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Paper 2

Prospective for Developing a Transboundary Conservation Landscape in the Eastern Himalayas

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Abstract

The landscape surrounding Mount Kanchenjunga spreads over a wide spectrum of ecological zones in eastern Nepal, Darjeeling and Sikkim (India) and western Bhutan. It has twelve important protected areas scattered as 'islands' covering about 5904 km². The area is considered as part of one of the 34 Global Biodiversity Hotspots of the world. It has a unique situation where within a 100 km N-S transect, habitats range from tropical to alpine vegetation. The landscape provides contiguous habitat across the political boundaries for many umbrella species such as snow leopard, takin, tigers and elephants, which otherwise could have been restricted in the individual existing protected areas. This paper emphasizes the feasibility assessment of developing a landscape with conservation corridors as connecting links to existing protected areas in the Kangchenjunga complex. The study revealed many potential forested areas that could be developed to provide connectivity between the protected areas as well as across the landscape. There is a high potential for developing a transboundary landscape across the complex, and conservation corridors can connect the existing protected areas to play an important role on both vertical (altitudinal) and horizontal coverage for conservation. Such a transboundary landscape helps countries to meet conservation goals under international agreements. However, the dependency of people on these forested lands is enormous. To address the livelihood issues will require economic development as incentives for conservation. The immediate output of the assessment signals that transboundary landscape management with regional cooperation is possible if biological, social, economic and political concerns are considered by the countries sharing the landscape.

Keywords: conservation, corridors, economic development, landscape, participatory, protected area, transboundary

Introduction

The Hindu Kush-Himalayas (HKH), with an area of 4.3 million km², sustains about 150 million people and with its biodiversity and environmental services has an impact on the lives of three times as many people living in the downstream regions. Approximately 39% of the HKH consists of pasture, 33% is designated as protected

area, 21% is forest, and 5% is agricultural land. In terms of biodiversity, the HKH region is one of the 34 'Biodiversity Hotspots' of the world endowed with both a rich variety of gene pool, species, and ecosystems of global importance and a high degree of threat (Myers *et al.* 2000). The region has also been identified as one of the 200 Global eco-regions (Wikramanayake *et al.* 2001). In recognition and realization of this, the region's member countries, namely Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan, are signatories to the 1992 Convention on Biological Diversity (CBD), whose commitments were renewed during the World Summit on Sustainable Development (WSSD) in 2002. So far, the governments of the HKH member countries have established 358 protected areas covering a wide range of habitats across the region and many other concrete steps have been taken to make biodiversity conservation effective and integrative. However, the majority of the protected areas are isolated as conservation 'islands' and quite a few of them are transboundary in nature, demanding an integrated approach of conservation through regional cooperation for their effective management (Shengji & Sharma 1998; Sherpa *et al.* 2003; Chettri & Sharma 2005; Sharma & Chettri 2005). Despite the ecological and economic importance of the HKH, the region has been subject to great human stress and continues to face multiple threats (Ives *et al.* 2004). Even the national parks and wildlife sanctuaries face tremendous pressures from communities living inside or outside these protected areas. The pressures are mainly from forest resource extraction, land use change, poaching, mining, unregulated tourism and other market forces (Byers 1986; Chettri *et al.* 2002; Sherpa *et al.* 2003, Chettri & Sharma 2006). Thus, human-induced environmental degradation in the region continues unabated, and if the current trends were to continue, much of the region's biodiversity would be lost in near future (Brown & Logo 1990; Menon *et al.* 2001; MEA 2005).

Establishment of protected area networks has long been one of the main strategies for safeguarding the world's biodiversity. Over the past several decades, more than 102,000 protected areas covering 12% of the land area have been established worldwide (Chape *et al.* 2003; Chape *et al.* 2005). The international community has also endorsed the protected area concept for minimizing biodiversity as a global agenda (Secretariat of CBD 2004a). These data provide a basis for assessing the extent of formal protection of global biodiversity, and a measure of conservation commitments at the global scale; however, gaps in information regarding the effectiveness of these protected areas on biodiversity conservation still remain (Chape *et al.* 2005; Secretariat of CBD 2004b). In recent years due to increasing forest fragmentation, inadequate coverage of important habitats, poor management and lack of monitoring, the effectiveness of existing protected areas for global biodiversity conservation has been questioned (Brooks *et al.* 2002; Brooks *et al.* 2003; Pressey *et al.* 2003; Brooks *et al.* 2004; Rodrigues *et al.* 2004). This indicates that the conservation measures taken to safeguard biodiversity for its sustainability are

ineffective and insufficient (Secretariat of CBD 2004b, Brooks *et al.* 2004; Chape *et al.* 2005). Moreover, it also reveals that the conservation of biodiversity through establishment of protected areas with conventional regulatory mechanisms alone is ill-suited in developing countries due to the higher dependency of rural communities on these resources for their subsistence economy (Nepal & Weber 1995; Maharana *et al.* 2000; Chettri *et al.* 2002; Borrini-Feyerabend *et al.* 2004; Chettri *et al.* 2005a; Chettri & Sharma 2006).

Ironically, the communities living in remote areas, where biodiversity is conserved, are economically, physically, and socially vulnerable (Sharma *et al.* 1992). As a result, landscapes are under acute pressure. This is an important factor to be considered for effective conservation measures. However, conservationists to date have often been reluctant to incorporate land occupied by people into conservation plans because of social disputes and the associated cost of managing conflicts (Wells 1992; Nepal & Weber 1995; Bawa *et al.* 2004). The conservation initiatives taken so far are often ecologically oriented and ignore social driving forces and the relationship between conservation and human needs (Nepal & Weber 1995; Chettri *et al.* 2002; Bawa *et al.* 2004). Since most of the protected areas in the developing countries are either inhabited or neighboring people are dependent on them for their subsistent livelihood, the conventional exclusionary approach has engendered profound social costs to the communities living in these fragile areas. This has demonstrated an inexorable link between human dependency with environmental degradation and biodiversity loss (Myers *et al.* 2000; Chettri *et al.* 2002; Bawa *et al.* 2004; Ives *et al.* 2004; MEA 2005). Therefore, balance between natural habitats and human needs at a landscape level is a necessity to determine the sustainability and effective conservation of biodiversity (Vanclay *et al.* 2001; Velazquez *et al.* 2003; McNeely 2004). The transboundary biodiversity conservation that started in the early nineties has taken great strides forward and has gained enormous experience. This paper highlights the genesis, process and the achievements made so far in the Kangchenjunga transboundary complex of the eastern Himalaya.

Methods

Why A Landscape: The Context

Landscape-level biodiversity conservation is an evolving concept and an important paradigm shift in the global conservation scenario (Smith & Maltby 2003; Secretariat of the CBD 2004b). The beauty of the landscape approach in conservation is that it involves all levels of stakeholders, including local communities, in conservation effort in hopes of ensuring that they benefit to make 'conservation' truly sustainable (McNeely 1999; Velazquez *et al.* 2003; Bennett 2004). In the recent years the eastern Himalaya has also witnessed a number of landscape initiatives in conservation (Gurun 2005; Sherpa *et al.* 2003; HMG/MFSCV 2005; Sharma & Chettri 2005).

