ICIMOD Working Paper 2012/7

ICIMOD

FOR MOUNTAINS AND PEOPLE

Transboundary Landscape Management Framework for Ecological and Socioeconomic Resilience

United Nations Decade on Biodiversity

About ICIMOD

The International Centre for Integrated Mountain Development, ICIMOD, is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalization and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.

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Transboundary Landscape Management Framework for Ecological and Socioeconomic Resilience

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Acronyms and Abbreviations

CBD	Convention on Biological Diversity
HKH	Hindu Kush Himalayas/n
ICIMOD	International Centre for Integrated Mountain Development
KSLCI	Kailash Sacred Landscape Conservation Initiative
MA	Millennium Ecosystem Assessment
NAPA	National Adaptation Programme of Action
PA	Protected area
PES	Payment for ecosystem services
RCF	Regional cooperation framework
REDD	Reducing Emissions from Deforestation and Forest Degradation
UNFCCC	United Nations Framework Convention on Climate Change

Introduction

Present-day land management approaches, especially those focused on conservation, have two main goals: ensuring that natural resources, and especially biodiversity, are maintained in the face of the challenges posed by various drivers of change; and ensuring that those who depend on the land resources will be able to meet their needs now and in the future. In other words, the aim is to achieve ecological and socioeconomic resilience.

In the past, interventions have tended to focus on specific sectors or needs in small areas. However, natural systems are highly complex and intricately interconnected, and interventions that promise positive outcomes for one aspect may be counterproductive for another. Increasingly, more holistic approaches are being developed that take into account the full range of functions in a large area of land. Such approaches are commonly described as ecosystem or landscape-level approaches. The term 'landscape' can be understood in different ways, but in this context it is taken to mean an area of land that contains a mosaic of interrelated ecosystems, including human-dominated ecosystems, together with the culture and traditions that have shaped them.

As elsewhere, the Hindu Kush Himalayan region is experiencing the effects of a wide range of drivers of change, including the impact of growing populations with increased needs, and pressures on biodiversity and productivity resulting from climate change. Furthermore, the mountain region is shared among eight countries, and contiguous landscape areas often extend across national boundaries, which further challenges consistent management. Transboundary landscape management offers a promising way of addressing these challenges and designing interventions at a landscape scale that will contribute to maintaining the health of the ecosystems while ensuring sustainable development for the human population. However, in order to be effective, the management approach must be guided by a common framework that provides a basis and mechanisms for developing understanding and cooperation among the countries of the landscape and for designing appropriate interventions for the whole landscape area.

This paper presents a framework for transboundary landscape management to support the development of ecological and socioeconomic resilience in the Hindu Kush Himalayan region. First, the specific characteristics and challenges of the region are discussed, together with the basic concepts of transboundary landscape management, to provide a background for understanding the framework. Seven landscape areas selected by the International Centre for Integrated Mountain Development (ICIMOD) for particular attention are described as pilot sites where the framework is being tested. Following this introduction, the rationale and main elements of the framework are presented in detail, and a mechanism for implementing the approach is discussed, together with examples of some activities carried out in support of the approach in the pilot areas. A glossary of relevant terms is also provided.

The paper is likely to be of interest mainly to policy makers, conservation and development practitioners, landscape and protected area managers, and institutions and researchers concerned with regional biodiversity conservation and management in the greater Himalayan region and beyond.

