Sustainability of Mountain Natural Resources and Biodiversity in the Hindu Kush-Himalayas

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Abstract

The Hindu Kush-Himalayas (HKH), the highest mountains of the world, act as water towers for major Asian rivers and also abodes of great diversity – cultural, climatic and biological. Since the early 1970s deforestation and loss of top soil, as well as their impacts on the livelihood of the poor farmers of the HKH mountains, have attracted global attention and debate.

The uncertainty surrounding this debate is further complicated by recent evidence of climate change impacts in the HKH. The most obvious impacts are widespread deglaciation, as indicated by quickly retreating glaciers, an increasing number of glacial lakes and catastrophic floods caused by the bursting of such glacial lakes, and a rising trend toward extreme weather events. Such impacts have further damaged the natural resource base, particularly land, water and biodiversity resources, increasing poverty in these mountains.

Recent regional initiatives have, however, shown that participation of local communities in managing their natural resources can reverse degradation and ensure sustainable use and conservation of natural resources and biodiversity both within and outside the protected areas, through appropriate policy incentives.

This paper also discusses lessons in this regard from some recent regional initiatives.

Key words: Biodiversity, climate change impacts, community forestry, conservation, Hindu Kush-Himalayas, mountain ecosystem, natural resources, Nepal

1. Introduction: the Hindu Kush-Himalayas

The Hindu Kush-Himalayas (HKH), stretching 3,500 km from Afghanistan in the West to Myanmar in the east is the highest mountain range of the world, and include Mt. Sagarmatha (Mt. Everest: 8,848 m), the highest peak of the world, and the Tibetan Plateau, the 'roof of the world'. The HKH region is spread across eight countries, viz, Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan (Fig. 1).

The Hindu Kush-Himalayas are often referred to as the 'Third Pole' as they contain the largest mass of ice and snow outside the earth's polar regions. These areas under ice and snow are located at the highest elevations on earth.

The Hindu Kush-Himalayas together with the Tibetan Plateau serve as water towers to major Asian rivers, viz, the Indus, the Ganges, the Brahmaputra, the Mekong, the Yangtze and the Yellow rivers (Fig. 2) and are thus the source of fresh water for nearly 150 million people in the mountains and about three times more in the populous plain downstream spread across several countries.

These high mountains act as a climatic divide between the warm, moist southwest monsoon and the cold, dry continental climate of the north. However, changes in altitude and topography within short distances influence local weather and climates immensely, giving rise to a multitude of micro and meso climatic regions and diverse ecosystems rich in biodiversity.

The mountain ecosystems of the HKH are very fragile and vulnerable. The upward lifting due to active tectonic forces, and the downward pull of gravity on these mountains create an inherently unstable, high-energy environment which is extremely vulnerable to hazards. Growing evidence of global warming impacts such as quickly retreating glaciers and increasing frequency of extreme weather events and associated disastrous floods and landslides have been

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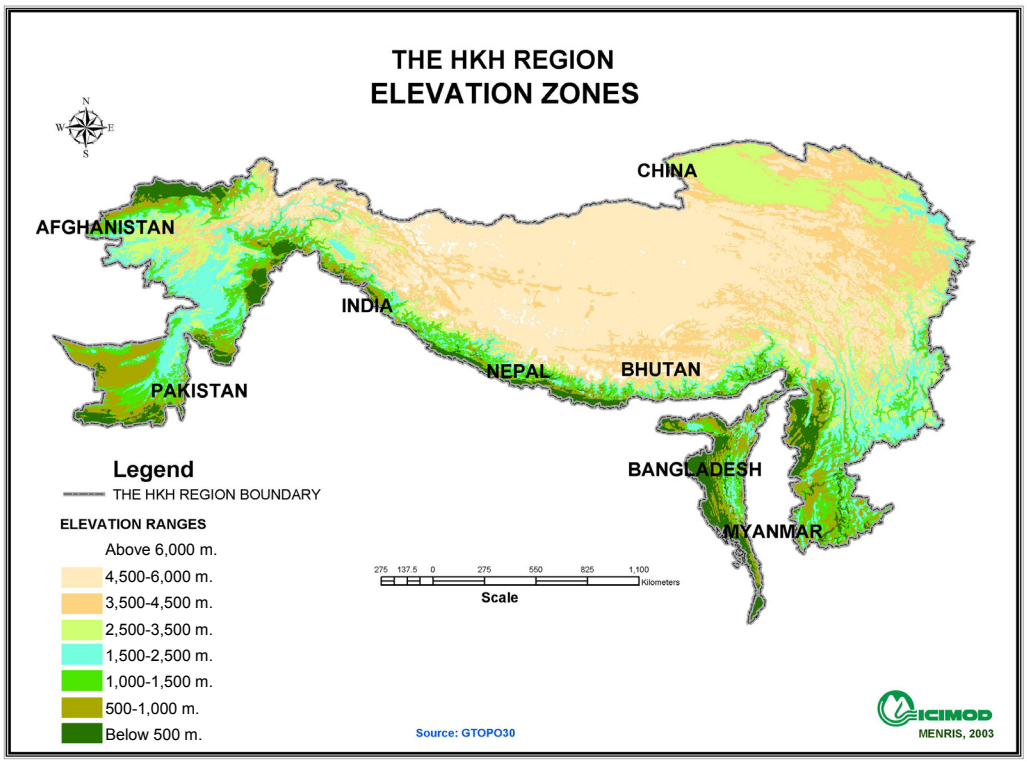

Fig. 1 The Hundu Kush-Himalayan region.