The eastern Himalaya, with a wide spectrum of ecological zones, is shared by Nepal, Bhutan, India, China and Myanmar. Many critical eco-regions and critical transboundary conservation complexes are of global importance (Sandwith *et al.* 2001; Wikramanayake *et al.* 2001; CEPF 2005; Chettri & Sharma 2005). The area surrounding Mount Kangchenjunga is one of the richest landscapes of the 'biodiversity hotspots' and one of the world's most critical centers of biodiversity (Yonzon *et al.* 2000; WWF & ICIMOD 2001; CEPF 2005; Sharma & Chettri 2005). Due to its strategic location between Nepal, India, Bhutan and China, it is an important area for biodiversity conservation and needs transboundary cooperation to make conservation efforts effective (Shengi & Sharma 1998; Sandwith *et al.*, 2001; CEPF 2005). During the past several years, many consensus-building processes on regional cooperation for some of the critical transboundary areas have been initiated in the eastern Himalaya (Rastogi *et al.* 1997; Sherpa *et al.* 2003; Gurung 2005; HMG/MFSC 2005; Sharma & Chettri 2005).

The Kangchenjunga landscape has been seen as a cornucopia of living treasures by many past works. The genesis for transboundary cooperation started in 1997 when researchers and government authorities attended a workshop organized by ICIMOD and discussed the status and potential of the Kangchenjunga complex in terms of its biological diversity (Rastogi *et al.* 1997). This workshop advocated immediate cooperation for conservation actions in the Kangchenjunga complex. Similarly, Yonzon *et al.* (2000) produced extensive reports on the Kangchenjunga complex with biodiversity values and a suggested plan of action. These three consolidated reports from eastern Nepal, Darjeeling and Sikkim recommended expansion of protected areas to cover more landscape elements of potential habitats. Later WWF and ICIMOD (2001) strongly recommended this complex as critical for transboundary cooperation.

These past experiences showed that conservation of biodiversity requires a comprehensive and multiscaled approach that includes both reserve and non-reserve areas considering human dependency for their subsistence living. It was realised that the existing protected areas, which have increased greatly in number and extent, 'cannot exist in isolation as islands', neither within countries nor across national borders, until the needs of people and the surrounding lands ('the matrix') are considered (Sharma & Chettri 2005; Sherpa *et al.* 2003). Realising this as early as 1995, ICIMOD initiated regional cooperation initiatives for biodiversity management in the HKH region. The concept was to bring its regional member countries together and facilitate effective conservation for critical transboundary complexes across the HKH region. This concept was taken further and tested in transboundary landscapes such as the Mount Everest ecosystem and the Hkakaborazi mountain complex (Guangwei 2002; Sherpa *et al.* 2003). With these experiences, ICIMOD realized that to

achieve local, national, regional and global conservation goals, the protected areas alone are inadequate to meet the demands of conservation and a holistic approach at the landscape/ecosystem scale, including human beings as part of the system, is needed. To address biodiversity conservation through participatory processes at landscape levels a separate sub-program on 'Transboundary Biodiversity Management' was initiated year 2003 within the Natural Resources Management integrated program in ICIMOD (see Chettri & Sharma 2005). A strong thrust has been given to community development at the local level, followed by regional cooperation at the regional level to meet the global commitments (Fig. 1). Since then, ICIMOD has been playing a pivotal role in forming partnerships, developing community-based natural resource management strategies in and around the protected areas and exploring the feasibility of developing corridors to link parts of the landscape. The essence of the transboundary landscape initiative involves an integrated approach with partnerships between communities and government agencies of countries sharing a conservation area of common interest for effective biodiversity management.

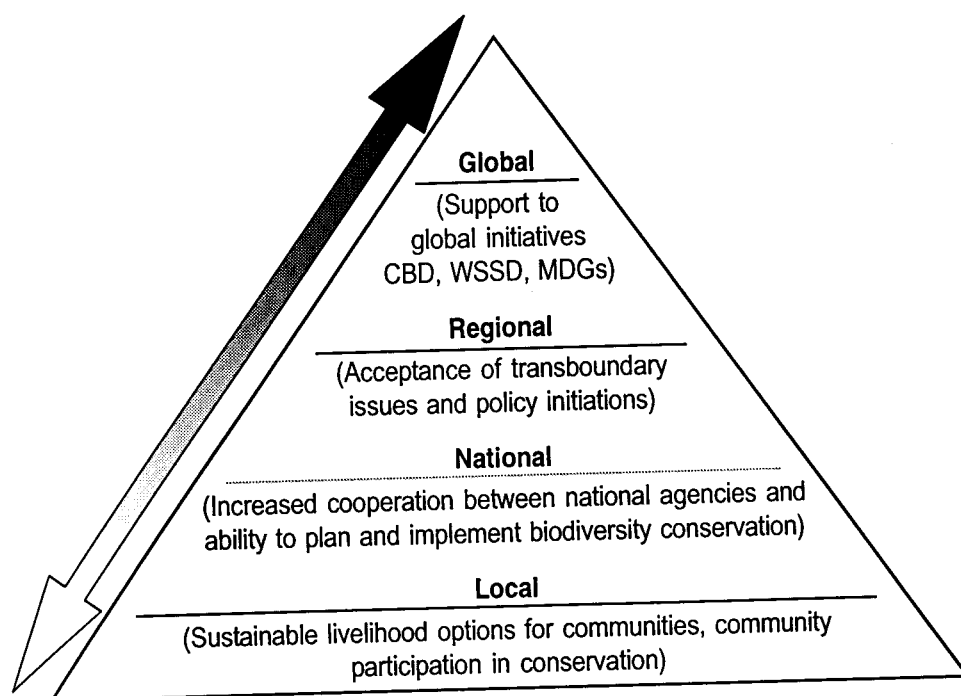


Figure 1. ICIMOD's conceptual framework showing linkages from community level to global commitments. (CBD - Convention on biological diversity; WSSD- World summit on sustainable development; MDGs- Millenium development goals).

Criteria Adopted for Transboundary Complexes

ICIMOD builds on community-based natural resource management for achieving regional conservation goals. Such management in the context of the HKH region is complex, resulting from diverse cultures, ecological variations, differences in climatic regimes and difficult terrain. Watersheds and landscapes often fall within different political boundaries that could be best addressed by regional cooperation. Criteria promoted by ICIMOD for successful community-based biodiversity management at the country level include: policy and legal measures to facilitate community-based management; strengthen institutions, management and processes; empower communities for equity; and maintain ecological sustainability (see Sharma & Chettri 2005).

ICIMOD adopted similar criteria for addressing the issues in Kangchenjunga Landscape, which are as follows:

1. Identify corridors required to maintain biodiversity links between protected areas in the wider Kangchenjunga landscape covering parts of Nepal, India, and Bhutan;
2. Identify options for promoting conservation-linked micro-enterprises and ecotourism at the project sites;
3. Develop a stakeholder-based participatory biodiversity conservation strategy for these corridors;
4. Identify transboundary conservation and management issues and develop strategic mechanisms for incorporating them into the management of the various landscape elements in ways that are consistent with the various government policies and community and farmer management systems in the area;
5. Identify policy changes that can enable better transboundary landscape conservation;
6. Identify and develop an action plan to strengthen the capabilities of community institutions and government agencies to implement the strategy; and
7. Assist collaborating agencies to develop follow-on proposals for strategy implementation by governments and for outside financing.

During the last three years (2003-2005) ICIMOD with its partners has mainly focused on the first four criteria addressing the feasibility assessment for developing transboundary landscape and conservation corridors as linkages to the exiting protected areas. Three broad outputs have been: a) identification and delineation of potential conservation corridors; b) participatory research on biodiversity values and services; and c) suggested strategies for conservation and economic development.