Drivers of change in the Hindu Kush Himalayan region

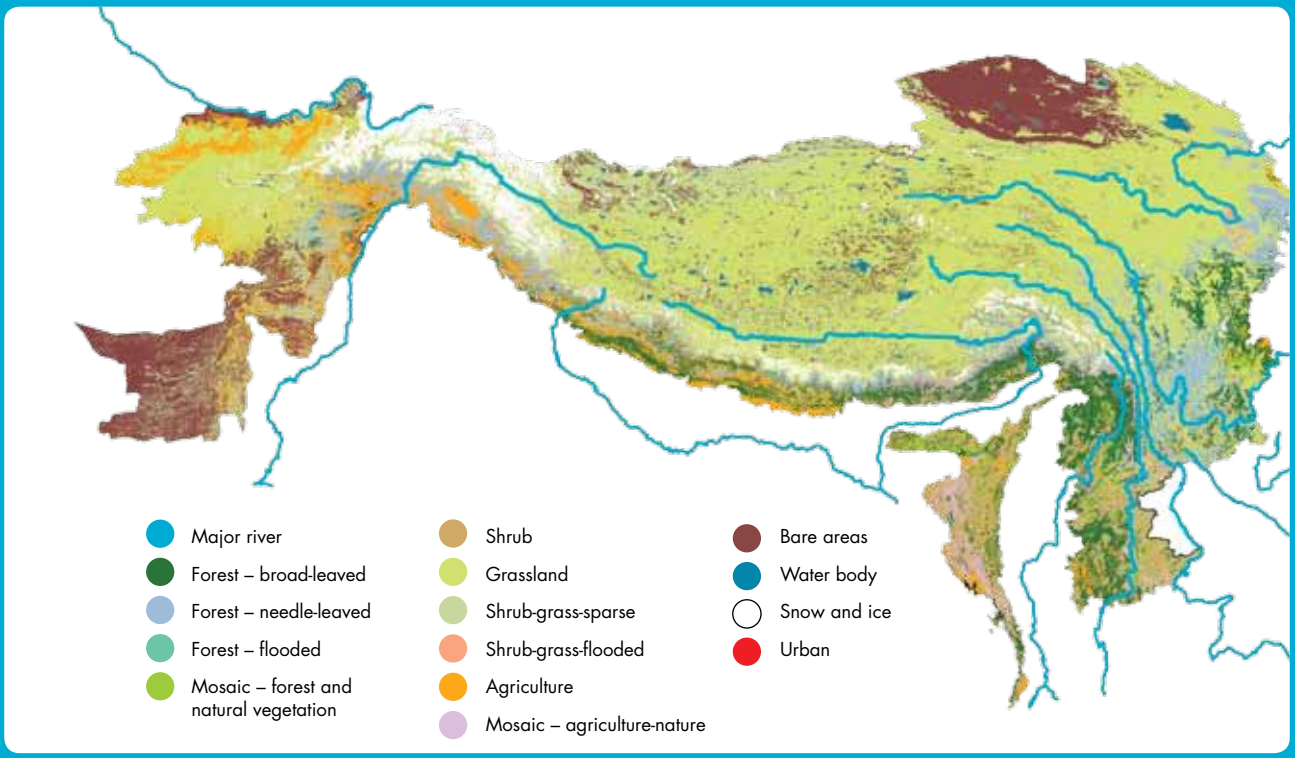
The resilience, vulnerability, and adaptive capacity of ecosystems, including the species they contain and the people that inhabit them, are affected by a combination of climate change-associated disturbances and non-climatic drivers such as land use and land cover change, pollution, globalization, poverty, and demographic changes (IPCC 2007a). These drivers put pressure on ecosystem goods and services and directly influence people's lives and livelihoods.

The Hindu Kush Himalayan (HKH) region (Box 1) is particularly vulnerable to climate and other drivers of change as a result of its ecological fragility and economic marginality (Jodha 2011). Mountain environments respond strongly to small changes in temperature because their steep profile creates altitudinal gradients of temperature, precipitation, and solar radiation, leading to rapid variation in habitat types and a limited range for many species (ICIMOD 2009a). The fragile soils are easily disturbed by changes in precipitation and land use, and large areas can be rendered infertile in a short time as shown, for example, by desertification in rangeland areas. Climate warming in the region is predicted to be twice the global average (Eriksson et al. 2009), and concern is growing

