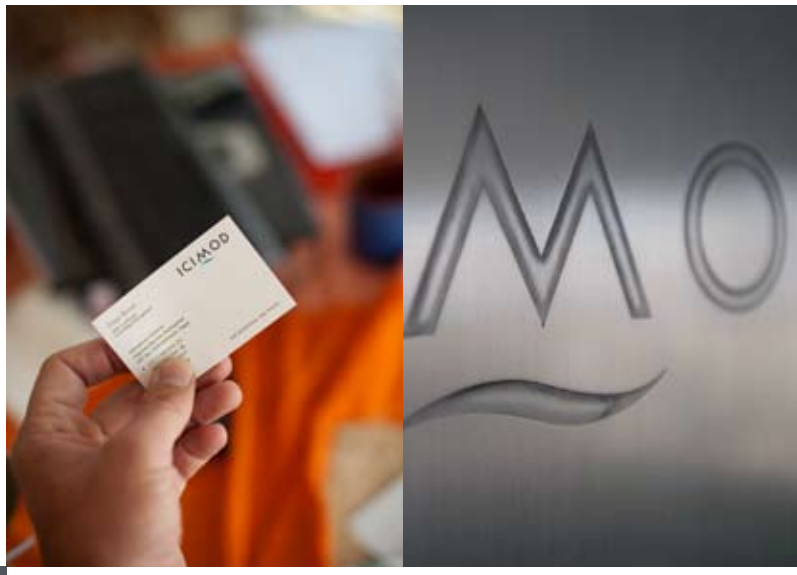
Dr A K M Jahir Uddin Chowdhury
Professor, Institute of Water and Flood Management
Bangladesh University of Engineering and Technology, Bangladesh

Dr Andreas Schild
(Ex-officio) Director General, ICIMOD

ICIMOD: New challenges, new look

On Monday, 15 September 2008, ICIMOD opened with a new look, new website, and new design for all its print and electronic materials to support the new orientation and way of working outlined in the Strategic Framework introduced in January 2008

The Strategic Framework is intended to guide the Centre's activities, help it meet the growing challenges of sustainable and equitable development, and respond to the growing need for adaptation to climate change. The clear new look developed to support implemention of the framework underscores ICIMOD's belief in flexibility with consistency, and diversity within a common framework It reflects the need to reduce the complexities of development thinking and focus on clarity and simplicity within a complex field. The logo highlights the focus on mountains and the importance of the environment and water for the people of the region, while the strapline emphasises ICIMOD's theme 'For Mountains and

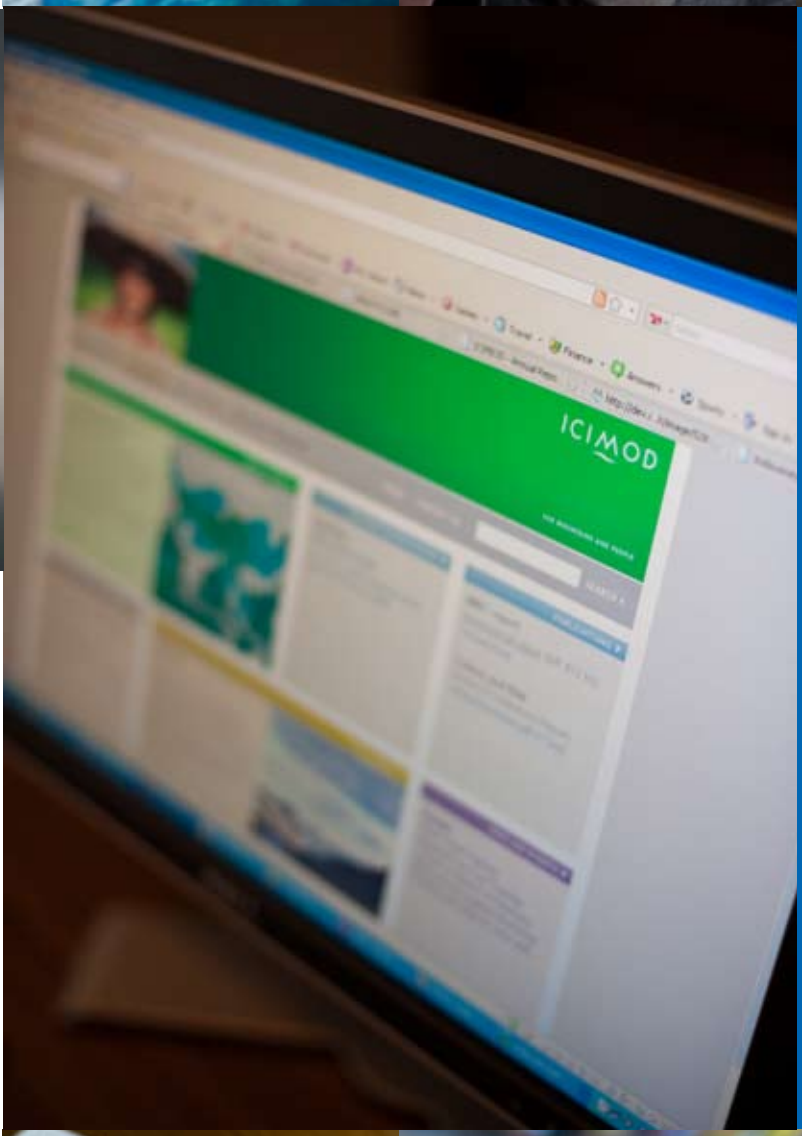


People'. Visually arresting images are used to underscore the communication messages.

ICIMOD was fortunate to be able to interest Alex Treadway, an experienced designer and photographer from England, in the project (see box). Supported by a dedicated team of ICIMOD staff, Mr Treadway took on the responsibility of developing the overall brand, the designs of all materials including the website, and much of the photography. In 2008, all existing products were redesigned; during 2009 new communications products are being developed and designs added to broaden the overall scope. Examples of the design can be seen everywhere, from this newsletter, through to signs and information boards in the HQ building and the Training Centre, to business cards, email signatures, and ICIMOD vehicles.

The website www.icimod.org was restructured and rebuilt to facilitate knowledge sharing and support ICIMOD's regional role as a platform and a hub. The website offers an overview of the new strategy, programmes, and activities, and an introduction to the themes and topics that are most important for the people of the region. During 2009, the many additional websites linked to ICIMOD's programmes are being integrated into the main website. When this is complete, all ICIMOD information will be fully searchable and available in one place. The new website will help ICIMOD to communicate efficiently and provide easy access to the data, information, and knowledge compiled and developed to help the people of the region.

A Beatrice Murray, bmurray@icimod.org



Alex Treadway - Designer and Photographer

Alex Treadway studied graphic design and photography in England before moving to Denmark and completing a Masters Degree in Graphic Communication at Denmark's Design School in Copenhagen. He started his career with the London-based multimedia agency 'DOGS', where he worked as a graphic designer. Following this, he took on a position as senior designer with the top web agency 'Rufus Leonard' before being appointed creative director for the strategic brand agency 'Blue Goose'. In 2005, he set up his own company and has carried out a number of freelance branding and photography projects since then

Alex has been working and travelling in Asia for the past two years. In 2008 he decided to stay in Nepal when ICIMOD requested him to produce a new overall image for the organisation. Apart from rebranding ICIMOD, Alex has supported publicity campaigns for international organisations and companies, such as the adventure group 'The Last Resort', and has undertaken a series of photography projects. He is currently planning to produce a coffee-table book depicting the striking transformation Everest mountaineers go through during their attempt to reach the top of the world.

You can see more of Alex's work at:
www.alextreadway.co.uk

The Annual Meeting of the ICIMOD Board of Governors, 2008

The Annual Meeting of the ICIMOD Board of Governors and associated meetings were held from 1 to 6 December 2008 in Kathmandu. As 2008 was the twenty-fifth anniversary of ICIMOD, the annual meeting of the Board of Governors was held in a celebratory mood. A field trip was organised for Board members on 1 December to Hamsapur village, Kaski District prior to the start of the meetings (see Box).

On 1 December, the Sixth Meeting of the ICIMOD Foundation was convened, and the value proposition for fund raising discussed. Although the reactions to the proposition were positive, the Foundation realised that, due to the global financial crisis, the coming year will be more of a consolidation year for the Foundation.