Results

Identification and Delineation of Potential Corridors

ICIMOD has identified five most important transboundary complexes in HKH region (see Chettri & Sharma 2005); the Kangchenjunga landscape is one such complex in the eastern Himalayas where ICIMOD is working for transboundary biodiversity management. The intention is to address global commitments such as that of the CBD for conservation, sustainable use and fair and equitable sharing of benefits arising out of the use of genetic resources. India has already brought the Kangchenjunga area under a protected area network by managing it as Kangchenjunga Biosphere Reserve and other small protected areas in Sikkim; Singhalila National Park, Neora Valley National Park, Sanchal Wildlife Sanctuary and Mahananda Wildlife Sanctuary are protected areas within Darjeeling Gorkha Hill Council. Adjacent to these, Kangchenjunga Conservation Area is an important part of the protected area network in Nepal. Some parts of western Bhutan also fall in the wider Kangchenjunga landscape covering Toorsa Strict Nature Reserve, which is connected by a natural corridor to Jigme Dorji National Park. Many of these protected areas are transboundary in nature (Fig. 2).

ICIMOD carried out extensive consensus-building processes with communities, conservation authorities, conservation experts and organizations working in the landscape. Three national-level consultative workshops were organized in Nepal, India and Bhutan where participation of policy makers, government officials, academic and research institutions, NGOs, CBOs and communities was ensured. During these consultations five potential conservation corridors were identified for feasibility assessment (Fig. 2). Conservation corridors interconnect protected areas and other relevant territories surrounding them. Human activities are promoted in these areas on a sustainable development basis; that is activities are undertaken that do not endanger the rich natural resources contained therein and which benefits both nations in general and communities in particular. Conservation corridors are thus a flexible planning tool that interconnect protected areas through combination of land use strategy.

The whole landscape is about 14432 km² and the identified corridors account for about 11% of the total. The first corridor is the buffer area on the Nepal side to Kangchenjunga Biosphere Reserve, Barsey Rhododendron Sanctuary and Singhalila National Park of India; the second is the corridor between Singhalila National Park and Sanchal Wildlife Sanctuary in India; the third is the corridor between Sanchal Wildlife Sanctuary and Mahananda Wildlife Sanctuary in India; the fourth is the corridor between Mahananda Wildlife Sanctuary and Neora Valley National Park in India; and the fifth is the corridor between Neora Valley National Park in India and Toorsa Strict Nature Reserve in Bhutan that links to Jigme Dorji National Park (Fig. 2).

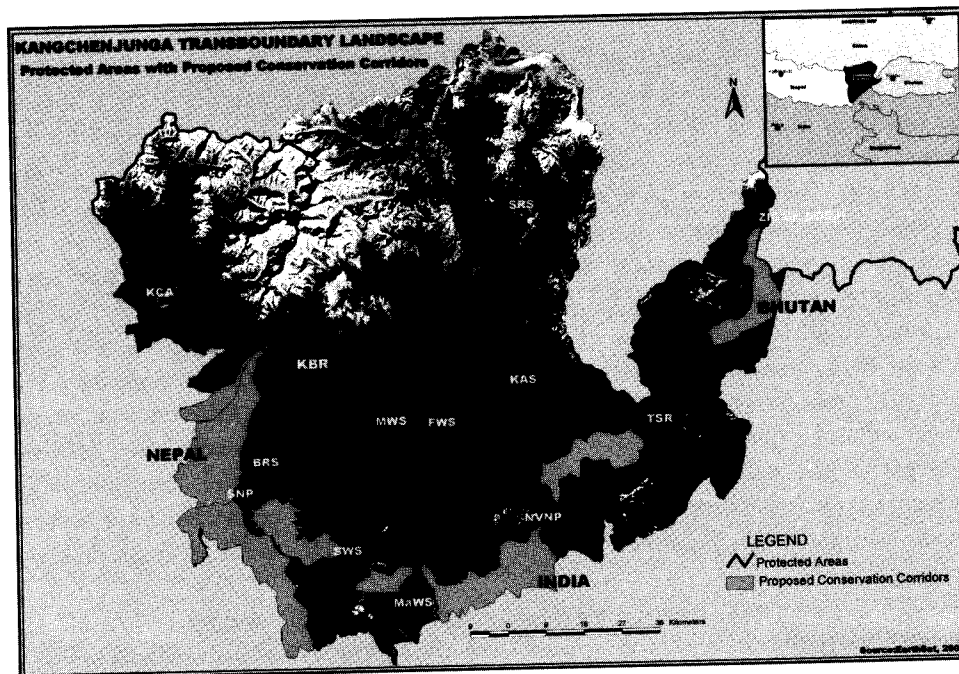


Figure 2. Map showing the potential corridors between the protected areas of the Kangchenjunga landscape (KCA- Kangchenjunga Conservation Area, Nepal; KBR- Kangchenjunga Biosphere Reserve, BRS- Barsey Rhododendron Sanctuary, Fambong Lho Wildlife Sanctuary, Singba Rhododendron Sanctuary, Mainam Wildlife Sanctuary, Kyongnosla Alpine Sanctuary, Sikkim, India; SNP- Singhalila National Park, Senchel Wildlife Sanctaury, Mahananda Wildlife Sanctuary, Neora Valley Nationa Park, Darjeeling, India; and Toorsa Strict Nature Reserve, Jigme Dorzi National Park, Bhutan).

Landscape Elements and Conservation Challenges

To collect baseline information, participatory research was carried out in the potential conservation corridors. The main focus of the studies was to assess the biodiversity values and services in terms of available resources, dependency of the local communities and options for linking conservation with development. The research revealed that the Kangchenjunga landscape has a complex land-use and land tenure systems (Table 1). Numerous landuse types have varied tenure systems belonging to reserve forests, private commercial land and many other arrangements. The complexities are more pronounced when encroached lands were found and there are conflicts between the government authorities and local communities. Numerous other conservation issues were reported as limitations for long-term conservation goals. Some of the issues such as illegal trade of resources, limited agricultural lands, man-

animal conflict and encroachment of forested land are quite common across the landscape (Table 1). However, some specific issues such as use of chemicals in the tea gardens, dependency of tea garden laborers in forests for firewood, and unregulated tourism are country-specific and need special focus. With a landscape shared among three countries, it is obvious that the landscape have many transboundary issues. Cross-border grazing, dual citizenship, illegal trade of high-value medicinal plants and animals, and timber logging are some of the major transboundary issues identified so far (Table 1).

Biodiversity Values and Services

Beginning at low elevations and consequently increasing altitude, the landscape has diverse ecological zones compressed within a 100 km north-south stretch. It starts from a tropical zone and goes up to a nival zone, providing habitat for a diverse flora and fauna. The review and research on flora from the landscape provided outstanding results. It was learned that the landscape is a home for about 7,000 flowering plants, including 400+ orchids, 60+ rhododendrons, above 350 wild edible plants and hundreds of high value medicinal plants. Among this vast floral diversity a significant proportion is endemic to the region.