Box 1: The ecosystems of the Hindu Kush Himalayan region

The Hindu Kush Himalayan (HKH) region extends across all or part of eight countries (Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan) and is home to an immense biodiversity of global importance, which is reflected in the nine global conservation priority templates (Brooks et al. 2006). The region contains all or part of four global biodiversity hotspots and 60 ecoregions, of which 29 belong to the global 200 ecoregions known for their unique ecosystem structure, species endemism, and intensity of threats to which they are exposed (WWF and ICIMOD 2001). The overall land cover distribution is shown in Figure 1 (Singh et al. 2011). More than half of the region is covered by rangeland (grasslands, including alpine pastures and meadows, and shrubland, especially above the tree line). These areas have high floristic richness and large numbers of grazers and browsers. Approximately 14% of the region is forested, and these forests provide important altitudinal connectivity for species exchange between lowland and montane habitats. Approximately a quarter of the land area is classified as 'agricultural', with a diversity of mostly mixed farming systems containing a rich genetic diversity of cultivated plant species and livestock breeds. The region's wetlands, high and low altitude, provide a habitat for several globally significant migratory large mammals and birds. The overall ecosystem goods and services derived from these diverse ecosystems directly support the livelihoods of the 210 million people who live in the region and contribute to the wellbeing and livelihoods of a further 1.3 billion people downstream (Schild 2008).

Figure 1: Land use and land cover in the HKH region



about rapidly receding glaciers and an increased likelihood of glacial lake outburst floods (Mool 2009) and extreme events such as flash floods, landslides, and droughts (Xu et al. 2009; Singh et al. 2011). The impact of climate change is evident on water resources, natural biodiversity, agriculture, and the wellbeing of people, especially those who depend almost exclusively on natural resources for their livelihoods (Tse-ring et al. 2010). This impact is compounded by a range of human activities such as deforestation, intensive grazing, agricultural expansion, and unsustainable harvesting and overexploitation of biodiversity resources (Chettri et al. 2010). The potential impacts of drivers of change on biodiversity structure, function, and services identified by various authors are summarized in Annex.

The protected area network

Close to 40% of the geographical area of the HKH region is included in a protected area (PA) of some form (Chettri et al. 2008a). However, many of these areas are very small, and their management effectiveness and ability to cope with multiple drivers of change remains a challenge. Smaller PAs need an adequate natural buffer area around them to reduce island syndrome and corridor connectivity with other areas at a landscape level to provide an effective range of habitat for resident species. Equally, many of the PAs in the HKH are subject to considerable anthropogenic pressure and external driving forces, and many people depend on biomass resources from the PAs and their surrounding buffer areas for their livelihoods (Sharma and Yonzon 2005). Overall, the PA network requires adequate biogeographic and ecosystem coverage to ensure overall resilience and the fulfilment of multiple functions such as provision of natural gene banks, refuge for evolutionary and other ecological processes, refuge for populations affected by climate change, and adequate provision of ecosystem goods and services.

Protected area management needs to pay more attention to the extended matrix of multifunctional areas in which the PA is embedded and expand the scale of conservation in order to enhance PA effectiveness (Dudley et al. 2010; Mawdsley et al. 2009; Galatowitsch et al. 2009; McNeely 2008; Chappe et al. 2005). Most of the countries of the region are beginning to pay more attention to the extended matrix of multifunctional landscapes and the way in which these can contribute to maintaining the integrity of the entire landscape (Chettri and Shakya 2008).

Transboundary landscape management and the ecosystem approach

The Convention on Biological Diversity (CBD) adopted an ecosystem approach for conservation management in 2004 (CBD undated). The ecosystem approach stands at the meeting point of sustainable ecosystem management and enhanced livelihood security for the poor and encompasses both conservation and development concerns. The CBD defines the approach as a "strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way". This use incorporates the concept of an area used by humans as well as one containing plants and animals in a recognizable configuration (Shepherd 2008), in other words a landscape. The ecosystem approach focuses on the management and restoration of ecosystem functions and services rather than on the ecological structure alone. It also provides a way of looking at PAs as a part of a larger landscape, thereby widening PA objectives beyond the protection of static patterns of biodiversity (Lovejoy 2005) to incorporate large-scale changes and management heterogeneity outside the PA itself (Hannah 2009). The ecosystem approach focuses on increasing connectivity between PAs in order to generate positive outcomes for both conservation and sustainable development, and increasingly also for climate change adaptation.

Transboundary biodiversity management is a particular aspect of the ecosystem approach which focuses on the management of natural ecoregions that have remained neglected as a result of their remote location and inclusion of international boundaries and resultant discontinuous management practices. It integrates the traditional socio-cultural practices of local communities with modern approaches of landscape management by involving multiple stakeholders in a participatory manner (Sharma and Chettri 2005).