On 2 December, Centre's Day was organised at ICIMOD's headquarters, during which ICIMOD partners made presentations to the Board and International Support Group (ISG) members, and staff presented the programme activities at an 'information market'. In the afternoon, the photo exhibition 'Himalaya – *Changing Landscapes*' was opened against the backdrop of Nepal's national heritage site, Hanuman Dhoka. In the evening, the Finance Committee of the Board met to discuss the financial management of the Centre and expressed satisfaction with the current status.

On 3 December, the Programme Advisory Committee was convened, and detailed progress of each programme was presented. The committee commented on the programmes and provided important guidelines for the way forward. In the afternoon, the International Support Group convened its 19th meeting. ICIMOD's regional member countries expressed their continued support for the Centre and non-regional members of the group pledged support for the five-year period covered by the current Medium Term Action Plan (MTAP).

The main event, the 39th Meeting of the Board of Governors, was held on 4 December. Besides routine business, the Board reviewed the progress made during the first year of the new strategic plan. The Board expressed satisfaction at the impressive start. Considerable progress has been made in each of the new programmatic areas set out in the Medium Term Action Plan: Integrated Water and Hazard Management (IWHM), Environmental Change and Ecosystem Services (ECES), and Sustainable Livelihoods and Poverty Reduction (SLPR). The changes brought about in the organisation will be further consolidated in 2009.

The Board approved a budget of US$ 12.7 million for 2009 and appointed Price Waterhouse as auditors for the next three years, to replace KPMG who retired in 2008 after a period of 5 years. The Board also realised the need to expand the Directorate and redefine the roles therein and approved the new position of Director of Programme Operations. After the meeting, the Board members joined in the 25th anniversary celebrations with ICIMOD staff (see separate report).

Milan Raj Tuladhar, mtuladhar@icimod.org

Field visit by the Board of Governors to Hamsapur village, Kaski district

A field trip was organised for the ICIMOD Board of Governors on 1 December 2008 to Hamsapur village in Kaski district near Pokhara. The aim was to provide the Board with an opportunity to observe the field activities of ICIMOD's partners and to interact directly with local communities and understand their problems and the benefits received through ICIMOD supported activities. The field trip also demonstrated how ICIMOD is working with and through its partners.

The group visited a multi-partnership, community-implemented, biodiversity conservation and community development project funded by UNDP/GEF, ICIMOD, and others. The project is being implemented by a local NGO, the Indragufa Community Development Foundation. Through support from other donors, the village high school has 24-hour internet connectivity, providing information and knowledge services to the students and villagers.

During the field trip, the Board members visited the new school construction site, interacted with the school management community, visited the local biodiversity fair, and enjoyed a brief cultural programme on the local Gurung culture and practices. The Board members also interacted with locals and, in particular, with a large number of women from various community-based organisations. The Board members walked through the village in two groups to observe programme activities such as biodiversity conservation and community forestry, home gardens with medicinal plants, coffee plantations, honey processing, and tourism promotion activities.

Madhav Karki, mkarki@icimod.org

Professor Bruno Messerli, ICIMOD's Change at a Time of Global Change

After three exciting years as a member of the Programme Advisory Committee (PAC: 2006 – 2008) and two years (2007 – 2008) as Chair of the PAC, I am looking back with two great impressions: First, the strategic change of ICIMOD at an unbelievable speed of less than two years, and second the high motivation and engagement of the staff at all levels, from the reception at the airport to the secretariat, from the professionals to the management team and the Director General. This too short and too general statement can be better appreciated by looking back on the 25 years history of ICIMOD.

During a research project of the United Nations University on so-called 'Mountain Hazards' in Nepal's Kakani and Khumbu areas at the beginning of the 1980s, I became involved in the preparatory discussions about a future centre for mountain development in Kathmandu, based on the principles of UNESCO's 'Man and the Biosphere' programme. After the inauguration in 1983, I was once more involved in the first five-year evaluation report, where I proposed the creation of a regional programme with strong transboundary components. Then I lost all contacts with ICIMOD until 2004, when I was invited to the inauguration of the new building and headquarters in Khumaltar.

Based on this fragmentary history of ICIMOD, I was surprised and fascinated to experience in these last years a change towards a changing world. Globalisation was no more an economic process alone, but also include such things as the climate, water resources, biodiversity, and food security in general, and the mountains with their resource treasures in particular. It was exciting to see that we need to scale down innovative results from the global change programmes to the regional level and to scale up the results from the more precise national-regional level to the global level in order to improve predictions and projections of future scenarios. Most important, the global programmes need a better regional knowledge and this means comparable and reliable data in a free exchange about water and hazards, biodiversity and ecosystem services, livelihood and poverty, exactly as it is defined in ICIMOD's longer term strategy. I am persuaded that in the near future the global environmental change programmes will reach a higher accuracy and a higher significance for all the Hindu Kush-Himalayan countries, and that it will therefore be fundamental that ICIMOD is creating a knowledge centre with the necessary capacity to assist the member countries in their future decision processes.

I am sure that UN-institutions, government and non-government organisations, and especially the regional member countries, will realise the unique position of ICIMOD very soon. I hope that the Board of Governors and the PAC will accept and appreciate this long term responsibility besides the necessary short-term results and impacts, both compiled in a meaningful combination of research and development for the mountains and their environment and resources, and also for the concerned highland and lowland populations.

I thank the Director General, the management team leaders, the whole staff and the colleagues and friends of the PAC for all the exciting discussions and interactions. I felt really at home in ICIMOD and I may say that these three years were a real highlight in the last phase of my mountain career.

Dr Robert Visser, Chief Scientist of Development Cooperation, Netherlands Ministry of Foreign Affairs and Professor in Development Cooperation, University of Utrecht

Dr. Rober Vissser was appointed as an Independent Member of the ICIMOD Board of Governors in 2001 and completed his term in 2008, at the time of ICIMOD's 25th Anniversary celebrations in December 2008. During his tenure, Dr Visser served on the Board's Programme Advisory Committee and gave valuable guidance and advice on our many programmes. His expertise was particularly welcome in the area of knowledge management and innovation, and especially during the development of the new knowledge management strategy. He has also provided outstanding services to the mountain people and environment of the Himalayan region. His sharp analysis and in-depth knowledge of the issues, as well as his strong commitment to ICIMOD's work, has been highly appreciated. ICIMOD bade him a warm farewell in December 2008, and looks forward to remaining in contact with him in the future.

New Regional and Independent Board Members

Mr Vijai Sharma, Secretary, Ministry of Environment and Forests, Government of India

Mr Vijai Sharma, Secretary, Ministry of Environment and Forests (MoEF), Government of India joined the Indian Administrative Service in 1974. He is a science and law postgraduate. As a career bureaucrat, he has held several distinct positions and made invaluable contributions at both the State and Central levels. He has wide experience in matters relating to industry, agriculture and cooperatives, pollution control, energy, the environment, and forests, as well as law and justice. Before joining the MoEF as Secretary, he was Special Secretary of the Cabinet Secretariat.

Professor Kyaw Htun, Deputy Director General, Planning and Statistics Department, Ministry of Forestry, Myanmar

Professor Kyaw Htun is Deputy Director General of the Planning and Statistics Department in the Ministry of Forestry, Myanmar and Professor at the University of Forestry, Forest Department, Myanmar. Born in 1950, he has had a long professional career in forest services in different capacities. He started as a junior plantation assistant in Pyinmana Forest Division, Forest Department of Mandalay Division in 1977 and became a senior plantation assistant in 1980 at the Forest Headquarters in Yangon. In 1984, he was appointed as a senior computer programmer at the Forest Department Computer Center. He joined the Planning and Statistics Division of the Forest Department as a staff officer in 1990 and became Assistant Director in 1995. He played a key role in formulating the District Forest Management Plan at the forest management unit level covering the whole country for the period 1996/97 to 2005/06. From 2000 to 2003, he was Associate Professor at the University of Forestry (where he is now Professor) and Head of the ASEAN and International Relations Unit of the Forest Department. He is one of the authors of the *National Action Programme of Myanmar to combat desertification in the context of the United Nations Convention to Combat Desertification* (UNCCD) and coauthored the *Sustainable Development Strategy* for Myanmar. His research focus is on the general assessment of teak plantations in the Bago Yomas region, the analysis of the productivity of commercial plantations in Myanmar, and predicting the possibility of deforestation using logistic regression models.

Professor Dr Gunanidhi Sharma, Vice Chairman, National Planning Commission, Nepal

Professor Dr Gunanidhi Sharma was appointed by the Government of Nepal to the ICIMOD Board of Governors effective 16 January 2009. He is Vice Chairman of the National Planning Commission, Nepal and has three decades of experience working in different capacities in academic institutions, government, development agencies, and NGOs. He started his career as Assistant Lecturer at the Central Department of Economics, Tribhuvan University in 1973, where he was appointed Professor in 1997.