The fauna in this landscape is diverse and rich. The protected areas are habitats for many flagship species that are of global importance. Over 100 species of mammal have been reported from the protected areas of this landscape, including more than 50 species of conservation importance. Similarly, over 550 species of birds and 600 butterflies have also been reported from the landscape (source ICIMOD unpublished database). Interestingly, during the course of our participatory research, about 25-30% of these species were also reported from the identified corridors. Among the different ecological zones the alpine zone is of prime importance due to the presence of many species of global importance. The endangered snow leopard (*Uncia uncia*), Blue sheep (*Pseudois nayur*), Himalayan tahr (*Hemitragus jemlahicus*), Goral (*Naemorhedus baileyi*), Serow (*Capricornis sumatraensis*) and Takin (*Budorcas taxicolor*) in the alpine zone, and Red panda (*Ailurus fulgens*) and Himalayan Musk deer (*Moschus chrysogaster*) in the subalpine zone are some of the important mammals of the landscape. Similarly, birds of conservation interest include Lammergeier (*Gypaetus barbatus*), Himalayan Griffon (*Gyps himalayensis*), Black Eagle (*Ictinaetus malayensis*), the Northern Goshawk (*Accipiter gentile*), Himalayan Snowcock (*Tetraogallus himalayensis*), Tibetan Partridge (*Perdix hodgsoniae*), Snow Partridge (*Lerwa lerwa*), and Satyr Tragopan (*Tragopan satyr*).

This analysis revealed that the Kangchenjunga landscape is an extended habitat, beyond the political as well as protected area boundaries, for many umbrella species

such as snow leopard, red panda, takin, and tigers (*Panthera tigris*), and for many endemic plants. Though most efforts at biodiversity conservation have focused primarily on protected areas, the unprotected lands surrounding these areas (the "matrix") also seems to be equally important for conservation of biodiversity. Thus, development of corridors to provide the missing links between the protected areas was felt necessary for connectivity to enhance the conservation of many of the species that need wider habitats.

Table 1. Inventories of issues and information from the identified conservation corridors in Kangchenjunga Transboundary landscape.

Variables	India	Nepal	Bhutan
Locations	Corridors linking Singhalila National Park, Senchal Wildlife Sanctuary, Mahananda Wildlife Sanctuary and Neora Valley National Park and	Corridors buffering protected areas of India in Taplejung, Panchthar, Ilam	Corridors between Toorsa Strict Nature Reserve of Bhutan and Neora Valley National Park of India; Toorsa Strict Nature Reserve of Bhutan and Jigme Dorji National Park within Bhutan
The landscape elements (dominant features)	<ol style="list-style-type: none"> 1. National reserve forests 2. Cinchona plantations 3. Tea gardens 4. Khasmal areas 5. Private lands with orchards and agricultural farms 6. Built up areas with clustered hamlets of settlements 7. River valleys, 8. Waste and barren lands, 9. Rocky out crops 	<ol style="list-style-type: none"> 1) National forests 2) National pasture lands 3) Private/subsistence agriculture/agroforestry areas 4) Commercial agriculture lands (tea gardens) 5) Slash and burn agriculture 	<ol style="list-style-type: none"> 1. Largely national forests 2. Grazing area (govt. restricted forests in which people have access rights for grazing) 3. Alpine scrub and cliffs 4. Private lands with orchards and agricultural farms
Major conservation issues	<ol style="list-style-type: none"> 1. Landslide-prone areas; 2. Chemical pollution as a result of chemical use in tea gardens and agricultural lands 3. Ineffective rule enforcement and forest management 	<ol style="list-style-type: none"> 1) Poor enforcement of policy and law 2) Complicate land tenure systems 3) Open grazing and encroachments 4) Over harvesting of NTFPs 5) Poaching 6) Forest fires 	<ol style="list-style-type: none"> 1. Increasing grazing pressure 2. Conflicts between people and wildlife 3. Poaching for bile and musk 4. Overexploitation of NTFPs 5. Illegal felling of trees, collection of firewood

	4. Communities with limited agriculture areas and production	7) Large number of unproductive domestic livestock	and timber along the border areas
	5. Illegal timber logging, fuel-wood collection for sale, fodder collection, open grazing	8) Conflicts between people and wildlife	
	6. Poaching/hunting and illegal butterfly collection		
	7. Encroachment and habitat destruction, over exploitation of NTFPs, small scale forest fires		
	8. Tea garden labour's dependency on near by forests		
	9. People wildlife conflicts		
	10. High volume of tourists and poor management of garbage		
Major trans-boundary issues	1. Cross border grazing	1) Trans-boundary use of forest and grassland resources	1. Illegal trade in <i>Cordyceps</i> , and musk pods across the border
	2. Lokta debarking from across the border	2) Dual citizenship and ownership over resources	2. Illegal felling of trees; collection of firewood and timber along the border areas
	3. Exploitation/extraction of NTFPs especially from across the border	3) Custom barriers and cross border related trade problems	

Livelihoods and Challenges

While delineating conservation corridors it was realized that human livelihoods are critical components in the conservation paradigm. Diverse ethnic groups inhabit these potential corridors. The majority of the people living in remote border areas are economically vulnerable. The livelihood of most of these people revolves around agriculture and forest resources. For instance agriculture accounts for about 39% of gross domestic product in Nepal and provides employment to more than 80% of the labour force. The cultivable land area in Nepal alone is estimated to be about 18

percent of the total land area of the landscape. However, only 5% of these productive lands are used for agriculture, which is to a large extent for subsistence, and the rest 12% has been changed to cardamom, tea plantations and other land use types.

Agroforestry is another promising economic activity practiced in the landscape. Planting broom grass (*Thysanolaena maxima*) on the steep terraces is an age-old practice. Likewise, large cardamom plantations with the moisture-loving shade trees and tea cultivation are other options recently developed in some parts of the landscape. Likewise, non-timber forest products (NTFPs) make a significant contribution in the local economy for the people living in this landscape. Collecting season, method and frequency of specific products are well known to the local farmers. Some community forests in Nepal are already conducting training for nursery preparation, transplanting and harvesting of NTFPs. Traditional practices of technology transfer skill exchange at people-to-people level still take place between the farmers of Nepal and Sikkim. Cultural exchange is well associated with the appropriate technology that people have been practicing since time immemorial.

The integration of community development for conservation goals is important in landscape development. Being located in remote areas, many of the livelihood options are beyond the reach of the people living there. Some of the identified challenges are lack of modern technologies, market information for agricultural and non-agricultural products, and motivations to try more profitable economic activities (Table 2). The communities have to struggle to sell their products in the markets mainly due to lack of transport facilities or limited information on market opportunities. In many instances economic development is facing crises simply due to lack of human resources and institutional support. Coordination between development organizations, government agencies and social workers, and appropriate policies for transborder trade were also reported as bottlenecks to the overall development in the landscape (Table 2).

Suggested Strategies

The preliminary assessment for developing corridors in the Kangchenjunga landscape provided information for some possibilities for establishing connectivity between the existing protected areas. The identified corridors have adequate reserve forests. However, it is imperative to consider the land use cover change in the landscape. This assessment is necessary for knowing the trend in land use change and to identify critically pressured areas. Moreover, understanding the land use patterns within the corridors is important to identify the intervention areas and bottlenecks for a functional conservation corridor. Besides the land use types, the landscape is poorly explored for its biological components. More systematic biodiversity inventory and the distribution patterns of different threatened and endemic species would help plan conservation measures.

Table 2. The list of current and potential livelihood options to focus while designing transboundary landscape in the Kangchenjunga complex.