Transboundary landscape management is more or less synonymous with the ecosystem approach, but applied in transboundary areas and with less focus on PAs. Transboundary landscape management promotes an integrated approach for management of extended landscapes, defined by ecosystems rather than administrative boundaries, in which both the conservation and sustainable use of the components of biological diversity are considered, and in which people and their socio-cultural resources are placed at the centre of the conservation framework. This approach has been strongly recommended for linking conservation with sustainability by involving communities in decision-making processes and exploiting biodiversity judiciously to ensure effective management. Transboundary landscape management has been endorsed within the context of the CBD ecosystem approach, which has highlighted the significance of regional cooperation in critical transboundary landscapes among the signatories to the convention.

ICIMOD as a regional knowledge and enabling centre is mandated by its regional member countries to promote the mountain agenda and provide a regional voice for sustainable mountain development. ICIMOD and its partner

institutions have been advocating for the conservation of biodiversity in transboundary landscapes and the use of a transboundary landscape management approach for more than a decade. The aim is to bring together a wide range of stakeholders from the regional countries to understand the complexity of landscape dynamics and the drivers of change that affect biodiversity and people in order to develop approaches that meet the needs of conservation goals while supporting socioeconomic development (Sherpa et al. 2003; Sharma and Chettri 2005; Sharma et al. 2007; ICIMOD 2010a).

Himalayan transboundary landscapes and transects

ICIMOD's 'transboundary landscapes' and 'trans-Himalayan transects' approach provides a conceptual framework for promoting regional cooperation for biodiversity conservation and management among the countries of the region, and the development of strategies that will help build both ecosystem and local community resilience (Chettri et al. 2009; Schild and Sharma 2011). Seven transboundary landscapes have been identified along an east-west gradient representing geographically distinct and ecologically contiguous areas that extend across the borders of two or more countries (Figure 2). These landscapes have a combination of characteristics: a unique ecosystem, biodiversity rich areas, culturally rich sites, the presence of globally significant species, the presence of socioeconomically marginalized communities who are highly dependent on natural resources for their livelihoods and are affected by various drivers of change, and historical and socio-cultural linkages across national boundaries. In general, they also represent areas where the national governments have recognized the need for transboundary cooperation for effective management of the biodiversity (Sharma and Chettri 2005; Zomer and Oli 2011). The transboundary landscapes are embedded within four north-south trans-Himalayan transects envisioned for long term climatic, ecological, and socioeconomic monitoring (Messerli 2009; Chettri et al. 2009).

These priority landscapes in the HKH region are the designated 'pilot sites' for more in-depth studies and knowledge generation. They provide an opportunity for developing ecological interconnectedness and

Figure 2: The seven transboundary landscapes and four north-south trans-Himalayan transects identified in the HKH region

connectivity across islands of PAs within the landscapes, and facilitate inter-sectoral policy coordination to address transboundary landscape issues such as wildfires, poaching, illegal trade, and climate change (Sharma et al. 2007). Specifically, they provide sites for testing the transboundary landscape management approach. The transboundary landscape concept offers advantages in assessing and responding to the impacts of a changing climate such as monitoring of environmental and socioeconomic changes at greater temporal and spatial scales; allowing for different types of governance systems in protected areas; promoting habitat interconnectedness with corridors and connectivity; and enabling people to be part of the conservation process and thus increasing their socioeconomic resilience. The HKH Conservation Portal provides more information on the transboundary landscapes (www.icimod.org/hkhconservationportal).

Transboundary landscape initiatives

A range of initiatives related to transboundary landscape management are underway or under discussion in the seven transboundary landscape areas.

A pioneer transboundary initiative in the Everest landscape between China and Nepal first demonstrated the challenges and opportunities of the landscape approach in biodiversity conservation and planning and helped identify a range of transboundary biodiversity issues (Sherpa et al. 2003). Activities in the southern part of the Kangchenjunga landscape (Bhutan-India-Nepal) then highlighted the way in which biodiversity corridors could be used to ensure habitat connectivity and supplement the conservation role played by protected areas. Conservation-linked livelihood opportunities in such corridors can be used to address the needs of the people living in the landscape while increasing the opportunities for species to adapt to a changing climate (Chettri et al. 2007). Substantial scientific baseline information has been generated for this landscape and 6 potential conservation corridors have been identified that link 15 protected areas (Chettri et al. 2008b).