As an educationist, Professor Sharma was a teacher, advisor, and PhD thesis examiner at Andhra University, India. In the government sector, he has held several positions on advisory and governing boards such as the Nepal Rastra Bank and the National Planning Commission. He has also worked as an expert and consultant for such organisations as Winrock, UNFPA, UNEP/UNDP, GTZ, and IIDS. While working for the government and in development, he has served as a member of various evaluation committees, taskforces, and commissions. He has also served on the editorial board of the Economic Journal of Nepal, Central Department of Economics, Tribhuvan University, and of the Nepalese Economic Review since 1989.

Professor Sharma has carried out considerable research and authored and co-authored many scientific research papers, seminar papers, and books. He received his PhD in Economics on 'Monetary control techniques in Nepal' from the University of Rajasthan, Jaipur, India, in 1984.

Dr Lars-Erik Liljelund, Director General, Swedish Prime Minister's Office, Sweden

Dr Lars-Erik Liljelund from Sweden was appointed as an Independent Member of ICIMOD's Board in December 2008. He brings with him valuable experience in the field of environment and natural resources. Currently, he is Director General of the Swedish Prime Minister's Office where he is responsible for climate change issues and the Baltic Sea. Prior to this, he served as Director General of the Swedish Environment Protection Agency from 1999 to 2008.

Dr Liljelund started his career as a researcher and lecturer in ecology at Stockholm University in 1977 where he obtained his PhD in Plant Ecology in the same year. He served as Senior Advisor at the Department of Environmental Research, Swedish Environment Protection Agency from 1984 to 1989. He joined the Swedish Association for the Conservation of Nature in 1989 as a Department Secretary General. He has held other senior positions in different capacities in the Swedish Environment Protection Agency. He also served as a Director of the Swedish Environment Advisory Council, Ministry of Environment from 1994 to 1998.

Dr Liljelund is actively involved in many scientific organisations. He is currently serving as Chair of the Board of the International Meteorological Institute, Stockholm University and member of the Board of the Swedish University of Agricultural Science, both since 2008, and has also been a member of the China Council (the Environmental Advisory Board to the Chinese Government) since 2007. He has been Vice Chair and Chair of the Arctic Monitoring and Assessment Programme (1993-1998), member of the Board of the Swedish Space Agency (1997-2003), member of the Board of the Swedish Polar Research Secretariat (2003-2007), member of the Board of the Swedish Forestry Agency and Foundation for Environmental Strategic Research (2000-2007), and Chair of the European Environment Agency (2003-2008). From 1985 onwards, he served as an expert on several governmental taskforces, and as a member and negotiator in Swedish delegations to different conventions and/or on political cooperation on environmental and sustainable development issues.

Professor Dr Matthias Winiger, Rector (Vice Chancellor), University of Bonn, Germany

Professor Dr Matthias Winiger, a physical geographer and climatologist from Switzerland, was appointed as an Independent Member of ICIMOD's Board in December 2008.

Professor Dr Winiger is currently Rector (Vice Chancellor) of the University of Bonn, Germany. He started his career as a research assistant at the University of Waterloo, Canada in 1970. He joined the University of Berne, Switzerland, as an Assistant to Professor Dr B. Messerli in 1971 and held various positions there until 1988. He gained his PhD from the same university in 1974. In 1988 he joined the University of Bonn as Professor and Director of the Department of Geography. He has since held several other positions at the university before taking up his present position as Vice Chancellor in 2004.

From the very beginning of his professional career, Professor Winiger tried to combine fieldwork, remote sensing, and GIS modelling in the fields of climatology and landscape ecology, mainly in mountain areas in different geographical settings (the Alps; north, east, and Southern Africa; and South and Central Asian mountain ranges such as the Karakorum, Hindu Kush, and Western Himalayas).

At the University of Berne, the pioneering WESAT Programme (Weather Satellite Programme, with satellite receiving stations, an archive, and application programmes on mountain climatology) was initiated in 1980 and is still running today. At the University of Bonn, his research group established remote sensing and GIS technology programmes that became independent university research units and successfully cooperate with United Nations programmes in Bonn (e.g., UNU, INRES, Biota).

Professor Winiger has been associated with many renowned scientific organisations since 1992. He served as the Chair of the IGU Commission 'Mountain Geoecology and Sustainable Mountain' from 1996 to 2000. He is a founding member of the Subprogramme ProClim (Climate Programme) at the Swiss Academy of Natural Sciences. He has been Editor–in-Chief of Erkunde since 2006 and is the founding editor of the African Studies series of Geographische Bernensia. He has also auth ored and co-authored many research papers.

ICIMOD workshops, meetings and training programmes

(April 2008 - March 2009)

Event	Date	Place
2008		
Mountain Forum's Asia Pacific Mountain Network (APMN) Board Election	March - April	Kathmandu, Nepal
Mountains and People Global Digital Photo Contest	March - June	Kathmandu, Nepal
Topographic Survey for Paghman Botanical Garden in Afghanistan	1 April	Afghanistan
Country Operational Planning Workshop	1 April	Thimpu, Bhutan
Country Operational Planning Workshop	5 April	Islamabad, Pakistan
Securing Livelihoods in Uplands and Mountains of HKH Region Phase II Review and Planning Workshop	14 - 15 April	Lalitpur, Nepal
Workshop Application of Geo-Informatics and Earth Observation for Natural Resources/and Cover Assessment in Protected Areas	14 - 25 April	Islamabad, Pakistan
Launch Eco Everest Expedition, ICIMOD Research Expedition, and photo exhibition, '50 Years of Change – Glaciers, Landscapes, People and Resilience in the Mount Everest Region, Nepal'	18 April	Khumbu, Nepal
BRAHMATWINN Regional Level Stakeholder Meeting	21 - 23 April	Kathmandu, Nepal
State Level Consultative Workshop on Access and Benefit Sharing from Biological Resources for Local Communities	22 - 23 April	Gangtok, Sikkim, India
Awareness Workshop on Adaptation to Climate Change and Increasing Resilience of Local People in Khumbu	25 April	Namche, Nepal
Study Tour for Afghan Policy Makers	26 April - 4 May	Kathmandu, Nepal
Workshop on Application of FAO/UNEP Land Cover Classification System (LCCS) for the Study of Land Cover Dynamics in CKNP	28 April	Islamabad, Pakistan
Knowledgebase System of the HKH Partnership Project	29 April	Islamabad, Pakistan
E-discussion on 'Building Resilience of Mountain Communities to Climate Change'	30 April - 14 May	Kathmandu, Nepal
Mission to Afghanistan: Kahmard District	3 - 13 May	Kahmard, Afghanistan
Fourth Mission for ICIMOD's Watershed Assistance	5 - 15 May	Pakistan
Regional Technical Consolidation Workshop on the Management of the Kanchenjunga Landscape	6 - 7 May	Thimpu, Bhutan
Regional Inception Workshop for the Action Research Project on Value Chains for *Cinnamomum tamala*	9 - 10 May	Kathmandu, Nepal
Training on Apiculture for Agriculture Teachers of Council for Technical Education and Vocational Training (CTEVT)	2 - 16 June	Kathmandu, Nepal
World Environment Day	5 June	Kathmandu, Nepal
Landslides, Risk and Decision-making in Central Nepal: a Multi-Stakeholder Approach	9 June	Kathmandu, Nepal
Regional Workshop on Climate Change and Vulnerability of Mountain Ecosystems in the Eastern Himalayan Region	12 - 13 June	Kathmandu, Nepal
Regional Field Work Planning on Assessing Adaptation to Climate Induced Water Stress and Hazards in the Greater Himalayan Region	17 - 21 June	Kathmandu, Nepal
Programme Advisory Committee and Special Board Meeting	24 - 28 June	Kathmandu, Nepal
Bio Briquette Training of Trainers (ToT)	24 - 27 June	Godavari
1st Abu Dhabi Knowledge Forum (ADKF) Rivers of the Greater Himalayas: from Source to Sea, Present and Future	25 - 27 June	Singapore