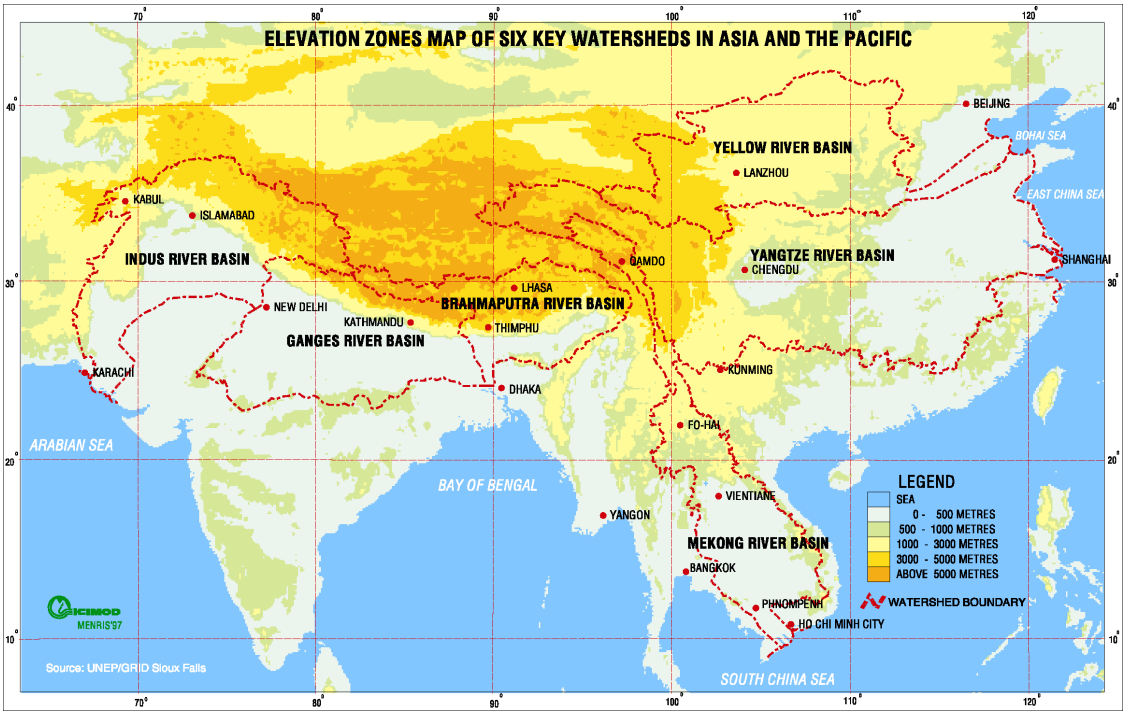

Fig. 2 Map of six key watersheds.

observed, adding to the problem of management and conservation of the mountain ecosystems.

Culturally the HKH region is a meeting point of people of diverse ethnicity and languages who came to inhabit these mountains in successive waves of migration from the northeast and southwest (Gurung, 1984: 203). The intermingling of diverse races and cultures has made these mountains a veritable living anthropological museum of diverse cultures, languages and religions.

These mountains have also been the place of pilgrimage, worship and spiritual realisation for people of many faiths since time immemorial. Nature lovers, mountaineers and adventure seekers from all

over the world have been attracted to these lofty mountains throughout the ages. Tourism is, therefore, a growing economic opportunity for the mountain people, who unfortunately have also been adversely affected, as these mountains are also the stage for territorial or internal arms conflicts, which have been increasing in recent years.

Biogeographically most of this region lies in the transitional zone between the Indo-Malayan and Paleoarctic realms. The eastern Himalayas are also a transitional zone between the Indo-Malayan and Sino-Himalayan realms. The HKH region is therefore very richly endowed with biodiversity, which includes several endemic species of flora and fauna. Indigenous knowledge and management of biodiversity resources by local people have been the principal sustaining features of biodiversity, which is now eroding fast due to market forces.

2. Biological Diversity and Conservation

Natural biodiversity is very high in the Hindu Kush-Himalayas. This is due to the fact that the HKH mountains rise northwards from the Indo-Gangetic plains towards the Tibetan Plateau in a series of folds of rising altitudes, from a few hundred metres above sea level to the highest point on earth, Mt. Sagarmatha (Mt. Everest, 8,848 m a.s.l.), creating four distinct latitudinal zones of varying altitudes.

- The Siwaliks or outer Himalayas: about 10-50 km wide, with altitudes below 1,000 m. Densely populated plains in the adjacent south.
- The Middle Mountains or lesser Himalayas; about 50-80 km wide, with altitudes of 1,000-4,000 m. A region of densely populated middle hills.
- The Higher Himalayas or the Great Hindu Kush-Himalayan range: about 80-140 km wide, with altitudes of 4,000-8,000 m and above. A region of perpetual snow, glaciers and glacial lakes.
- Inner and trans-Himalaya and the Tibetan Plateau: altitudes above 4,000 m.

These altitudinal zones provide the physical setting for vertical zonation of climate and vegetation. Hence, almost all kinds of climates can be found in the HKH, from tropical and subtropical in the southern lowlands to temperate, alpine and tundra in the northern highlands of perennial snow. However, the climate of the HKH is dominated by the southwest summer monsoon which provides precipitation in summer and is stronger in the eastern and central parts than in the western part of the HKH. The eastern Himalayas receive very high precipitation (5,000-10,000 mm annually) during the summer monsoon, although winters can be very dry. The western disturbances, are strong in the western part of the HKH and important for winter precipitation. However, the influence of the western disturbances is weak in the central and eastern parts of the HKH. In general, aridity increases from east to west as well as from south to north. Air circulation and incoming radiant energy are influenced by altitude, aspect and orientation of these complex mountains, causing wide variations in temperature and precipitation, and hence in the climate on the local scale. Such micro-climates, which can differ from one watershed to the other, are very important ecologically. Along with differences in the properties of soil and rocks in different altitudinal zones, such diversity in microclimates has contributed to the existence of diverse ecosystems and hence to the rich biodiversity of the HKH.

The HKH mountains have profoundly influenced the fauna and the flora of the region acting as a barrier between the north and south and allowing only eastward or westward migration of plants and animals. The level of endemism is high among the available species in the HKH. The wild areas of these high mountains, being harsh and inhospitable to human beings and also being remotely located from densely populated areas, have provided protection to many rare and endangered species. The biodiversity of the mountain areas is valuable as it is seen that nearly 50% of the endemic flowering plants found in India are restricted to the Himalayan region (Khoshoo, 1996). This is generally true for the other HKH countries as well.