The Kailash Sacred Landscape Conservation Initiative provided the first pilot for implementation of ICIMOD's trans-Himalayan transects framework. Starting in 2010, this initiative has been facilitating transboundary and ecosystem management approaches for biodiversity and cultural conservation, sustainable development, and climate change adaptation through regional cooperation. Partner institutions from China, India, and Nepal have agreed on a common framework to develop a regional conservation strategy and long-term environmental monitoring strategy (Zomer and Oli 2011). Partner institutions in India, China, and Myanmar have also agreed in principle to adopt a regional approach to manage the Brahmaputra-Salween landscape with its extremely rich biodiversity (ICIMOD 2009b). Initiatives in the remaining three landscapes – the Karakoram-Pamir and Wakhan landscapes in the west and the Cherrapunjee-Chittagong landscape in the east – are under development.

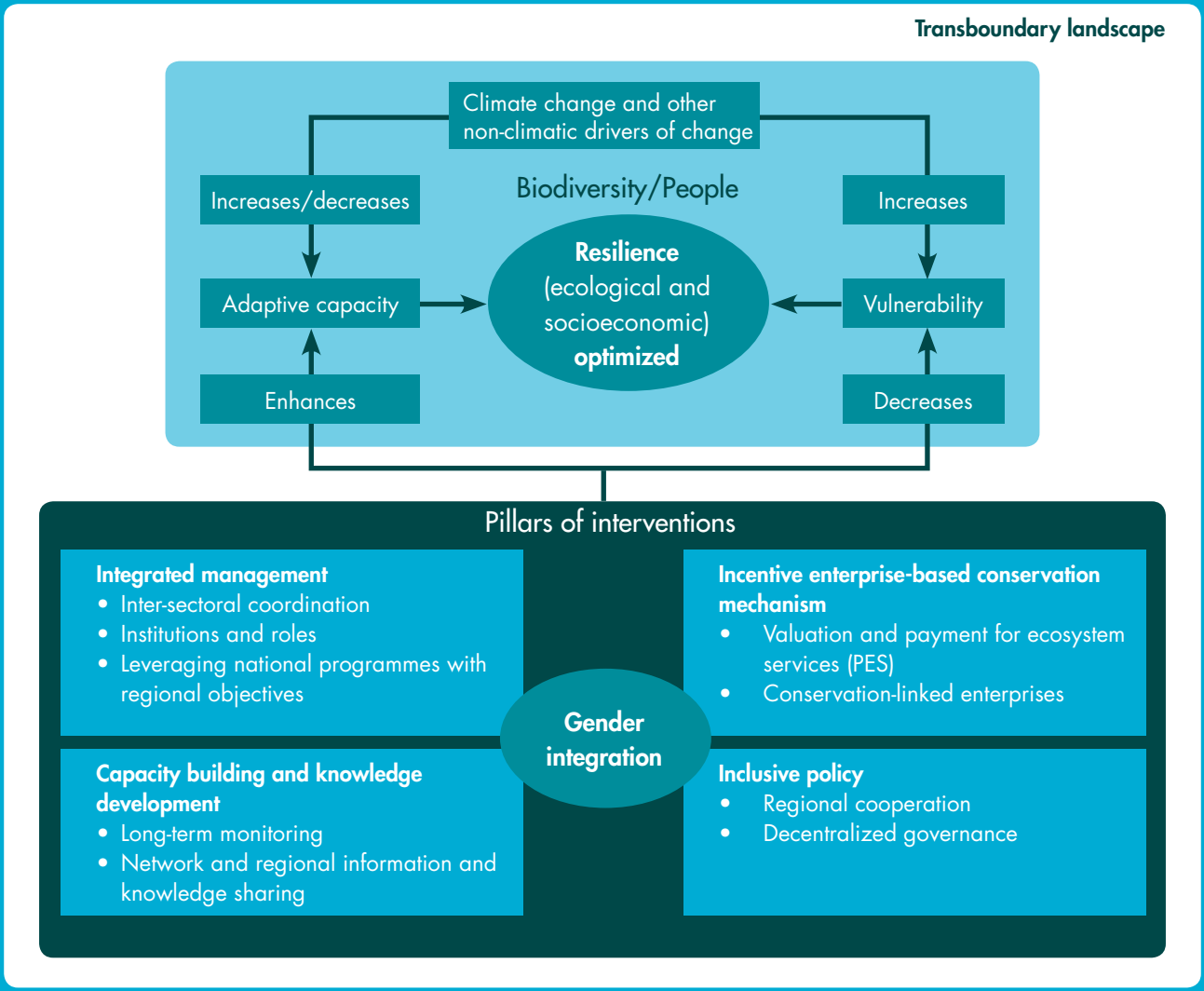
The Regional Transboundary Landscape Management Framework