Variables	India	Nepal	Bhutan
Indicative economic interventions / thrusts to address livelihood issues	<ol style="list-style-type: none"> 1. Livelihood strategies based on off-farm earning options such as mushroom, floriculture, horticulture, apiculture and ecotourism 2. Micro-enterprises based on NTFPs and medicinal plants 3. Cultivation of commercial crops such as cardamom and tea 	<ol style="list-style-type: none"> 1) Micro-enterprises based on cultivation, processing, marketing of wild species 2) Identification of (high-value) niche products for market 3) Legitimizing the cultivation, production and sale of NTFPs 4) Promotion of local resource based small scale cottage industry 	<ol style="list-style-type: none"> 1. Biodiversity based micro-enterprises focusing on local potential 2. Hand made paper, vegetable dyes, cane and bamboo based products, incense, brooms, floriculture 3. Cash crops; orchard, local tea 4. Ecotourism, pilgrimage 5. Yak husbandry
Major Constraints (general and specific)	<ol style="list-style-type: none"> 1. Lack of motivation and support to the communities 2. Lack of know how and modern technologies 3. Poor market infrastructures and opportunities 4. Coordination between diverse institutions and stakeholders to act in unison for reaching the common goals 	<ol style="list-style-type: none"> 1) Inadequacy and gaps in policy and law and their enforcement 2) Poor information system and knowledge base 3) Lack of modern technologies 4) Poor market opportunities 5) Poor awareness about sustainable bio-resource usage, 6) Poor economic resource base 	<ol style="list-style-type: none"> 1. Shortage of funds to promote micro-enterprises 2. Accessibility 3. Lack of market information and access to market 4. Poor infrastructure development 5. Lack of trained human resources 6. Lack of technical assistance
Suggestive Strategy	<ol style="list-style-type: none"> 1. Community mobilization, motivation and support 	<ol style="list-style-type: none"> 1) Review and promulgation of required policy and law 	<ol style="list-style-type: none"> 1. Market information and infrastructure 2. Human resources

2. Incentives for conservation	2) Grass roots level institutional strengthening	3. Provision for technical assistance in micro-enterprise development and ecotourism
3. Capacity building and provide technology options to farmers	3) Provision for information centers	
4. Promotion of traditional knowledge	4) Promotion of community forestry,	
5. NTFP based micro-enterprises	5) Promotion of medicinal plants and cash crops	
6. Market opportunities and infrastructures	6) Networking in ecotourism	
7. Ecotourism development in potential areas	7) Adoption integrated landscape approach	

The socio-economic studies revealed that subsistence farming practices are the basis for livelihood for most of the people, whereas in some areas tea gardens have become the primary source of income. Due to the limited options and opportunities, the dependency on forest resources is considerable. The communities living in the remote transborder areas are more vulnerable, but they have potential options for micro-enterprise development such as NTFPs, off-season and organic vegetable cultivation, agroforestry practices, and animal husbandry (Table 2). Some of the high altitude areas of eastern Nepal, Sikkim and Darjeeling and western Bhutan are the hub for many high-value medicinal plants. Domestication, production and value addition to these plants could boost the local economy. Similarly, the whole landscape is a paradise for tourism development. Wildlife-based tourism, adventure tourism and pilgrimage tourism are strongly recommended options for the local economic development. Human resource development, technology transfer and information dissemination on market options are also essential (Table 2).

Critical transboundary issues include illegal transborder grazing inside the protected areas, illegal logging, illegal trade of high-value medicinal plants across the borders, and poaching of animals. These need joint action by the countries, including information sharing among the park managers of two neighboring countries, joint research and monitoring, sharing of activities such as training, management and patrolling (Table 3). However, the existing conservation practice among the participating countries does not have such a framework. Therefore, developing a regional framework to combat such issues would make the management effective and mutually beneficial to the countries.

Table 3. The issues and suggestive strategies for addressing transboundary challenges in the Kangchenjunga landscape

(a) Nepal – India Case	
Issues:	Challenges/possible solutions:
<ul style="list-style-type: none"> ▪ Unclear asset ownership and resource use rights ▪ Illegal forest and grassland use by people in the transborder areas ▪ Illegal poaching of wildlife and trade across the border ▪ Illegal trade of high value medicinal plants across the border ▪ Unregulated tourism and expansion of settlements ▪ Effects of land uses on downstream people ▪ Lack of a common platform for exchange on transboundary issues 	<ul style="list-style-type: none"> ▪ Community rights on the use and tenure of resources should be clarified ▪ Illegal trade and poaching to be controlled jointly ▪ Negative impacts through tourism are to be controlled through policy ▪ Trade of timber and NTFPs should be monitored and regulated ▪ Information and expertise exchange program should be initiated between the two countries ▪ Cooperation between two countries strengthened in handling cross border issues
(b) India – Bhutan Case	
Issues:	Challenges/possible solutions:
<ul style="list-style-type: none"> ▪ Illegal felling by corporate sector as well as individuals from across the border ▪ Poaching from across site border ▪ Unplanned tourism and developmental activities ▪ Land encroachments ▪ Unsustainable extraction of NTFPs from across the border 	<ul style="list-style-type: none"> ▪ Common code of conduct or common minimum program should be developed, including conservation, development and tourism ▪ Alternative livelihood opportunities to be jointly promoted ▪ Sharing of experiences/resources at different levels ▪ Develop compensatory mechanism for ecosystem services to the people as a joint activity ▪ Cooperation between two countries strengthened in handling cross border issues

Discussion

Prospective for Developing a Transboundary Landscape

The 12 protected areas in this landscape range from 39 km² to 2,620 km² and are home to many species that are of global importance. However, the present landscape level analysis revealed that the lands outside these protected areas are also important in terms of agro-biodiversity, wildlife, ethnic diversity, culture and more importantly as options for biodiversity tradeoffs. To accommodate these wider

biodiversity values, the people living in and around the corridors are considered an integral part of the conservation efforts. Conservation of this wider landscape is impossible without the involvement of local communities and cooperation from the participating countries. In order to fully accommodate the range of biodiversity targets and ecological processes supported by ecosystems, as well as to safeguard against the potential vagaries of global scale change, conservation priorities must be scaled up across the larger landscape (Vanclay *et al.* 2001; Velazquez *et al.* 2003, MEA 2005). The landscapes capture more biodiversity than smaller sites because of the 'beta-diversity effect', especially since landscapes include more ecosystems, wildlife habitats, local communities and their lifestyles and land-management variability (Sharma & Chettri 2005).

Biological Prospective

During the past three years the Kangchenjunga Landscape has gained impetus as a transboundary conservation initiative (Sharma & Chettri 2005). Our participatory research and reviews revealed that protected areas of the Kangchenjunga landscape were home to many globally significant flora and fauna (Chettri 2000; Chettri *et al.* 2001; Chettri *et al.* 2005b). Many of these species were also found outside the protected areas as reported by Yonzon *et al.* (2000) and CEPF (2005). The species that were found in the mountainous areas were normally found in low density with wider habitat needs, using habitats outside the protected areas and across the borders to widen their range of habitats. There have been reports from the communities that many of the well-managed community forests in Nepal, gullies, streams and even tea gardens of Darjeeling and surrounding forest adjacent to the villages in Bhutan were widely used by wildlife. Magraw (2004) and Williams (2005) also reported that in the eastern Nepal forests outside protected areas were critical for many species of important flora and fauna. Thus, so-called incompatible lands outside these protected areas were making important contributions toward achieving long-term conservation goals.