Many primitive and relict species have been found in the eastern Himalayas, which are considered to have been relatively stable physically and climatically since the Quaternary epoch and very little eroded by glaciers (Chen, 1990). The eastern Himalayan region, which includes part of Nepal, Bhutan, northeastern Indian states and the contiguous areas of Yunnan Province of China, is also listed as one of the ten 'hot spots' of richest areas for biodiversity in the world's threatened tropical forest biotas (Myers, 1988). Many deep and isolated valleys of the region are exceptionally rich in endemic biotas. In Sikkim (area 7,298 km^2), of 4,250 plant species, 2,250 (60%) are endemic. In the other Indian part of this region, roughly 2,000 (36%) of the 5,800 plant species are endemic. In Nepal at least 500 (7%) species out of a total of 7,000 plant species are considered to be endemic. In Bhutan 750 (15%) of the 5,000 species of plants are considered to be endemic to this region. In Yunnan, China, some 12,000 species of plants were recorded and plant endemism rates range from 10% to 34%. A conservative estimate for the whole of the eastern Himalayas is set at 9,000 species with 3,500 of them being endemic (Myers, 1988; Chalise *et al*., 1994).

The HKH region is also rich in faunal diversity. Table 1 gives the number of species of birds, mammals, reptiles, amphibians and fish in the HKH regional countries.

In situ conservation of biodiversity of the HKH region has received good attention and there is a good

Table 1 Faunal diversity in the HKH countries (no. of species).

Country	Birds	Mammals	Reptiles	Amphibians	Fish
Afghanistan	389	119	2	6	2
Bangladesh	632	125	154	23	736
Bhutan	800	160	NA	NA	197
China	572	499	1186	380	279
India	2,100	350	453	182	NA
Myanmar	967	300	241	75	NA
Nepal	844	181	100	43	185
Pakistan	666	188	174	16	156

Data Source: Country Review Papers. *In*: Pei Shengji, ed., (1996) Banking on Biodiversity. Report on the Regional Consultation on Biodiversity Assessment in the Hindu Kush-Himalayas. Kathmandu: ICIMOD.
Note: NA= information not available.

network of national parks and protected areas of various categories in all the countries. There are 420 protected areas spread across the countries of the HKH, which occupy about 2.5% of the geographical area of the region (Chalise *et al*., 1994). Although they do not represent all the ecosystems, they are essential to biodiversity conservation in the region.

More recently neighbouring countries have cooperated to establish transboundary national parks and work together for the conservation of biodiversity as seen between China and Nepal through the establishment of Qomolongma Nature Preserve in the Tibetan Autonomous Region of China and the Makalu Barun National Park and Conservation Area of Nepal through the facilitation of the Mountain Institute (Campbell, 1997: 247). Together with the existing and contiguous Sagarmatha (Mt. Everest) National Park and Langtang National Park in Nepal, a large area around Sagarmatha (Mt. Everest) has been dedicated to conservation across the two countries.

There are also other encouraging developments such as the Annapurna Conservation Area Project (ACAP) in Nepal under which protected areas are managed by an NGO in partnership with local communities (this is discussed in detail later on), and communal managed local forests in Nepal and India which contribute significantly to biodiversity conservation in the region.

Systematic and comprehensive information on natural biodiversity and agro-biodiversity is, however, still not available. Regional consultations facilitated by ICIMOD on biodiversity (Pei, 1996) and agrobiodiversity (Partap & Sthapit, 1998) have strongly emphasised the need to develop such a systematic data base and information on biodiversity on the national and regional levels.

Incorporation of the concerns of agrobiodiversity into biodiversity conservation poses new challenges. There is a real need to take a more holistic view of biodiversity conservation that recognises people's cultural practices as a positive factor contributing to higher biodiversity levels.

The need for involving local people and women in biodiversity conservation is critical. Generally speaking, it is necessary to define clearly, who the real beneficiaries of conservation in conservation activities will be and also the clear benefits or compensations that will be provided to local people in order to help conservation, although these issues are also complex (Blaikie & Sadeque, 2000). This also applies to biodiversity conservation.

3. Breaking the 'Myths' of Himalayan Environmental Degradation

Much of the global discussion about environmental degradation in the HKH, which started in the mid-1970s, focused primarily on ecological concerns, particularly on deforestation caused by rapidly growing human and animal populations and its negative impacts on local and regional ecologies and the livelihoods of mountain farmers. Erosion of productive top soil and sedimentation downstream were considered the principle causes of poverty and the increase in the extent and magnitude of flood events downstream on the national and regional scales (Eckholm, 1975, 1976). Since then most research work has focused on quantifying relative roles, impacts, and contributions of human and natural processes in causing ecological and environmental degradation in the region. These studies, which include a sustained and systematic UNU project on Highland-Lowland Interactive Systems, have clearly demonstrated that relevant and reliable data and information were lacking to deal with the 'uncertainty' in quantifying the impacts of human and natural processes on increased loss of topsoil on the mountain slopes, sedimentation and downstream flooding (Thompson *et al*., 1986; Ives & Messerli, 1989). The 'Myth' of a downward spiral of environmental disasters presumed to be unleashed by deforestation caused by indigenous mountain farmers, which has been widely publicized, has been challenged and discussed extensively by Ives and Messerli (1989) in their book *'The Himalayan Dilemma*.' They have argued that the connections between various parts of the so-called 'Theory of Himalayan Degradation' are untenable, some of which can neither be proved nor be disproved in terms of the available body of information. A recent study from Nepal, where community forestry has been successful in in-

creasing forest cover, has reported that the overall landscape is being steadily afforested at the hands of the farmers (Gilmour & Nurse, 1991). The linkage between deforestation in Nepalese mountains and floods in Bangladesh has also been questioned and there is no agreement among experts that deforestation in uplands is an important contributing factor to downstream flooding in general (Hofer, 1998).