ICIMOD Board Executive Committee (BEC) Meeting	27 - 28 June	Kathmandu, Nepal
Orientation on WOCAT Tools and Methods	5 July	Kabul, Afghanistan
Progress Review Meeting of Kyoto: Think Global Act Local Project	6 - 9 July	Kathmandu, Nepal
E-discussion on 'Can Disasters Help to Improve a Country's Economy'	7 - 28 July	APMN List
Beekeeping Colony Management and Hive Making Training	23 - 29 July	Godavari
Consultation Workshop on GLOF and Flash Flood Risk Assessment in the Hindu Kush-Himalayas as part of the initial phase of the Feasibility Study of a Himalayan Climate Change Impact and Adaptation Assessment	30 July - 1 August	Kathmandu, Nepal
Refresher Course on Recent Developments in Geo-hazard Disaster Management Focusing on Earthquake Vulnerability Reduction in Mountainous Regions	11 - 21 August	Peshawar University, Pakistan
Side event: Himalayan Water Towers – Resources under Threat at the Stockholm World Water Week	17 - 23 August	Stockholm, Sweden
Photo Exhibition: Himalaya – *Changing Landscapes*	17 - 23 August	Stockholm, Sweden
Regional Meeting on Sustainable Agriculture and Rural Development in Mountain Regions (SARD-M)	18 - 19 August	Kathmandu, Nepal
Training on Documentation and Dissemination of SLM Technologies and Approaches using WOCAT Tools	25 - 30 August	Thimpu, Bhutan
Curriculum Development Workshop	30 - 31 August	Kabul, Afghanistan
Regional Technical Workshop on the Himalayan Initiative	1 - 3 September	Kathmandu, Nepal
Geo-Informatics for Mountain Environment Management	1 - 11 September	Kathmandu, Nepal
Higher Secondary Level Teachers Training on GIS/RS jointly organised by ICIMOD, ESA/EDU SPACE, and Nepal GIS Society in connection with HMRSC-X	1 - 5 September	Lalitpur, Nepal
The Tenth International Symposium on High Mountain Remote Sensing Cartography	8 - 11 September	Kathmandu, Nepal
Global e-conference on 'Culture and Risk: Understanding the Socio-Cultural Settings that Influence Risk from Natural Hazards'	22 September - 3 October	Kathmandu, Nepal
GTZ-ICIMOD Workshop	2 - 3 October	Kathmandu, Nepal
Barcelona Photo Exhibition at the IUCN World Congress	5 - 12 October	Barcelona, Spain
Regional Workshop on Development and Harmonisation of Land Cover Classification in the HKH Region	13 - 24 October	Kathmandu, Nepal
Exposure Visit on Economic Activities in Nepal	15 - 26 October	Kathmandu, Nepal
BRAHMATWINN Workshop in Munich	19 - 26 October	Munich, Germany
Training on Alternative Technologies and Rangeland Management	3 - 5 November	Afghanistan
Steering Committee Meeting for the project 'GLOF Assessment and Mitigation Study of Potential GLOF Lakes in Nepal'	5 November	Kathmandu, Nepal
Pre-conference: The Mountain Transboundary Protected Area and Connectivity Conservation Workshop	11 - 15 November	Dhulikhel, Nepal
Inception Workshop for the project 'GLOF Assessment and Mitigation Study of Potential GLOF Lakes in Nepal'	12 November	Kathmandu, Nepal
Gender Mainstreaming in Rangeland Regions	12 - 14 November	Lalitpur, Nepal
Pre-conference: Linking Geodata with Biodiversity Information in the Himalayas	15 - 16 November	Kathmandu, Nepal
Conference on Biodiversity Conservation and Management for Enhanced Ecosystem Services: Responding to the Challenges of Global Change	16 - 18 November	Kathmandu, Nepal
Post-conference: Research Strategy on Global Change in Mountain Biosphere Reserves	19 November	Kathmandu, Nepal
Post-conference: Field Visit for Exploring GLORIA Target Regions in Nepal	20 - 25 November	Kathmandu, Nepal
Regional Experience Sharing and Networking Workshop – Advocacy	24 - 27 November	Kathmandu, Nepal

Training Workshop on River Basin Information (RBIS) and DANUBIA Hydrological Modelling for Upper Brahmaputra Basin	24–28 November	Kathmandu, Nepal
39th ICIMOD Board of Governors' Meeting	30 November - 4 December	Kathmandu, Nepal
Outdoor Photo Exhibition: 'Himalaya – *Changing Landscapes*'	2 - 8 December	Kathmandu, Nepal
Third International Training School on Atmospheric Brown Cloud	3 - 7 December	Kathmandu, Nepal
SAARC Consultation Meeting	4 - 5 December	Kathmandu, Nepal
Atmospheric Brown Cloud Workshop	4 December	Kathmandu, Nepal
ABC Science Team Meeting	5 December	Kathmandu, Nepal
The Role of the Hindu Kush-Himalayan (HKH) Mountain System in the Context of a Changing Climate, A Panel Discussion	5 December	Kathmandu, Nepal
ICIMOD Open House	5 December	ICIMOD, Nepal
Regional Workshop on Payment for Ecosystem Services (PES)	10 - 12 December	Dhulikhel, Nepal
Training Workshop on Capacity Building of Media on Access and Benefit Sharing	15 - 16 December	Meghalaya, India
Inception Workshop/Training on Application of Satellite Rainfall Estimates in the HKH Region – Phase II	15 - 19 December	Kathmandu, Nepal
NEPCAT Workshop – Nepal Conservation Approaches and Technologies	16 December	Kathmandu, Nepal
2009		
IFAD Partner Consultation, Review and Planning Workshop	6 - 8 January	Kathmandu, Nepal
Mountain Pastoralism History and Modernity in Asia	7 - 9 January	Kathmandu, Nepal
World Wetlands Day 2009	2 February	Kathmandu, Nepal
Land Use Change and Human Health in Eastern Himalaya Project Workshop: Summarising Year One and Planning Year Two	2 - 5 February	Kunming, China
Dissemination Workshop on Flash Flood Risk in the Bhote Koshi	2 - 6 February	Bhote Koshi, Nepal
Regional Review and Planning Meeting of the 'Medicinal Plants and Herbs: Developing Sustainable Supply Chains and Enhancing Rural Livelihoods in Eastern Himalayas'	10 - 12 February	Kathmandu, Nepal
Inception Workshop on Capacity Building for Improved Monitoring of Snow, Ice and Water Resources in the Indus Basin	11 - 13 February	Kathmandu, Nepal
Interaction with Nepal's Constituent Assembly, Natural Resources, Economic Powers and Revenue Sharing Committee (NREPRS) Members	13 - 14 February	Kathmandu, Nepal
Experience Sharing on Pro-poor Value Chain Promotion in Nepal's Mountain Areas: Good Practices, Strengths and Weaknesses of Approaches Currently Practised in Nepal	16 February	Kathmandu, Nepal
Regional Inception Workshop of the Honeybees Project entitled Improving Livelihoods through Knowledge Partnerships and Value Chains of Bee Products	23 February - 2 March	Kunming, China
Brown Bag Seminar on 'Understanding the Global Carbon Budget – An Imperative for Mitigation and Adaptation to Climate Change'	2 March	Kathmandu, Nepal
Assessing Local Adaptation Strategies to Climate Induced Water Stress and Hazards in the Greater Himalayan Region Regional Report Back Workshop	2 - 6 March	Dhulikhel, Nepal
International Women's Day 2009	8 March	Kathmandu, Nepal
Regional Training Course on 'Low-cost Soil and Water Conservation Techniques and Watershed Management Activities'	9 - 27 March	Kathmandu, Nepal
World Water Day 2009	22 March	Kathmandu, Nepal
Online Training Course on 'The Basics of Advocacy'	26 February - 20 March	Kathmandu, Nepal
Regional Workshop on Cryosphere- Assessment and Monitoring of Snow and Ice in the HKH	31 March - 2 April	Kathmandu, Nepal

Mountain Forum

Mountain Forum Workshop on Information and Knowledge Sharing Systems and Tools

In mid 2008, Mountain Forum set out to review its information and knowledge sharing systems and tools to ensure that they provide an effective and up-to-date platform for sustainable mountain development. The Board and regional networks stressed the need to pool resources and focus on the joint development of tools and shared procedures to make information easily accessible.

As part of this process, a workshop was held in January 2009, which brought together managers of the regional networks and partners, notably, APMN/ICIMOD, Mountain Partnership Secretariat Asia-Pacific Decentralised Hub, InfoAndina, One World South Asia, InfoBridge, and the Mountain Forum Secretariat, whilst interacting with the University of Central Asia and North American and Himalayan networks. A questionnaire on the needs and tools of the regional networks and partners, combined with an assessment of new technologies in 2009, formed the basis for the workshop. The workshop addressed the integration of content, decentralised management, use of shared procedures, and the possibility of customising shared tools. It was recommended that the system should address interaction and dialogue with members and partners, as well as having networking and repository functions such as the e-calendar, online library, and membership. The workshop outlined the steps to be taken including identifying the information needs of Mountain Forum's regional networks and partners towards the development of a joint tool by mid 2009. This is to be led by InfoAndina and coordinated by the Secretariat, with regular feedback and input from partners.