Our analysis revealed that there are still potential contiguous forests both across the political borders of Nepal and India and India and Bhutan as well as between the protected areas in Darjeeling and Sikkim. These forests were also use by many large mammals that need larger habitats to sustain their viable population. The landuse analysis revealed that almost 40-50% of these potential conservation corridors were under dense forest, while other areas were covered by a mosaic of other landuse types such as open forest, scrublands and agroforestry systems. Such mosaic habitats could be important to accommodate more biodiversity (Chettri *et al.* 2005b) and have potential corridors (Gurung 2005). These potential corridors could play an important role in maintaining altitudinal connectivity between the habitat types for larger Himalayan ecosystem (Chettri *et al.* 2001; Wikramanayake *et al.* 2001). However, the long-term

conservation goals depend upon linkages between the conservation areas in the form of conservation corridors. Such corridors address the concern of community development and conservation measures without compromising each other (McNeely & Scherr 2003). Therefore, we strongly recommend that the conservation measures should take account of the local people's aspirations and address them by utilizing the opportunities provided by biodiversity.

Social Prospective

The societal integrity of the different ethnic groups in natural resources management was strong. The local communities had long-standing traditions of conservation and restrained resource use guided by conservation ethics, customary laws and traditional rights. They were the owners and co-managers for considerable forested land and had been instrumental for conserving natural and domestic biodiversity, both inside and outside the protected areas. There were age-old traditions of exchanging resources and expertise among the people in the region (Oli 2005). Traditional belief in Buddhism, Hinduism, and a varying blend with animistic beliefs cuts across all mountain people and imparts a sense of compassion and awareness for all forms of life and the surrounding natural environment. Buddhist beliefs in 'hidden treasures' or *ters* (Ramakrishnan 1996), and '*Buk rup*' as a conservation norm among Lepcha (Jha 2002) are often linked to the ethics of conservation. Such practices provide a strong organizing principle in how people relate to vast natural spaces and the biodiversity therein. Likewise, the traditional natural resources management systems such as *Dzumsa* by the *Pipon* (village head) among the Lanchungpas in Sikkim (Rai *et al.* 1994), *Na Zong Nyo* as wise indigenous knowledge and sustainable natural resources use practices among the Lepchas (Jha 2002) and strong ethics for landscape level conservation among Sikkimese Buddhists (Ramakrishnan 1996) were some of the effective traditional conservation measures that were seen to address "sustainability" of resources. Thus, conservation was culturally enforced within many of the indigenous groups of the Kangchenjunga landscape. This reflects the strong resilience between biological resources and the human needs. However, these practices were fading slowly due to various driving forces leading to numerous conservation challenges (Murphy 2005; Yonzon 2005). The revitalization of such practices might regain the cultural values and contribute to conservation goals. This is possible when an integrated approach for sustainable development is promoted at the scale of a culturally and biologically contiguous landscape.

Economic Prospective

Due to remoteness and limited options for livelihoods, people living in this landscape were highly dependent on the forest resources for their subsistence. There was increased demand on land for cultivation, timber, fuel and animal grazing due to population growth, farm-based family fragmentation and growth in tourism. Such

prevalent issues had also been reported earlier (Rai & Sundriyal 1997; Chettri *et al.* 2002; Chettri *et al.* 2005a; Chettri & Sharma 2006). These prevailing poverty and related driving forces are seen as bottlenecks to conservation. Habitat continuity and intactness are essential to maintain the integrity of biodiversity values and their services to mankind, and conservation of biodiversity is contingent on maintaining the interconnectedness of the various types of ecosystem functions found in the region. Such functions could be explored through economic opportunities available therein (Costanza *et al.* 1997). The diverse high-value medicinal plants, ecotourism, agroforestry and agricultural potentials, animal husbandry, horticulture and silvicultural options and potentialities for diary products are some of the most promising economic options available in this landscape. These renewable natural resources have a very high potential for tradeoffs (Sundriyal & Sundriyal 2003), but these potentialities are still untapped and unorganized. The regional understanding in trade, transfer of technology and policy for mutual benefits could be expanded and made more practicable. With recent development in tourism, some communities in the tourism-destination areas have started to be associated in this enterprise (Rai & Sundriyal 1997; Maharana *et al.* 2000). But this sector also needs coordination and mutual understanding to be able to harness its full potentialities.

Political Prospective

The location of the Kangchenjunga landscape across the four national boundaries is an important asset for the region's geopolitics. The contiguous habitat and open border situation make the landscape an ideal place for cooperation for biodiversity conservation. As signatories to the Convention of Biological Diversity, all these countries are committed to promote an ecosystem/landscape approach to conservation and to establish regional and transboundary collaboration (Sharma & Acharya 2004). This provides a strong basis for actually cooperating by the countries signatory to CBD in managing biodiversity over transboundary landscapes (McNeely 2004). The suggested actions include strategies to promote integrated transboundary cooperation for sustainable development in mountain ranges, through mutually agreed-upon arrangements by the countries concerned.

Over the past decade, regional and transboundary cooperation for research, adaptive management, exchange of expertise and other resources have been promoted to strengthen and improve conservation and management of mountain biodiversity (Rastogi *et al.* 1997; Sherpa *et al.* 2003; Sharma & Chettri 2005). The Government of Nepal has already recognized the Kangchenjunga landscape as potential area for cooperation (GON/MFSC 2002) and extended the concept of transboundary landscape from the Kangchenjunga complex to the Sacred Himalayan Landscape (SHL), which covers the greater mountain areas of Nepal (GON/MFSC 2005). Likewise, the National Biodiversity Strategy and Action Plan of India (MoEF and Kalpavriksh in

press) and Bhutan (Anonymous 2002) also emphasizes transboundary biodiversity conservation and biological corridor development and shift the conservation thinking from species and protected area to a landscape approach that includes human beings as part of the system. This development has strongly supported the global conservation paradigm shift where policy emphasizes landscape rather than species (Balasinorwala *et al.* 2004, Secretariat for the CBD 2004b). Thus, there is strong political basis for developing a transboundary landscape in the Kangchenjunga complex.

Conclusion

The initiative taken by ICIMOD with its partners has already brought some positive steps towards the development of Kangchenjunga landscape for effective biodiversity conservation. With research, consultations and advocacy the transboundary landscape conservation concept is now gaining impetus among the three participating countries. All relevant stakeholders are involved in the process of planning and improving conservation corridors between protected areas. After a decade-long conceptualization, cooperation for conservation at the landscape level among India, Nepal and Bhutan is becoming a reality. For the first time conservation and developmental issues have been built from the community perspective and placed together in a regional forum for discussion. Collaboration for landscape conservation approach has provided an opportunity to consolidate a cohesive partnership among conservationists, developmental authorities and civil society. Participatory planning tools have been adopted and action-planning processes initiated by each of the three participating countries. These include options to combine conservation with enterprise development by the communities in the corridor areas, including community forests, agro-forestry and mixed agriculture, using existing biodiversity resources.

The extensive consultative processes and applied research concluded that it is critical for all the three countries to develop a joint strategy and carry out activities of transboundary nature that will provide mutual benefits to people and the landscape while fulfilling their commitments for achieving the global biodiversity conservation goals. Based on the recommendations, ICIMOD has played a facilitating role to develop a strategy for cooperation at a regional scale for conservation of biodiversity based on three elements: i) reducing the threats to protected areas and biodiversity corridors through generating economic incentives by developing micro-enterprise based on bio-resources and ecotourism; ii) facilitating participatory management of forest areas adjoining and linking them with protected areas; and iii) strengthening cooperation for transboundary biodiversity conservation involving local communities and concerned departments of the three participating countries.