'*The Himalayan Dilemma*' (Ives & Messerli, 1989) can be considered as a milestone publication on the Himalayan environment, which has helped and even forced people all over the world to reconsider the issue of environmental degradation in the Himalayas in terms of real facts and figures and not simply in terms of plausible but unsubstantiated theories and myths, which started with the publication of '*The Losing Ground*' (Eckholm, 1976). Both publications, however, have helped to raise global attention to the problems of increasing poverty and environmental and ecological degradation in the Himalayas. Since then national and international programmes for innovative forestry and watershed management, environmental conservation, poverty alleviation, and appropriate policy changes have no doubt been intensified in almost all the countries of the HKH.

Such interventions, however, have not been able to achieve the desired goals, although there are some good and successful examples of environmental conservation and development in some isolated pockets of the HKH countries.

4. Poverty, Outmigration, Women and Ecosystem Degradation in the Hindu Kush-Himalayas

4.1 Poverty and outmigration

The population has been found to be doubling every thirty years, and the people in the HKH mountains are becoming poorer day by day. According to a recent World Bank report (2001), the per capita income of some of the HKH countries is among the lowest in the world.

As these mountains have no significant deposits of coal or other mineral resources, except for some localised mining and cement industries, there do not seem to be significant prospects for industrial employment in the HKH mountains. With lowering agricultural productivity, particularly due to the non-availability of irrigation water during the dry period, outmigration of able bodied men is increasing. There exists a long tradition of mountain men leaving home for employment in the army and the cities in the plains. In addition mountain people leave their countries in increasing numbers in recent years for employment abroad. The remittance economy has always been important for the mountain people of the HKH countries. However, in some countries like Nepal more and more young women also migrate from their village to seek new opportunities in the cities along with their menfolk. For example, the Kathmandu-based carpet industries attract a lot of women and men from neighbouring hills and mountains. This new trend of outmigration of both the male and female youth population from the mountains to the national capitals or urban centres and also to foreign countries has seriously affected the rural agricultural sector. Outmigration to emerging urban areas and market towns is also significant due to increased natural hazards in the midhills of Nepal as shown by a study in the Madi watershed of central Nepal (Khanal, 2001).

4.2 Women and mountain ecosystems

For most parts of the HKH mountains, it can be said that women are the true managers of their farmlands and forests. As able bodied men tend to leave home fairly young and return only when they retire, much of the day-to-day management of farmlands and use of forests in the HKH mountains is carried out by women. The drudgery of mountain farming has been passed cleverly by men to their women for a long time. Furthermore, as sons are considered insurance for old age. Whereas daughters marry and leave their parents, sons are prized and receive all the attention for education, food and freedom from household chores, while girls are discriminated against right from childhood. In general, therefore, women in the mountains grow up with no opportunities even to be literate. However, when they marry, they have to face the predicament of managing the husband's farm with whatever knowledge and experience they might have gathered in their parental home. This has been repeated from generation to generation.

Conservation or degradation of mountain ecosystems, whether agricultural or natural, therefore, depends largely upon the ability of women in the mountains to manage them. As the status of women in the HKH mountains is very low, the first prerequisite for sustainable conservation of the mountains natural resources and biodiversity is to empower women and raise their status so that they have the same access as men to education, physical development and employment. Unless women understand the importance of conserving their ecosystem and are skilled enough to conserve, and unless they derive benefits from such conservation, it will be difficult to improve the health of the mountain ecosystem or to halt its degradation.

5. Water: the Critical Natural Resource for the Sustenance of Biodiversity

5.1 Sustainability of Water Resources in the HKH

Sustainability of biodiversity in the HKH mountains will depend largely upon year round availability of water for the plant and animal species of its ecosystem. Generally speaking the HKH mountains have abundant water resources; however, its year round availability is a problem in the mountainous regions, except in the higher Himalayas with altitudes above

4,000 m.

Water supplies in the HKH mountains are seasonal, mostly from precipitation caused by the southwest monsoon in summer and the western disturbances in winter. The influence of the summer monsoon is strong in the east and diminishes gradually to the west, being almost insignificant in the Karakoram region. Similarly, the influence of the western disturbances is predominant in the west and becomes insignificant in the east. The influence of the monsoon is essentially confined to the south of the main Himalayan crest. The northern Trans-Himalayan region and the Tibetan Plateau are practically dry. In the areas affected by the monsoon, mostly in the central and eastern HKH, precipitation is confined to four months between June and September (about 80%) and the remaining months are practically dry. The eastern Himalayas receive maximal monsoon precipitation (*e.g.*, Cherapunji, India; 12,000 mm/year, the world's highest). In the western HKH, precipitation caused by the western disturbances occurs mostly during four months in winter and early spring (late November to early March). Such a marked seasonal precipitation pattern greatly influences water supplies at different times of the year, even in areas where precipitation is high. Scarcity of water is common during the dry periods. Thus, people in the HKH mountains have had to cope with either 'too much' or 'too little' water at different times of the year. This seasonal characteristic of precipitation across the HKH also influences natural hazard events in the region, which contribute significantly to land degradation.

However, precipitation in the western HKH, trans-Himalayan region and Tibetan Plateau is very low and these are very arid regions with precipitation as low as 100 mm per annum. Hence the ecosystems in the HKH mountains vary widely from west to east and south to north in terms of aridity and wetness.

As mentioned earlier, this region is the origin of major Asian rivers which have nurtured major civilisations. Table 2 provides annual discharges of these rivers.

There are naturally high hopes for water to transform the economy of the region through its utilization for power generation, irrigation and flood control. The hydropower potential of HKH countries is high according to the available estimates: the total theoretical power potential of HKH countries (not including Afghanistan) is nearly 429,000 MW (Chalise, 2000). This is a substantial amount and naturally raises high hopes in the region (Verghese, 1990), although few countries have been able to utilize such hydropower potential optimally, mainly due to their inability to invest and collaborate in national and regional power projects. Political differences have overwhelmed and prevented economic cooperation between countries to undertake large scale regional hydropower projects so far, although there are some examples of bilateral cooperation in the region.