For more information, contact info@mtnforum.org.

Global E-Conference on 'Culture and Risk: Understanding the Sociocultural Settings that Influence Risk from Natural Hazards'

A global e-conference on 'Culture and Risk: Understanding the Sociocultural Settings that Influence Risk from Natural Hazards' was organised by ICIMOD and facilitated by the Mountain Forum Secretariat and APMN from 22 September to 6 October 2008. About 450 participants registered to participate from over 70 countries. The discussion was held on the Mountain Forum platform and moderated by Kenneth Hewitt. The goal was to improve understanding of the links between cultural/social factors and risks from natural hazards.

The e-conference report is available at www.books.icimod.org. The complete documentation of the e-conference can be found at http://www.mtnforum.org/rs/ec/index.cfm?econfid=16.

Franciscus Neuman, f.neuman@mtnforum.org

Asia-Pacific Mountain Network (APMN)

Established in 1994, Asia-Pacific Mountain Network (APMN) is a knowledge sharing platform connecting mountain regions and members through dialogue and networking. The network, which is managed by ICIMOD, captures, enriches, and disseminates information on mountain development issues in and for the Asia-Pacific region. APMN acts as the Asia-Pacific node of Mountain Forum (MF), a role it has played since 1996. The network has been generously supported by a small grant from the Swiss Agency for Development and Cooperation (SDC). In addition to moderating two MF discussion lists (mf-asiapacific and mf-centralasia) and contributing to Mountain Forum's other activities, APMN has its own programme and webpage <http://apmn.icimod.org>. ICIMOD also uses the APMN platform to disseminate information on its own activities to a broader public. As of March 2009, the APMN network has 230 organisational members from 23 countries and 1641 individual members from 39 countries.

Between May 2008 and April 2009, APMN collaborated with the Mountain Forum Secretariat and ICIMOD in the organisation of an e-conference on 'Culture and Risk', a digital photo contest on 'Mountains and People', and the south Asia regional meeting of the Global Knowledge Partnership; implemented three communication projects with the Mountain Partnership Secretariat; and supported e-discussions on 'Slashing Mountaineering Charges for Climbers' and 'How Disasters Can Help to Improve a Country's Economy'. The recent focus has been on developing 'Recommendations for a Strategic Direction 2008- 2012', and a joint action plan with the Asia Pacific decentralised hub of the Mountain Partnership Secretariat (MPS). The network also participated in various outreach activities including seminars and talk programmes; International Day events; conferences; and training. Two issues of the APMN Bulletin and two e-discussion synthesis reports were prepared and can be accessed at www.books.icimod.org.

Tek Jung Mahat, tmahat@icimod.org

Mountain Partnership Secretariat – Asia Pacific Decentralised Hub (MPS-APDH)

The Mountain Partnership is a voluntary alliance of partners dedicated to improving the lives of mountain people and protecting mountain environments around the world. It currently has over 160 members, including countries, intergovernment organisations, and groups (e.g., civil society, NGOs, and the private sector). The Mountain Partnership Secretariat structure consists of central and decentralised hubs hosted by FAO in Rome (Central Hub), ICIMOD in Nepal (Asia Pacific Hub), the Banff Centre in Canada (North America Hub), and the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN) in Peru (Latin America Hub), as well as the Environmental Reference Centre hosted by UNEP in Vienna.

The work of the Asia Pacific Hub (MPS-APDH) is based on the acknowledgement of the uniqueness of the Asia Pacific Region, as well as the different developmental stages and challenges these countries face. However, what brings together these diverse members is the commitment to the sustainable mountain development agenda. In order to serve more effectively and link members together in activities and lessons learned, the hub has intensified its communication and outreach activities with a variety of communication tools and platforms. The results have been positive, with more than 80 per cent of the members coming together for regular interactions and networking.

Integration with ICIMOD's activities is also considered essential, as well as building on the organisation's in-house expertise and extensive knowledge of the Hindu Kush-Himalaya region. Some of ICIMOD's past activities, such as the successful advocacy training run for ICIMOD's regional member countries, have been replicated and adapted by MPS-APDH as online training for Asia Pacific members of the Mountain Partnership.

MPS-APDH also works closely with the Mountain Forum Secretariat (MFS) and the Asia-Pacific Mountain Network (APMN) in setting up information exchange platforms and tools such as the Needs Assessment Survey for Mountain Partnership's Asia Pacific members to help identify member demands and priorities for the creation of programmatic priorities. MP-APDH provides regular updates on funding and financial opportunities, especially on climate change and adaptation mechanisms, as well as liaising between country-based bilateral donors and Asia Pacific members. The MPS-APDH network is rapidly expanding, and four new members – CAMP Kuhiston from Tajikistan, ECOFORUM from Uzbekistan, MACDS from Pakistan, and NDRI from Nepal – have recently joined.

The hub provides regular bi-monthly activity updates to members and donors to ensure accountability as well as transparency. The information flow helps the hub to reach out to members and encourages updates and inputs, thus increasing members' ownership of MPS-APDH activities.

Elbegzaya Batjargal, ebatjargal@icimod.org

Partnership development (April 2008–March 2009)

With the implementation of its new five-year Medium Term Action Plan (2008-2012), ICIMOD has taken its institutional partnership efforts to new heights. Over the past year, ICIMOD has played a proactive role in global fora and formalised its ongoing collaboration with global knowledge hubs and centres of excellence in the Hindu Kush-Himalayan region. Moreover, ICIMOD has continued its role of raising awareness on the impacts of climate change in the Himalayas and mutual learning by working closely with its partners in regional member countries.

Securing a prominent role in global discourse

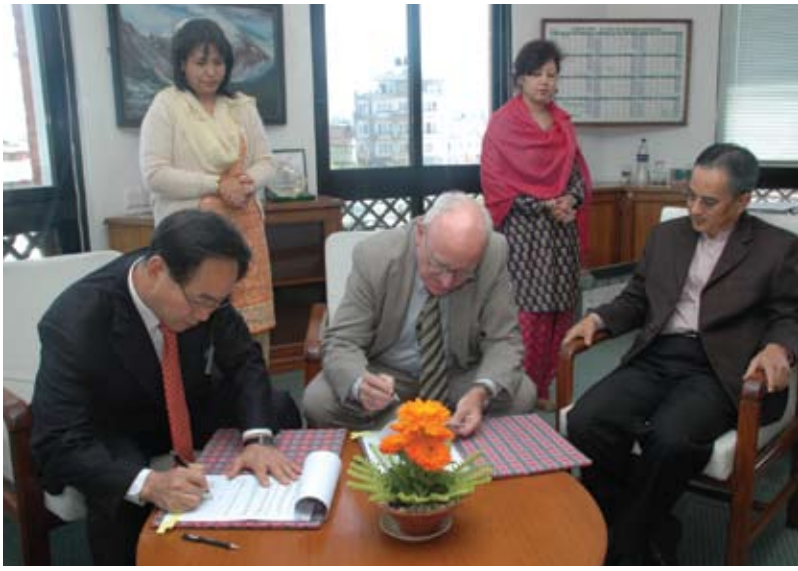
During 2008, ICIMOD became part of the global discourse on climate change and water by securing membership of various accredited forums. ICIMOD was granted provisional admittance by the United Nations Framework Convention on Climate Change (UNFCCC) in April, observer status by the Intergovernmental Panel on Climate Change (IPCC) in June, and observer status by RAMSAR in July. In August, ICIMOD drew global attention to Himalayan water issues by taking part in the World Water Week in Sweden. The Asia-Pacific Water Forum (APWF) acknowledged ICIMOD as a regional knowledge hub for water resources management in mountainous areas, and GEO (Group on Earth Observation) recognised ICIMOD as a participating organisation.

Formalising institutional collaboration with global knowledge hubs

In 2008, ICIMOD promoted its partnerships with global knowledge hubs by signing an MoU with The International Union for Conservation of Nature (IUCN) for collaboration in the areas of water management, climate change, ecosystem services, and poverty reduction; and with the United Nations Environment Programme (UNEP) to consolidate, develop, and intensify cooperation in the field of environment, specifically on climate change responses and ecosystem management.