Efforts to conserve biodiversity have gradually begun to shift away from law enforcement and use restrictions towards more participatory approaches

emphasizing equitable and sustainable use of natural resources by local communities. This change in approach was necessary in the remote rural areas where biodiversity is concentrated, poverty is pervasive, and development options are often limited. This has also led to a new emphasis on finding ways of deriving economic opportunities from biological resources. Conservation of biodiversity in ecosystems straddling international borders not only renders services to nature, but also constitutes an opportunity to strengthen processes for socio-economic development among the cooperating countries. Therefore, a landscape approach to conservation seems to be ideal to enable these three countries to benefit from the resources they share. It also enhances transboundary cooperation between the countries to meet their obligations under international agreements such as the Convention on Biological Diversity. Hence, landscape level conservation helps protect biodiversity through cooperation in the shared ecosystems and also combines resources and expertise to achieve the common goal.

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References

- Anonymous. 2002. Biodiversity action plan for Bhutan. Ministry of Agriculture, Royal Government of Bhutan.
- Balasinorwala, T., A. Kothari and M. Goyal, (compilers) 2004. Participatory conservation: paradigm shifts in the international policy. IUCN, Gland, Switzerland and Cambridge, UK and Kalpavriksh, India.
- Bawa, K.S., R. Seidler and H.P. Raven. 2004. Reconciling conservation paradigms. *Conservation Biology* 18(4): 859-860.
- Bennett, G. 2004. Integrating Biodiversity Conservation and Sustainable Use: Lessons learned from Ecological Networks. IUCN, Gland, Switzerland and Cambridge, UK.
- Borrini-Feyerabend, G., A. Kothari and G. Oviedo. 2004. Indigenous and local communities and protected areas: Towards equity and enhanced conservation. IUCN, Gland Switzerland and Cambridge U.K.
- Brooks, B.W., N.S. Sodhi and P.K.L. Ng. 2003. Catastrophic extinction follows deforestation in Singapore. *Nature* 242: 420-423.

- Brooks, T.M., M.I. Bakarr, T. Boucher, Gustava A.B. Da Fonseca, Craig Hilton-Taylor, J.M. Hoekstra, T. Moritz, S. Olivieri, J. Parrish, R.L. Pressey, A.S.L. Rodrigues, W. Sechrest, A. Stattersfield, W. Strahm and S.N. Stuart. 2004. Coverage provided by global protected area system: Is it enough? *BioScience* 54(12):1081-1091.
- Brooks, T.M., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca, A.B. Rylands, W.R. Konstant, P. Flick, J. Pilgrim, S. Oldfield, G. Magin and C. Hilton-Taylor. 2002. Habitat loss and extinction in the hotspots of biodiversity. *Conservation Biology* 16(4): 909-923.
- Brown, S. and A.E. Logo. 1990. Tropical secondary forests. *Journal of Tropical Ecology* 6:1-31.
- Byers, A.C. 1986. An assessment of landscape change in the Khumbu region of Nepal using repeat photography. *Mountain Research and Development* 7: 77-81.
- Chape, S., J. Harrison, M. Spalding and I. Lysenko. 2005. Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets. *Philosophical Transaction of the Royal Society B*. 360:443-445.
- Chape, S., S. Blyth, L. Fish, P. Fox and M. Spalding. 2003. United Nations List of Protected Areas. IUCN, Gland, Switzerland and Cambridge UK and UNEP-WCMC Cambridge, U.K.
- Chettri, N. 2000. Impact of habitat disturbances on bird and butterfly communities along Yuksam-Dzongri trekking trail in Khanchendzonga Biosphere Reserve. [PhD dissertation]. North Bengal University, India.
- Chettri, N. and E. Sharma. 2006. Assessment of natural resources use patterns: A case study along a trekking corridor of Sikkim Himalaya. *Resources, Energy and Development* 3(2): 42-35.
- Chettri N., E. Sharma and S.D. Lama. 2005a. Non-timber forest produces utilization, distribution and status in a trekking corridor of Sikkim, India. *Lyonia* 81(1):93-108.
- Chettri, N. and E. Sharma. 2005. Transboundary landscapes for protected areas and conservation corridors. Background paper for Hindu Kush-Himalayan biodiversity conservation E-conference on theme 'Transboundary landscape for protected areas and conservation corridors' Discussion dates: August 29-September 4, 2005. <http://www.mtnforum.org/E-Consultation05/backgroundpapers.htm>
- Chettri, N., D.C. Deb, E. Sharma and R. Jackson. 2005b. The relationship between bird communities and habitat: A study along a trekking corridor of the Sikkim Himalaya. *Mountain Research and Development* 25(3): 235-244.
- Chettri, N., E. Sharma, D.C. Deb and R.C. Sundriyal. 2002. Effect of firewood extraction on tree structure, regeneration, and woody biomass productivity in a trekking corridor of the Sikkim Himalaya. *Mountain Research and Development* 22(2):150-158.
- Chettri, N., E. Sharma, and D.C. Deb. 2001. Bird community structure along a trekking corridor of Sikkim Himalaya: A Conservation Perspective. *Biological Conservation* 102(1): 1-16.
- Costanza, R, R.d' Arge, R.de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V.O'Neill, J. Pauelo, R. Raskin, P. Sutton and M. Van den belt. 1997. The value of world's ecosystem services and natural capital. *Nature* 387:253-260.

Conservation Biology in Asia

- Critical Ecosystem Partnership Fund (CEPF). 2005. Ecosystem Profile: Indo-Burman Hotspot, Eastern Himalayan Region. WWF US-Asian Program.
- Guangwei, C. 2002. Biodiversity in the Eastern Himalayas: Conservation through Dialogue. ICIMOD, Kathmandu.
- Gurung, P.C. 2005. Terai Arch Landscape: A new paradigm in conservation and sustainable development. In: *Managing Mountain Protected Areas: Challenges and Responses for the 21st Century* (Eds. D. Harmone & G.L. Worboys). Andromeda Editrice, Italy, pp. 80-86.
- Government of Nepal, Ministry of Forests and Soil Conservation (GON/MFSC). 2002. Nepal Biodiversity Strategy.
- Government of Nepal, Ministry of Forests and Soil Conservation (GON/MFSC). 2005. Proceedings of the national stakeholders' consultation on Sacred Himalayan Landscape in Nepal.
- Ives, J.D., B. Messerli and E. Spiess. 2004. Mountains of the world: A global priorities. In: *Mountains of the World: A Global Priority* (Eds. B. Messerli & J.D. Ives). Parthenon Publishing Group, New York and London, pp. 1-15.
- Jha, A. 2002. Ecological Prudence for the Lepchas of Sikkim. *Tigerpaper* 29(1):27-28.
- Magraw, K. 2004. Beyond forest cover: An analysis of plant communities in the fragmented rural landscape of northern Ilam district, Nepal. [Master dissertation]. Colorado State University, Colorado.
- Maharana, I., S.C. Rai and E. Sharma. 2000. Environmental economics of Khangchendzonga National Park in the Sikkim Himalaya, India. *GeoJournal* 50:329-337.
- McNeely, J.A. 1999. Mobilizing Broader Support for Asia's Biodiversity: How civil society can contribute to protected area management. Asian Development Bank, Manila.
- McNeely, J.A. and S.J. Scherr. 2003. *Ecoagriculture: Strategies to feed the world and save wild biodiversity*. Island Press, Washington D.C.
- McNeely, J.A. 2004. Sustainable landscape- Linking conservation and production. In: *Millennium Development Goals and Conservation: Managing Nature's Wealth for Society's Health* (Ed. D. Joe). International Institute for Environment and Development, London, pp. 89-105.
- Menon, S., R.G. Pontius, J. Rose, M.L. Khan and K.S. Bawa. 2001. Identifying conservation-priority areas in the tropics: a land-use change modeling approach. *Conservation Biology* 15: 501-512.
- Millennium Ecosystem Assessment (MEA). 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.
- MoEF and Kalpavriksh (in press). National Biodiversity Strategy and Action Plan: Final Technical Report of the UNDP-GEF Sponsored Project. Ministry of Environment and Forests, Government of India and Kalpavriksh, Delhi/Pune, India.