The region has suffered major climate-induced disasters in recent years. Consecutive catastrophic monsoon floods occurred in Bangladesh during 1987 and 1988; there were floods in the Indus Basin in September 1992; a disaster was caused by floods and debris flows in south-central Nepal in July 1993; and there were floods along the Yangtze in 1995 and 1999. Relating these events to the impacts of climate change in any given pattern is difficult. It has been claimed that the Pakistan flood was caused by the changing strength and timing of summer monsoon incursions into the Trans-Himalayan region of Karakoram. This was earlier considered to be an event that occurred every fifty years, although now it has been found to occur more frequently. A recent analysis of extreme weather events with precipitation exceeding 200 mm/24 hr. in Nepal showed a significant increase in such events during the 1980s compared to the 1970s (Chalise & Khanal, 2002). However, the impact of climatic processes, particularly intense rainfall events of short duration, on the ecology and environmental degradation of the mountain ecosystems of the HKH, has received insufficient attention. A recent study demonstrates that human processes are more important in micro-basins, whereas natural processes predominate in macro-basins (Hofer, 1998). It has also demonstrated that without a better understanding of the processes occurring on the meso-scale and the linkages between these processes on different scales, it will be impossible to ascertain the actual roles of human beings and nature on environmental degradation in the HKH.

Systematic studies have yet to be carried out on seasonal snow cover in the HKH. One study shows that the glaciers in this region have been in a general

Table 2 Annual discharges of major Asian rivers.

River	Mean Discharge (m^3/sec)	Drainage Area (km^2)
Indus	3,850	1,263,000
Ganges	15,000	1,075,000
Brahmaputra	20,000	940,000
Mekong	15,900	795,000
Huang He (Yellow river)	1,365	445,000
Yangtze	35,000	1,970,000

Source: Institute of Geography, University of Berne (1998).
Mountains of the World, Water Towers of 21st Century.

state of retreat since AD 1850 (Mayewski & Jeschke, 1979). In the Indian and Nepalese Himalayas it has been observed that glaciers have been retreating more rapidly in recent years than before (Hasnain, 1999). This is also evidenced by the recent increase in glacial lake outburst flood (GLOF) events in many countries in the region.

Generally speaking increased monsoon rainfall, increased precipitation, and the shrinking of areas under snow, ice and permafrost are the likely impact of climate change in the HKH (Chalise, 1994). These have serious implications for food production; power generation; water supplies, particularly during the lean period; and the frequency of natural hazards (floods and landslides) in the HKH.

Although there are a lot of uncertainties involved in reliable assessment of global warming impacts on the water resources of the HKH, there is already ample evidence that deglaciation is widespread and glaciers are retreating rapidly in the region. As the Tibetan Plateau and the high Himalayas are found to be highly sensitive to climate change, a general inference from this evidence indicates a decrease in water availability in the region particularly during the lean period, in the not too distant future. This will have a devastating impact on both human and natural communities of the region.

The impact of global warming on the permafrost areas of the region is another important issue on which available knowledge is very limited.

A lack of water, along with a lack of other natural resources, leads to increased poverty, the intensification of social discrepancies, the growth of inter-ethnic tensions, and ultimately, the emergence of armed conflicts (Abdryazakov, 1997). Ecosystem degradation which is likely to occur in the future due to decreasing availability of water in the HKH mountains has, therefore, social, economic, and political implications.

6. Eco-Restoration, Biodiversity Conservation and Community Participation

6.1 Lessons from external interventions: national and international initiatives

During the last three decades or so, all the countries of the HKH have initiated programmes and policies, with some external assistance, for improved management of natural resources and ecosystem restoration. In fact the agenda of environmental conservation as a global priority was initiated by developed countries and the HKH countries are also expected to accord high priority to this agenda.

Broadly speaking, most of the projects, whether internally or externally funded, had mixed success in achieving the desired goals — ecological restoration through restoration of forests and poverty alleviation in the HKH mountains. Considering those programmes are concerned mainly with ecosystem and biodiversity conservation and soil and water conservation, failures can be traced to failure of beneficiaries to be involved or participate in the planning and management of the projects in which decisions are made generally at the central level. In many cases such projects seem to have too many externalities — external ideas and concepts, external expertise, external solutions and above all external funds which depended largely upon the interest and adhoc decisions of central authorities or donors and in which the real stakeholders have no influence. With weak national institutions and lack of sufficient commitment at the national level, these failures were probably unavoidable in the early years. The sad fallout of these failures was increased dependency on external assistance and an almost total decline of traditional conservation practices.

6.2 Community participation: the paradigm shift

During the same decades the development and conservation paradigm has also shifted gradually from sectoral to integrated and finally to participatory programmes. National policies of the HKH countries have also given increasing priority to decentralization in recent years. This has come through the realisation that without active involvement and participation of the real stakeholders, which are the beneficiary communities, the desired goals will not be achieved at any stage of a project/programme cycle. Thus development and conservation projects have now become 'people centric.' This is a welcome change and expected to ensure long-term sustainability of project activities.

At the same time non-governmental organisations (NGOs) and social action groups, whether local, national, or international, have also emerged as important partners in the formulation and implementation of conservation projects in the region.

7. Regional Initiatives

Some innovative regional initiatives involving local communities, NGOs and government institutions in natural resources management, nature conservation and ecosystem restoration have provided good results during the last decade or so. A few such initiatives are briefly discussed below.

7.1 ICIMOD and mountain ecosystem conservation

An important regional initiative is the establishment of the International Centre for Integrated Mountain Development (ICIMOD) in Nepal in 1983 through the initiative of UNESCO's Man and the Biosphere Programme with the support of the regional countries. ICIMOD is the first international centre devoted to ecologically sound and sustainable development of the mountains with a primary focus in the HKH (ICIMOD, 1998). Since its inception ICIMOD has contributed to the sustainable development and

conservation of the mountain ecosystems of the HKH through its various programme activities, which it implements in close partnership with the regional member countries (Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan), participating communities, NGOs and community-based organisations.