Streamlining regional member country partnerships

In 2008, an MoU was signed with the GB Pant Institute of Himalayan Environment and Development (GBPIHED), an autonomous Institute of the Ministry of Environment and Forests (MoEF), Government of India, to increase the potential for mutually beneficial research, enable efficient coordination, and ensure the sustainability of the partnership between ICIMOD and the Government of India. In 2009, an MoU was signed with the Ministry of Forestry (MoF), Myanmar, to increase capacity development activities (exchange programmes, training/ workshops, and pilot initiatives) in Myanmar.



Raising awareness on the impact of global warming and climate change

In 2008, ICIMOD helped to raise awareness of the impact of global warming and climate change in the Himalayan region and raise the Centre's international profile through the Eco-Everest Expedition (Nepal) and an international photo exhibition 'Himalaya – *Changing Landscapes*' held in Sweden, Spain, and Nepal (through an agreement with the Nepal Tourism Board).

Addressing the issues of too much and too little water

In 2008, ICIMOD started a collaborative programme with its partners to examine issues of too much and too little water in selected regional member countries. In June letters of agreement (LoA) were signed with Kunming Institute of Botany (KIB), China; AARANYYAK – a society for biodiversity conservation in India; the Institute for Social and Environmental Transition-Nepal (ISET-Nepal), Aga Khan Rural Support Program (AKRSP), Pakistan; and, in 2009, with Winrock International, India, to identify, document, and assess adaptation strategies at the community level to water shortages and water-induced hazards.

In 2009, an MoU was signed with the Department of Hydrology and Meteorology (DHM) of the Government of Nepal with the aim of improving the validation of

satellite-based rainfall estimates in Nepal as a part of the HKH regional study conducted in Phase I of the Satellite Rainfall Estimation Project.

Supporting community-based natural resources management

ICIMOD and its partners are promoting and collaborating on community-based natural resources management in the HKH region.

In 2008, ICIMOD signed an LoA with the Planning Commission (Gross National Happiness Commission) of the Royal Government of Bhutan to continue work under Phase III of the Regional Rangeland Programme to scale up innovations that enhance the livelihoods of herders and improve the ecological health of rangeland ecosystems; with the Aga Khan Foundation (AKF), Afghanistan, to undertake collaborative activities in line with the Afghanistan Biodiversity and Community Forestry Programme; and in 2009 with the Namsaling Community Development Centre (NCDC), Nepal, on biological corridors in eastern Nepal – conservation corridors are integral to the landscape approach to biodiversity conservation.

Promoting a university network for education and research in the Himalayas

ICIMOD is currently serving as the Secretariat of the Himalayan University Consortium (HUC) formed in March 2007 to promote mountain specific curriculum development in higher education, and collaborative training, research, and outreach for broader sustainable mountain development. The Secretariat is in the process of signing broader MoUs with its 15 member institutions and five associate member institutions, the first in December 2008 with the University of Central Asia (UCA).

Conclusion

To sum up, ICIMOD is promoting diverse partnerships at different levels: country-focused capacity building partnerships, regional knowledge generation partnerships, and partnerships to scale up/down and customise available knowledge resources. ICIMOD, in its new programming phase, has gained global recognition as a prominent and reputed institution for mountain people and the environment through this strategic partnership development.

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Outreach activities

'Himalaya – *Changing Landscapes*' photo exhibition

In 2008, ICIMOD embarked on a journey to create wider awareness of the impact of climate change in the Himalayan region. A major part of this campaign was the 'Himalaya – *Changing Landscapes*' photo exhibition. The exhibition was initially planned as a one-off event at the Everest Base Camp in April 2008 featuring mountain panoramas. But following its success, ICIMOD decided to extend the scope of the exhibition as one of the events held to celebrate ICIMOD's 25th anniversary. The format and concept of the exhibition were further developed, and a professional designer brought in to create a professional look. The aim was to provide a visual way to raise awareness of the impact of global warming and climate change in the Himalayas. In 2008, the exhibition was held in Stockholm, Barcelona, and Kathmandu.

The exhibition has now moved to its third phase with new photographs being introduced including repeat photographs of landscapes from the mid hills of Nepal showing cultural and socioeconomic changes that have taken place in the last few decades. In 2009, ICIMOD plans to hold exhibitions in Germany, Switzerland, Japan, and India. ICIMOD sees the exhibition as a powerful tool for promoting both the organisation and the cause – raising awareness of the impact of climate change in the Himalayas.

Nonna Lamponen, nlamponen@icimod.org

'Upstream-Downstream: Wetlands connect us all'

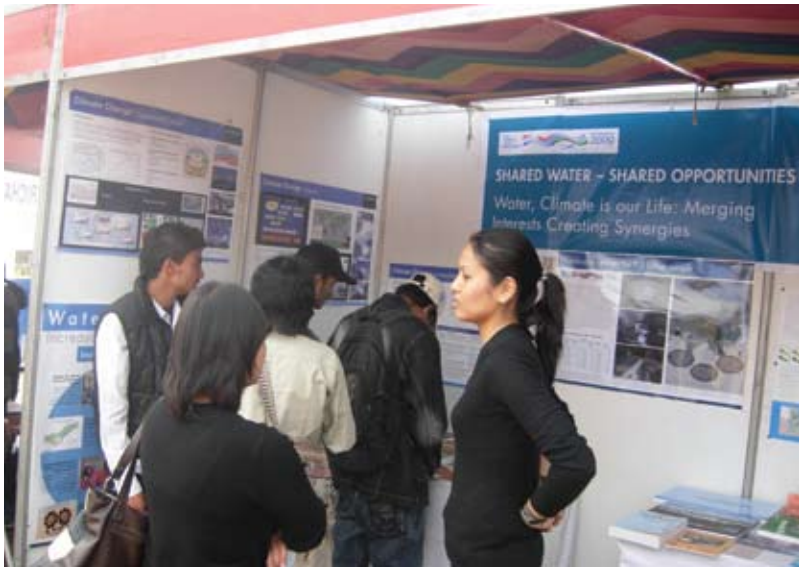
ICIMOD celebrated World Wetlands Day on 2 February 2009 with the slogan 'Upstream-Downstream: Wetlands connect us all' in close collaboration with the Nepal Department of National Parks and Wildlife Conservation (DNPWC), the government and RAMSAR focal agency; World Wildlife Fund (WWF) Nepal; IUCN Nepal; and the National Trust for Nature Conservation (NTNC), among others. Prof Hua Ouyang, Programme Manager, Integrated Water and Hazard Management (IWHM), and Dr Eklabya Sharma, Programme Manager, Environmental Change and Ecosystem Services (ECES) sent out a joint message through the Asia-Pacific Mountain Network (APMN) highlighting the role of Himalayan wetlands in connecting upstream and downstream physical systems and providing livelihood opportunities to local communities, and urging partners and others to work together for the sound management of Himalayan wetlands to ensure ecological sustainability in the context of global change. ICIMOD's publicity material on wetlands conservation was shared offline and online at <http://dev.icimod.org/elibrary/index.php/downloads/publication/579>.

Details of this event are available in the ICIMOD eNews # 28 [www.icimod.org/enews/index.php]

Nira Gurung, ngurung@icmod.org

ICIMOD celebrates World Water Day

ICIMOD celebrated World Water Day 2009 on 22 March. This year the slogan was 'Shared Water - Shared Opportunities' and ICIMOD focused on transboundary waters, highlighting the importance of freshwater and advocating for sustainable management of freshwater resources. ICIMOD's Director General Dr. Andreas Schild sent out a message emphasising the importance of cooperation in transboundary water management, and that it can help to build mutual respect, understanding, and trust among countries and people, and promote peace, security, and sustainable economic growth. The message is available at http://www.icimod.org/index.php?page=362



The World Water Week Organising Committee (Nepal), with representatives from the Government of Nepal, Nepal National Commission for IHP, UNESCO, UN HABITAT, NTNC, WWF-Nepal, ICIMOD and more than 50 water and climate organisations including 18 youth organisations, prepared a weeklong series of events from 18-23 March 2009 on a nationwide scale. The events raised awareness and sensitised policy makers, development planners, bureaucrats, environmentalistd, researchers, advocacy groups, students, and citizens on the proper management of water – a scarce resource. ICIMOD participated in the exhibition from 20 -21 March 2009, displaying various publications on water and climate change. The material brought out for the celebration of World Water Day is available at http://www.icimod.org/resource.php?id=137 The week culminated with the issuing of the Kathmandu Water Declaration 2009, which was adopted as the key outcome of the National Water Week 2009. The Declaration has been widely disseminated and is available at http://www.icimod.org/?page=367

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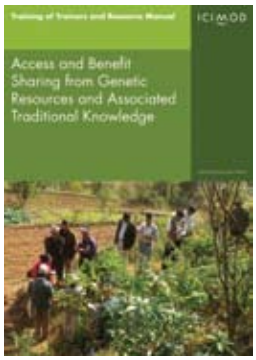
ICIMOD publications

The major documents published by ICIMOD between April 2008 and March 2009 are shown below. All publications can be downloaded free-of-charge from **www. books.icimod.org**. Hard copy publications can be ordered from the Distribution Unit, distri@icimod.org. They can be provided free-of-charge to institutions actively involved in sustainable development of the greater Himalayan region.