- Murphy, M.L., K.P. Oli and S. Gorzula. 2005. Conservation in Conflict: the impact of Moist-Government conflict on conservation and biodiversity in Nepal. International Institute for Sustainable Development, Canada.
- Myers, N., R.A. Mittermeier, C.G. Mittermeier, Gustavo A.B. da Fonseca and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403(24): 853-858.
- Nepal, S.K. and K.E. Weber. 1995. The quandary of local people-park relationships in Nepal's Chitwan National Park. *Environmental Management* 19(6): 853-866.
- Oli, K.P. 2005. The potential for transboundary protected area in the Kangchanjunga region of the eastern Himalaya. In: *Managing Mountain Protected Areas: Challenges and Responses for the 21st Century* (Eds. D. Harmone & G.L. Worboys). Andromeda Editrice, Italy, pp. 158-164.
- Pressey, R.L., R.M. Cowling, and M. Rouget. 2003. Formulating conservation targets for biodiversity pattern and process in the Cape Floristic Region, South Africa. *Biological Conservation* 112: 99-127.
- Rai, S.C. and R.C. Sundriyal. 1997. Tourism development and biodiversity conservation: A case study from the Sikkim Himalaya. *Ambio* 26: 235-242.
- Rai, S.C., E. Sharma and R.C. Sundriyal. 1994. Conservation in the Sikkim Himalaya: traditional knowledge and land use of the Mamlay watershed. *Environmental Conservation* 15: 30-35.
- Ramakrishnan, P.S. 1996. Conserving the sacred: from species to landscape. *Nature and Natural Resources*, UNESCO, Paris.
- Ramakrishnan, P.S. 1992. Shifting agriculture and sustainable development: An interdisciplinary study from north-east India. MAB Series, Vol. 10. UNESCO, Paris.
- Rastogi, A., P. Shengi and D. Amatya. 1997. Regional Consultation on Conservation of the Kangchenjunga Mountain Ecosystem. International Centre for Integrated Mountain Development, Kathmandu, Nepal.
- Rodrigues, A.S. L., S.J. Andelman, M.I. Bakarr, L. Boltani, T.M. Brooks, R.M. Cowling, L.D.C. Fishpool, G.A.B. da Fonseca K.J. Gaston, M. Hoffmann, J.S. Long, P.A. Marquet, J.D. Pilgrim, R.L. Pressey, J. Schipper, W. Sechrest, S.N. Stuart, L.G. Underhill, R.W. Waller, M.E.J. Watta and X. Yan. 2004. Effectiveness of global protected area network in representing species diversity. *Nature* 428: 640-643.
- Sandwith, T., C. Shine, L. Hamilton and D. Sheppard. 2001. Transboundary Protected Areas for Peace and Cooperation. IUCN, Gland, Switzerland and Cambridge, UK.
- Secretariat of the Convention of Biological Diversity (CBD). 2004a. Programme of work on protected areas (CBD Programme of Work). Montreal, Secretariat of the Convention of Biological Diversity.
- Secretariat of the Convention of Biological Diversity (CBD). 2004b. Biodiversity Issues for Consideration in Planning, Establishment and Management of Protected Area Sites and Networks. Montreal, Secretariat of the Convention of Biological Diversity. Technical Series No 15.

- Sharma, E. and N. Chettri. 2005. ICIMOD's Transboundary Biodiversity Management Initiative in the Hindu Kush-Himalayas. *Mountain Research and Development* 25(3): 280-283.
- Sharma, E. and R. Acharya. 2004. Summary report on mountain biodiversity in the convention on biological diversity (CBD). *Mountain Research and Development* 24(3): 63-65.
- Sharma, E., R.C. Sundriyal, S.C. Rai, Y.K. Bhatt, L.K. Rai, R. Sharma and Y.K. Rai. 1992. *Integrated Watershed Management: A Case Study in Sikkim Himalaya*. Gyanodaya Prakashan, Nainital.
- Shenga, N.C. 1994. Status paper on biodiversity in Sikkim. Panda 1: 5-10.
- Shengji, P. and U.R. Sharma. 1998. Transboundary Biodiversity Conservation in the Himalayas. In *Ecoregional Cooperation for Biodiversity Conservation in the Himalayas*. United Nations Development Programme, New York, USA.
- Sherpa, L.N., B. Peniston, W. Lama and C. Richard. 2003. *Hands around Everest: Transboundary Cooperation for Conservation and Sustainable Livelihoods*. Kathmandu: ICIMOD.
- Smith, R.D. and E. Maltby. 2003. *Using the Ecosystem Approach to Implement the Convention on Biological Diversity: Key Issues and Case Studies*. IUCN, Gland, Switzerland and Cambridge, U.K.
- Sundriyal, M. and R.C. Sundriyal. 2003. Underutilized edible plants of Sikkim Himalaya: Need for domestication. *Current Science* 85(6): 731-736.
- Vancly, J.K., A.G. Bruner, R.E. Gullison, R.E. Rice and G.A.B da Fonseca. 2001. The effectiveness of parks. *Science* 293: 1007-1008
- Velazquez, A., G. Bocco, F.J. Romero and A.P. Vega. 2003. A Landscape Perspective on Biodiversity Conservation: The Case of Central Mexico. *Mountain Research and Development* 23(3): 240-246
- Wells, M. 1992. Biodiversity Conservation. Affluence and Poverty: Mismatched Costs and Benefits and effort to remedy them. *Ambio* 21(3):237-243.
- Wikramanayake, E.D., C. Carpenter, H. Strand and M. McKnight. 2001. *Ecoregion-based Conservation in the Eastern Himalaya: Identifying Important Areas of Biodiversity Conservation*. WWF and ICIMOD, Kathmandu, Nepal
- Williams, B. 2004. *The Status of Red Panda in Jamuna and Mabu villages of eastern Nepal*. [Master thesis]. San Jose State University, USA.
- WWF and ICIMOD. 2001. *Ecoregion-based conservation in the Eastern Himalaya: Identifying important areas for biodiversity conservation*. WWF Nepal, Kathmandu.
- Yonzon, P. 2005. Impacts of insurgency and conflict on Nepal's protected areas. In: *Managing Mountain Protected Areas: Challenges and Responses for the 21st Century* (Eds. D. Harmone & G.L. Worboys). Andromeda Editrice, Italy, pp. 354-357.
- Yonzon, P., S. Pradhan, R. Bhujel, S. Khaling, U. Lachungpa and C. Lachungpa. 2000. *Kanchenjunga Mountain Complex. Biodiversity Assessment and Conservation Planning*. WWF Nepal.