The secretariats of the Mountain Forum and Asia Pacific Mountain Network which are global forum and electronic networks of researchers, academics, development practitioners, students and others interested in the development of the mountains and the mountain people are also located at ICIMOD. ICIMOD has also been providing a secretariat for a regional network of hydrological research, the HKH-FRIEND (Flow Regimes from International Experimental and Network Data), which is one of the eight groups of UNESCO's FRIEND project under its International Hydrological Program. Conservation of mountain ecosystems and sustainability of mountain natural resources and biodiversity have remained high priority focal areas for ICIMOD's initiatives. An innovative project of ICIMOD in this regard is briefly discussed as an example.

7.2 Rehabilitation of degraded lands in mountain ecosystems

A Regional Project for 'Rehabilitation of Degraded Lands in Mountain Ecosystems' was implemented by ICIMOD in China, India, Pakistan and Nepal to develop a better understanding of the extent and processes underlying land degradation, and to identify measures for restoring and developing degraded lands by using options that are field-tested and found to be economically, environmentally and socially viable. This regional project was supported by the International Development Research Centre (IDRC), Canada. The experiences of the Project implemented in the Kabhre Palanchok District, Nepal, are briefly discussed here.

The Project selected two sites in the Kabhre Palanchok District in April 1993 in collaboration with the District Forest Office, after prolonged discussion and consultation with local community leaders and participating communities of both sites. As both sites had degraded forest lands being used for open grazing by the local communities, considerable time was needed initially to discuss with and convince the communities to agree to social fencing of the planting sites instead of the traditional barbed wire fencing which had failed to protect earlier plantations at those sites. For this they had to keep the animals away and introduce stall-feeding. As stall-feeding was a new concept and more demanding than free grazing there was a considerable scepticism about its success in the beginning. However, the local people were willing to experiment with the idea of 'social fencing' and practice 'stall feeding.' Both sites are located on degraded common lands on 'red soil' which are considered as the most degraded lands in the watershed.

The local communities decided to manage the two project sites as community forests, and forest user groups were formed at both sites. The sites have been protected by them from domestic animal, through social fencing. This was achieved firstly through consensus in the forest user groups involving the majority of stakeholders, and reinforced by forest watchers employed by the forest user groups. A modified Sloping Agricultural Land Technology (SALT) (Partap & Watson, 1994) combining nitrogen fixing contour hedgerows, with tree seedlings planted between the rows, was used at the sites. It was probably the first time in Nepal that this technology had been applied for rehabilitation efforts on such a scale with community participation. Plant and fodder species were selected in accordance with the priorities of the participating communities and diverse species, including locally growing useful species were planted. Operational and financial management of the site was done by the communities themselves with technical support from the project. Financial support provided by the project was transferred to the bank account of each of the two forest users groups and transparency in financial operation was strictly maintained throughout the project period (ICIMOD, 1996).

Local community participation in the project-supported activities has been very good due to a collaborative mode of project implementation (Chalise *et al*., 1995). The formation of forest user groups; support for a water supply scheme, which the forest user groups planned and implemented; and capacity building were important in generating and sustaining the interest of the local people. Other factors that influenced people's participation include relevancy of the site and project activities and immediate or perceived benefits from planted trees and fodder (Karki & Chalise, 1998).

Since the project ended in 1995, the two rehabilitation sites have been included in the Jhikhukhola Watershed component of the People and Resource Dynamics Project (PARDYP) of ICIMOD, which was started in 1996 to provide continuity to the earlier works started under the Rehabilitation Project (ICIMOD, 1999).

Both sites have been taken care of by the local people even after 1996 and are being monitored under the PARDYP project. Because of strong community support and ownership of the project, social fencing has been fully successful at both sites and there has not been a single incidence of free grazing to date since the planting in 1993. In the Himalayan context this is a great achievement. Stall feeding has not only been widely accepted in the project areas; it has almost become a norm elsewhere in the district. This has contributed significantly to an increase in green cover in the common lands of the district and improved ecological health.

The project clearly demonstrated that even the most degraded lands could recover their vegetation cover and be productive. Participating communities started getting tangible benefits, such as fodder, from the degraded project sites, within a reasonably short period of time. The benefits from 'social fencing' could also be observed physically by the stakeholders in terms of an increase in natural regeneration, which was found to have increased by 15% to 100% at various sites (Karki & Chalise, 1998). Reduction in soil and gully erosion through the use of contour hedgerows and simple bio-engineering works, which were easy to comprehend for the local people and construct locally, was significant. The participating communities could observe such positive physical changes within a few years. Such benefits and physical improvement of the project sites convinced them of the usefulness of the project activities. A very important factor which provided the necessary incentive to the local people to own the project and participate actively in it was the legal framework for the community forestry program which ensures the sole rights of the participating communities, as members of their local forest user groups (FUGs), to the products and incomes from the existing forests or new plantations. The FUGs are entitled to 100% of the benefits and incomes from their community forests and they do not have to share them with the government or any other institution or individual outside the FUGs. Such a legal framework provided the necessary incentive to the local community, which also included a significant number of female members, to organize themselves, participate in the project actively, and continue the work even after the withdrawal of project support. Replication of the project activities could also be seen on the private lands of the local participants. The experience of this project shows that effective participation of the local community is possible in managing degraded land and forest resources to improve their status and that it can be sustainable if expected benefits are achievable within a reasonable time frame, provided the legal rights of the participating communities to the income, and benefits generated by improved management of such resources are clear and well protected.

7.3 The Annapurna Conservation Area Project (ACAP), Nepal

The Annapurna Conservation Area Project (ACAP) is an example of the growing role of NGOs in nature conservation in active partnership with local communities in the region where innovative ideas have led to encouraging success.

ACAP was started in 1986 by the King Mahendra Trust for Nature Conservation (KMTNC) a leading Nepalese NGO with Royal patronage, as a model protected area managed by an NGO in partnership with local people (Bunting & Wright, 1985). It has already completed a successful fourteen years of remarkable achievements in the conservation of natural resources and biodiversity of the ecosystems of the Annapurna region of central west Nepal. The legal framework for the management of the conservation area and the mandate to KMTNC to manage the area have been provided by His Majesty's Government of Nepal.