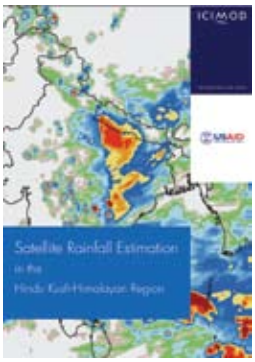


Oli K; Dhakal T (eds) (2009) *Access and benefit sharing from genetic resources and associated traditional knowledge*. 190p
ISBN 978 92 9115 115 8

This manual provides the materials needed to deliver a basic training in access and benefit sharing (ABS) of genetic resources and associated traditional knowledge as provided for under the Convention on Biological Diversity. The background, key components and procedures, and obligations, rights, and responsibilities of the different actors involved are presented in twenty sessions, supplemented by extensive resource materials and sources for further study. The manual is intended to be used for training trainers, who can then multiply the learning across the region, but can also be used to provide basic knowledge to graduate students of related disciplines.

Erikson, M; Xu Jianchu; Shrestha, AB; Vaidya, RA; Nepal, S; Sandstrom, K (2009) *The changing Himalayas: Impact of climate change on water resources and livelihoods in the greater Himalayas*. 24p
ISBN 978 92 9115 111 0

The greater Himalayan region contains the largest area covered by glaciers and permafrost outside the polar regions. The region and its water resources play an important role in global atmospheric circulation, biodiversity, agriculture, and hydropower, while serving more than 1.3 billion people in the basin areas of the ten large Asian rivers. Climate change is affecting the amount of snow and ice and rainfall patterns, but there is a severe lack of the data needed to understand these processes. This paper discusses these issues, the need to close the knowledge gap, the need for adaptation strategies, and the importance of strengthening local knowledge and the institutions relevant for adaptation.



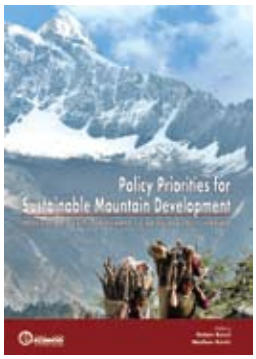
Shrestha, M; Bajracharya, SR; Mool, P (2008) *Satellite rainfall estimation in the Hindu Kush-Himalayan region*. (booklet plus full text on CD-ROM). 10p + CD-ROM
ISBN 978 92 9115 107 3 (printed) 978 92 9115 110 3 (CD-ROM)

Recently, it has become possible to make more accurate estimates of rainfall using observations from satellites to enhance ground-based data. This publication presents the findings of a project in which representatives of the hydrometeorological services of six Himalayan countries carried out quantitative validation of the satellite rainfall estimates (CPC-RFE2.0) obtained from NOAA climate prediction centres at the national and regional levels, and tested a rainfall-runoff model (GeoSFM) to predict discharge. The project had technical support from the United States Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA), and was funded by the United States Agency for International Development Office for US Foreign Disaster Assistance (USAID/OFDA). The results provide an important first step in the use of this new methodology in the region to reduce the impact of water-related disasters.

Rasul, G (2008) *ICIMOD and the Himalayan region – Responding to emerging challenges*. 162p
ISBN 978 92 9115 105 9

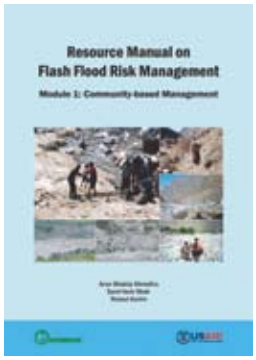
In 2008, ICIMOD celebrated its 25th anniversary, providing an opportunity both to look back and reflect, and to look forward and redefine the Centre's role, responsibilities, and orientation. Selected scholars, development practitioners, and scientists from the region and beyond were invited to provide a commentary on different aspects of the Centre from their personal perspective. This publication is the result. It provides diverse views and insights into the development

of the Centre, a review of its work from a regional and global perspective, ideas about the role it could or should play in the future, and prospects for the Centre.



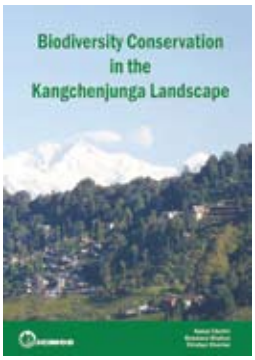
Karki, M; Rasul, G (2008) *Policy priorities for sustainable mountain development: Proceedings and selected papers from the ICIMOD regional policy workshop*. 144p + CD-ROM
ISBN 978 92 9115 098 4

For most governments and planners in the region, planning, programming, and policy making has often been done from the perspective of the plains only. This compendium of selected policy papers, the result of a regional policy workshop that brought together policy makers and development practitioners in the region in 2006, tackles a variety of mountain issues and themes from the perspective. Taken collectively, the papers offer a framework and a lens through which to review policies, government programmes, and development interventions and incorporate the mountain perspective in them. The book discusses policy options in the conservation and management of natural resources, fair trade in natural resources and mountain niche products, innovative mechanisms for payment for environmental services provided by mountain dwellers, and increased equity of access over mountain resources among mountain people. A more complete CD version includes all the other papers read and discussed during the workshop.



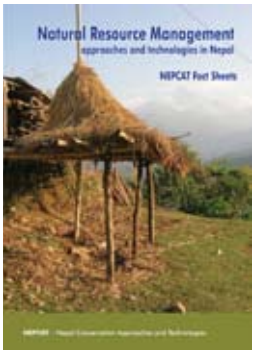
Shrestha, AB; Shah, SH; Karim, R (2008) *Resource manual on flash flood risk management*
Module 1: Community-based management
64p + CD-ROM
ISBN 978 92 9115 090 8
Module 2: Non-structural measures. 102p + CD-ROM
ISBN 978 92 9115 095 3

Flash floods are severe flood events that occur with little or no warning, triggered by intense rainfall, dam failure, outbursts of glacial lakes, and similar episodes. They occur frequently in the Hindu Kush-Himalayan region where they threaten life, livelihoods, and infrastructure, both in the mountains and downstream. Vulnerable groups – the poor, women, children, and people with disabilities – are often the hardest hit. ICIMOD has worked with partners to compile resource materials to help those who are working to reduce flash flood risks. These materials are now made available in the form of a resource manual. The first volume focuses on community-based approaches to managing flash floods; the second looks at technology-based non-structural measures. Both volumes were produced under a USAID/OFDA funded project.



Chettri, N; Shakya, B; Sharma, E (2008) *Biodiversity conservation in the Kangchenjunga landscape*. 172p.
ISBN 978 92 9115 088 5

Around the world, the old paradigm 'people or parks' is giving way to a more humane 'people and parks' approach to biodiversity conservation. ICIMOD's landscape approach to biodiversity conservation reflects this shift, incorporating protecting the rich biological diversity of the Kangchenjunga – a mountain landscape shared by Bhutan, China, India, and Nepal – with alleviating poverty through livelihoods in the areas traversed by the landscape. This publication is a collection of research papers on key conservation and development issues in the southern half of the landscape. It discusses conservation needs, biodiversity values, socioeconomic conditions, and potential enterprise development through income generating opportunities and a policy perspective. The sustainable use of forest resources and alternative livelihood options such as vegetable production, livestock management, and improved agricultural practices are discussed, as well as conservation measures and the impact of conservation policies on land use and tenure systems and customary laws in protected areas.