This is a pioneer project which has tried to provide a new concept of protected area management, in which the needs of the local people and nature conservation are well integrated in a symbiotic relationship between man and nature. ACAP was established to mitigate the problems of degradation of the fragile environment of the Annapurna region and improve the quality of life of the local people. It now covers an area of 7,629 km^2, spreading over 55 Village Development Committees in the districts of Manang, Mustang, and large parts of Kaski, Myagdi and Lamjung of Central and mid-western Nepal involving about 120,000 inhabitants (KMTNC, 2002).

The three guiding principles on which ACAP was designed are (KMTNC, 1999):

People's participation: To involve the local people in the planning, decision-making and implementing processes and delegating responsibilities for managing the conservation area. On the grassroots' level, the project has helped in the formation of various users' committees which facilitate the active participation of the people in all stages of project planning.

Catalysts or match-makers: To act as a matchmaker to meet the needs of the inhabitants and to manage over 100,000 annual visitors. In addition to tourism-related activities, the project attempts to act as a bridge between various international and national agencies and accesses appropriate expertise and resources to meet local needs.

Sustainability: To ensure that only those projects and programmes are implemented which people can manage even after external support is withdrawn. Sustainability has been ensured by encouraging people to participate and by making them invest in cash or kind in conservation and development.

The ACAP model has been successful in translating the above-mentioned criteria into action, and a new scheme of zonation has been introduced, which recognizes five major use types: biotic/anthropological zones, wilderness zones, protected forest/seasonal grazing zones, intensive-use zones, and special management zones.

One of the important features of this project is that of ploughing back the entrance fees of tourists into development programmes that directly or indirectly benefit the inhabitants of the conservation area. These include the introduction of and support for community forestry and tree planting, installation of mini hydropower plants, training of lodge owners, and supporting the establishment of lodge owners' associations and forest user groups.

This project has successfully demonstrated that conservation areas in the remote mountains of the

HKH can be managed very well even by NGOs if the local communities are closely involved in the planning and management of such areas, with necessary policy support from the government.

7.4 Nepal's community forestry programme

The community forestry programme in Nepal grew out of an innovative concept on Community Forestry developed and implemented successfully in 1973 by the Chautara Forestry Division in some areas of the two districts of Nepal, Sindhu Palchok and Kabhre Palanchok, as an exercise in 'productive partnership' in forestry between the local people and His Majesty's Government (HMG), Department of Forest (Mahat, 1987). This initiative was further developed and implemented within the same two districts of Nepal, under the Nepal–Australia Forestry Project (NAFP) in its Phase II program during 1979 and 1985. According to Mahat (1987), 'The Australian side thus joined the partnership of the local people and HMG Forest Department in the Chautara Community Forestry Program.'

The success of the Community Forestry program in Kabhre Palanchok and Sindhu Palchok under NAFP-II encouraged its expansion to other districts of the country and a national program in community forestry was launched in 1987 as part of the newly prepared Master Plan for the Forestry Sector (MPFS) with the support of the World Bank and other donors. Under this program, some parts of the national forests were handed over by the government to the local community for management and used to meet their basic needs for forest products, such as fodder, fuel-wood, timber and leaf litter for animal bedding and organic manure, with the proviso that they did not have to share the income from such community forests with the government. This program originated and was focused on the hill forests of the country in the beginning. Presently, it is implemented throughout the country and is facilitated by the Forest Act of 1993 and the Forest Rules of 1995 (Kanel, 2004). Initially, such community forests were handed over to the local political bodies, but later on they were handed over to the actual users living in close vicinity of such forests. The users were organized to form local community forest users' groups (CFUGs). These CFUGs were legitimized by the district forest officer (DFO) as independent, voluntary and self-governing institutions. Before handing over a forest to the local community, an Operational Plan for that forest was first prepared jointly by the DFO and the local CFUG for its future operation and management. The authority assigned to the DFO and CFUGs over the management of national forests and the relationship between them and other government institutions, civil society and the private sector have helped to resolve the problems of exclusion and extraction inherent in classical forest management regimes. This has led to a conducive governance environment leading to improved health of forests and enhanced livelihood of the local people. So far, about 1.1 million hectares of forest lands (25% of the total) have been handed over to more than 13,000 CFUGs, which constitute about 35% of the total population of Nepal (Kanel, 2004). Out of these 13,000 or more CFUGs, 648 groups consist only of women.

The community forestry programme has revolutionized the forestry sector in Nepal. Internalising the lessons learnt over time and refining the practices, it has been very successful in halting the degradation of forests and bringing back the green, particularly in the midhills of Nepal. It has also fulfilled to a large extent the basic needs of the local community for forest products. As farming in the midhills is still dependent heavily on forest products, it has also helped in maintaining, if not increasing, agricultural production in these areas. There is, however, a general concern in the midhills that despite the increase in vegetation cover, for which the CFUG members provide time and labour voluntarily, economic opportunities provided by community forestry are still insignificant, although this situation is changing slowly. A study of income and expenditure of 1,788 CFUGs from twelve districts, covering both the Terai and hills, in the year 2002 showed that the total sale of forest products from community forests fetched about US$10 million (747 million Nepali Rupees) (Kanel, 2004).

The formation of CFUGs has successfully brought the real stakeholders together and also helped in the devolution of authority and power to the local people. The incomes generated and benefits provided by the CFUGs have helped to ensure sustainability of the community forestry program. CFUGs have also filled the gap of local community institutions and helped their members become aware of their rights and realize the strength of being organized for their common good in other spheres of activities. CFUGs and their members are now contributing actively also to other spheres of community development in their localities all over Nepal. As CFUGs have legal backing and are firmly rooted, they are also likely to be more sustainable in the long run. Networks of CFUGs are emerging as an important lobby in Nepal through the national networking organization, the Federation of Community Forestry User Groups of Nepal (FECOFUN), and forest user groups' networks within districts (Karki & Chalise, 1998).