ICIMOD (2008) *Natural resource management – Approaches and technologies in Nepal. NEPCAT Fact Sheets*. Folder with 30 sheets (also available on CD-ROM)
ISBN 978 92 9115 087 8

Thirty technologies and approaches from the Nepal Conservation Approaches and Technologies (NEPCAT) database, documented using the WOCAT tool, have been published as printed fact sheets to facilitate sharing with a wider audience. The fact sheets are designed to support the efforts of

rural development, especially in Nepal, and provide impetus and ideas for decision makers, development actors, and land users. They cover adaptations of methods and new options for land use and rehabilitation and growing and processing crops that increase productivity and support income generation. Users are encouraged to print out, copy, and distribute the sheets in any form that facilitates sharing. All new contributions to the database and fact sheets are welcome.

Online only

Hewitt, K (2009) *Culture and Risk: Understanding the Sociocultural Settings that Influence Risk from Natural Hazards: Synthesis Report from a Global E-Conference organised by ICIMOD and the Mountain Forum*

ICIMOD (2009) *International Mountain Biodiversity Conference*. Proceedings of conference and pre and post conference workshops

Hoermann, B; Kollmair, M (2008) *Labour migration and remittances in the Hindu Kush-Himalayan region*, ICIMOD Background paper

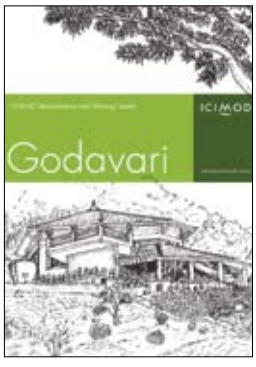
ICIMOD (2008) *Food Security in the Hindu Kush-Himalayan Region*, ICIMOD Position paper.

DVD films

ICIMOD, for Mountains and People

Disaster Risk Reduction (compilation of publications related to disaster risk reduction produced by ICIMOD between 1985 and 2008)

General publications



The Next Five Years: Changes and Challenges in the Himalayan Region (Newsletter No. 54, Spring 2008)

Annual Report 2007

Great Himalayan Trail Preparatory Study: Tsum Valley, Gorkha District (booklet)

ICIMOD Strategic Framework

ICIMOD Demonstration and Training Centre Godavari, Fact Sheets Folder (update)

APMN Bulletin, Newsletter of the Asia-Pacific Mountain Network Volume 9, No. 1

APMN Bulletin, Newsletter of the Asia-Pacific Mountain Network Volume 9, No. 2

Brochures

Responding to the challenges of global change (ICIMOD Flyer) (Lang: Burmese, Hindi, Chinese, Nepali)

Information sheets

Satellite rainfall estimation in the Hindu Kush-Himalayan Region - Validation

Access and benefit sharing from genetic resources

Regional framework on access and benefit sharing (ABS) in the Himalayan Region

Traditional knowledge in the Himalayan region

Pro-poor value chains in mountain areas

Labour Migration in the Hindu Kush-Himalayas : A core livelihood strategy

Labour Migration in the Hindu Kush-Himalayas : Gender Challenges

Can disasters help to improve a country's economy: E-discussion summary

Project Brochures

Regional rangeland programme

Land use change and human health in the Eastern Himalayas: An ecohealth approach: (Phase 2)

Regional project on shifting cultivation (RPSC)

New appointments at ICIMOD (to March 2009)

Ms Elbegzaya Batjargal, Mountain Partnership Development Officer, Asia-Pacific Mountain Partnership Decentralised Hub – Integrated Knowledge Management

Ms Batzargal, a Mongolian national, is an environmentalist with degree in history from Rostov on Don University (Russia) and a Masters in International Environmental Policy from the Graduate School of International Policy Studies, Monterey, USA. She has worked as a Programme Analyst for the Energy and Environment Team, UNDP, in Mongolia and the Maldives, and prior to joining ICIMOD, was the Marketing, Fundraising and Communications Director for WWF in Mongolia. Ms Batjargal enjoys working in multi-cultural teams and having the opportunity to learn and for self-advancement. She views diversity as the key to success and progress.

Ms Basundhara Bhattarai, Gender Specialist, Sustainable Livelihoods and Poverty Reduction Programme

Ms Bhattarai, a Nepali national, joined ICIMOD as a Gender Specialist in February 2008. Her work focuses on documenting gender issues, building the capacities of organisation(s) in mainstreaming gender equity, and promoting gender equity as a crosscutting theme for Hindu Kush-Himalayan mountain development and environmental sustainability. Prior to joining ICIMOD, Ms Bhattarai worked at ForestAction Nepal. She has more than 12 years of experience in research, training, and development, especially in gender and social inclusion dimensions of natural resource management and development. She brings with her the perspective of working together with community-based organisations, non-governmental organisations, bilateral projects, and national and international networks.

Dr Robert Zomer, Environment Change Specialist, Environmental Change and Ecosystem Services Programme

Dr Zomer, a US national, joined ICIMOD in May 2008 as an environment change specialist to provide technical expertise and support networking with global climate

change research. Dr Zomer has many years of experience in the HKH region in areas related to natural resources management, environment, and climate change mitigation. Previously, he was with the World Agroforestry Centre (ICRAF), Nairobi, and the International Water Management Institute (IWMI), Colombo. He was a Peace Corp Volunteer in Nepal from 1984 to 1986. Dr Zomer has a broad background in plant community, forest, and agricultural ecology; as well as practical application of GIS, remote sensing, and landscape level spatial analysis to the issues of sustainable development. Dr Zomer has a PhD in Ecology.

Professor Hua Ouyang, Programme Manager, Integrated Water and Hazards Management

Professor Hua, a Chinese national, joined ICIMOD in August 2008. Prior to this, he was working as Senior Research Scientist and Professor of the Graduate University at the Institute of Geographical Sciences and Natural Resources Research (IGSNRR) of the Chinese Academy of Sciences (CAS). Professor Hua brings with him more than 26 years of research and administration experience including over 14 years with CAS in different capacities. His research studies in the areas of climate change, alpine ecosystems, carbon cycling, and water resources over the past 10 years have resulted in the publication of more than 80 papers – many in international journals. Professor Hua has a PhD in Ecology from Michigan Technological University, USA.

Dr Ambika Gautam, Programme Manager and Country Representative for ICIMOD-Afghanistan

Dr Ambika P Gautam joined ICIMOD as Programme Manager and Country Representative for the ICIMOD-Afghanistan office in September 2008. He is a natural resources management (NRM) expert with over 20 years of experience in designing,

planning, and implementing different NRM programmes. Prior to joining ICIMOD, he worked as a faculty member at the Asian Institute of Technology, Thailand, and taught in other reputed universities as visiting faculty. Earlier, he was with the Government of Nepal as a district level forest manager, and has been associated with the International Forestry Resources and Institutions research programme since 2001. Dr Gautam has a PhD in Natural Resources Management from the Asian Institute of Technology, Thailand.

Dr Ashutosh Mohanty, Regional Capacity Development Officer, Human and Institutional Development Unit

Dr Mohanty, from India, joined the HID Unit in September 2008 and is involved in the IDRC-funded 'Human Capacity Development of Afghan Universities' (HCD/AU) project. Prior to joining ICIMOD, he worked in the University Consortium for Atmospheric Research (UCAR), and the National Center for Atmospheric Research (NCAR), USA; FORUM-ASIA, Thailand; FredKropset, Norway; and for Tsunami 2005-06, in India-Sri Lanka-Thailand. He has also been associated with a number of complex humanitarian programmes and research activities related to socioeconomic development, environmental management, and DRM/DRR programmes (Super cyclone 99, India; Sidr 2007, Bangladesh; Koshi flood 2008, Nepal, India). He has a Masters and PhD in Environmental Governance; LLB from Utkal University, India; and a Masters in Urban Environmental Management from the Asian Institute of Technology, Thailand.

Ms Ester Kruk, Eco-Tourism Expert, Sustainable Livelihoods and Poverty Reduction Programme

Ms Ester Kruk has more than nine years of experience in the field of international cooperation as a pro-poor sustainable tourism advisor and consultant, a researcher in social sciences and tourism, and a programme coordinator, for different international organisations. She studied international tourism management and consultancy as well as cultural anthropology and graduated from both studies with highest honours (summa cum laude). She has published several books, manuals, and papers on tourism, development, and anthropology; won different academic awards, and developed and conducted a number of training courses on topics in this field. She worked as a tourism expert for ICIMOD from February 2005 until October 2007, and happily rejoined ICIMOD in the same position in November 2008.

Sustainable Mountain Development,
periodical publication of the International Centre for Integrated Mountain Development

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Printed by Quality Printers Pvt. Ltd., Kathmandu, Nepal

This publication is available in electronic form at www.books.icimod.org

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