The main achievements of the community forestry programme can be said to be improved condition of forests, social mobilisation, income generation for rural development, and institution building at the grass roots level. Presently, nearly 143,000 committee members (of which 35,000 are women), who are elected representatives of over 13,000 CFUGs (representing over 35% of Nepal's population), are making decisions about forests, funds, and other development activities (Kanel, 2004). As protection and improved management of community forests have led to an increase in natural regeneration of indigeneous flora and

fauna, the Community Forestry Program has also contributed significantly to biodiversity conservation in Nepal. Unfortunatelly, biodiversity conservation has not received enough attention so far in preparing the Operational Plans. It is therefore difficult to quantify the impact of community forestry on biodiversity conservation. This should receive due attention in the future.

Emerging second generational issues in Nepal's community forestry are primarily concerned with increased representation of women and weaker sections of society in the CFUGs and sharing of CFUGs' income with the government. It has been found that CFUGs are largely dominated by the local elites and male members, and representation of women, the poor, and the disadvantaged groups belonging to the minority caste or ethnic groups must be improved so that they have a fair share of benefits and equitable participation in the decision making process of CFUGs. How to achieve this objective is presently under active debate and discussion. With regard to the sharing of income with the government, there has been a major shift in government policy after the community forestry programme was implemented in the southern Terai districts. Because of the potential and use of Terai forests for commercial purposes, the government has proposed that it will collect 40% of the earnings from the CFUGs of the Terai districts for programme implementation. This has raised fresh controversies and debate, and it is being opposed by the CFUGs from the Terai districts. Those who advocate revenue sharing between the government and the CFUGs cite the joint forest management programme on Social Forestry of neighbouring India, which was launched around the same time as Nepal's community forestry, during the late 1970s, in which revenue sharing between the government and the local forest user community organisation has been practiced from the very beginning. However, the debate is still continuing and no consensus seems to be emerging.

Nepal has launched a radical program in community forestry in the HKH region. Its success has attracted the attention and interest of other countries of the region and outside. It has also attracted wide attention of donors and researchers. A similar programme was also launched by India on social forestry. A closer dialogue between HKH countries would be beneficial for sharing experiences and exchanging information to refine the on-going programs, or to launch new programmes in community forestry in the region (ICIMOD, 1992).

8. Discussion and Conclusions: Sustainability of Mountain Ecosystems in a Changing Environment

Mountain environments in the HKH are changing rapidly. It is not only the doubling of the population over the last three decades, but also the changing aspirations and priorities of the mountain people. Mountain people are no longer satisfied to remain on the fringes. They also want to have control over their resources, whether it is water, forests or wildlife. In short, they want to have the power and authority to decide on how their environmental resources should be used and are no longer willing to let a central authority or an external agency decide on it. Given the chance and necessary support, as discussed in some of the regional examples earlier, they have shown their ability to manage their resources wisely and sustainably and are even willing to bear inconveniences or hardship to improve the health of their ecosystems. They certainly need help and they are seeking help from their governments or external donor agencies or academic bodies to develop their capacities in terms of both knowledge and skill to be able to manage their environment and use their natural resources sustainably in order to improve the conditions of their livelihoods and economic status.

Obviously, conflicts are on the rise in the mountains. They are no longer confined to territorial conflicts between nations. More and more, these conflicts are within the countries, between the mountain people and central authorities for local autonomy and control over their natural resources.

Aspirations of the people for a better life and an honourable place in the national and global arena are growing fast, because the impacts of globalisation have also reached the mountains. Telecommunications, satellite TV and internet are no longer unknown in the mountains and the latest lifestyles and entertainment of contemporary western life have reached even the most remote mountain households in the HKH. The impacts of these have been unprecedented. The old order and traditions are crumbling fast and people in the HKH mountains want to leapfrog from their near medieval life and traditions to the contemporary life of the 21st century.

Mountain environments are also changing in the HKH due to the impacts of global warming (Chalise, 1994). Studies from Nepal have shown an increasing trend in extreme weather events (Chalise & Khanal, 2002) and warming of air temperatures (Shrestha *et al*., 1999) in recent years. Deglaciation, retreating glaciers, an increasing number of glacial lakes and increasing events of glacial lake outburst floods have also been reported in some countries of the HKH (Ives, 1986; Hasnain, 1999; ICIMOD/UNEP, 2001a, b). These indicate growing impacts of global warming in the region, despite some uncertainties and difficulties in quantifying such impacts. It is certain that such changes are going to affect the ecosystems of these highest mountains profoundly in the coming years.

It is also seen that most of the generalisation on the state of HKH ecosystems is still based on short-term research and insufficient data. A longer term approach for systematic research on human and natural processes affecting the ecosystems is essential for dealing

with the known and new uncertainties that are impacting or are likely to impact on the ecosystems of these mountains overwhelmingly.

In the past, dissemination of success stories, ideas, knowledge and skills in the mountains was seriously hindered by the lack of communication facilities. In this age of the Internet, such hindrances are no longer insurmountable. The use of the Internet to disseminate the lessons from successes and failures as well as for the transfer of knowledge, technology and skills should be fully utilised. There are already some regional initiatives in this regard such as those of ICIMOD, which should be encouraged with appropriate support.

It is clear to all concerned what needs to be done, but the vexing question is how it should be or can be done and who should be doing it. In the final analysis, sustainability of natural resources and biodiversity of these mountains depends upon the willingness and ability of the people in these mountains to manage their resources sustainably. Even if conservation of mountain ecosystems and natural resources is a global agenda, the challenge lies in making it an agenda also of the marginalised and poor mountain people. Unless that happens, sustainability of natural resources and biodiversity in the HKH mountains will remain questionable.

Both the human and natural environments of the HKH mountains are poised to undergo dramatic changes. These changes will be rapid and are difficult to predict. Sustainability of mountain natural resources and biodiversity must be considered by taking into account the possible impacts of such rapidly changing human and natural environments of the HKH.

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