In order to introduce a transboundary landscape management approach, it is necessary to have a common framework that guides the process and provides a basis and mechanisms for developing understanding and cooperation and designing appropriate interventions among the countries that share the landscape.

ICIMOD has developed a transboundary landscape management framework for use across the HKH region. The focus is on maintenance and development of the landscape ecosystem as a whole – including the structure, functions, and services. Biodiversity management, sustainable development, and climate change issues are similar across all the countries of the HKH region. Thus the framework uses transboundary landscapes as the basic unit for assessing the impacts of climate and other drivers of change on land use and associated biodiversity resources and the consequences for people's livelihoods.

The main components of the framework are shown in Figure 3.

Figure 3: The transboundary landscape framework



The approach outlined in the framework aims to reduce the risk of impacts from climatic and non-climatic stressors on the landscapes and ensure that the landscapes continue to provide important ecosystem services locally, regionally, and globally. At the same time, the adaptive capacity of the women and men, indigenous people, and poor and socially marginalized communities who depend primarily on biodiversity resources for their livelihoods should be enhanced to enable them to deal with environmental and socioeconomic stressors so that they become more resilient to change. The framework recognizes that optimizing ecological and socioeconomic resilience is a complex process which depends on coordinated interdisciplinary action at different levels. It outlines four pillars of interventions related to integrated management, incentive- and enterprise-based conservation, development of inclusive policies, and capacity building and knowledge development. Integrated into all of these are indicators for gender integration to ensure that the skills, knowledge, position, and responsibilities of women and men, and their different needs, priorities, and decision-making powers in terms of ecosystem services, are adequately reflected. The four pillars of interventions and the cross-cutting gender approach are described in the following sections.

Integrated management

A multi-scale management approach is required to maintain intact and interconnected ecosystems within larger landscapes, to ensure continuous provision of ecosystem services, to maintain genetic continuity, and to support adaptation and mitigation processes. The landscape approach provides a better prospect for incorporating interdisciplinary management issues such as invasive species management, disturbance regime management,

buffer zone management, protection of climate refuges, watershed management, participatory forest management, and co-management of rangelands, than approaches based on administrative boundaries or sectoral issues (Galatowitsch et al. 2009). Similarly, there is scope for better integration of information from direct observation (ecological observation in real time based on long-term monitoring) and model-based information (climate-envelope model, population models, ecophysiological models) into conservation and adaptation planning, and for allocation of resources for effective biodiversity management (Dawson et al. 2011).

The transboundary landscape approach aligns the processes for biodiversity management, poverty alleviation, and sustainable development. It helps increase the scope of management interventions through inter-sectoral coordination and wider institutional involvement, participatory planning, and convergence of the sectoral objectives of different line departments. Table 1 summarizes the overall scope of integrated management under transboundary landscape management and the linkages to facilitating ecological and socioeconomic resilience.

Table 1: **Scope of integrated biodiversity management within the transboundary landscape and linkages with ecological and socioeconomic resilience**

Scope	Linkages to ecosystem resilience	Linkages to socioeconomic resilience
Adoption of the ecosystem approach of the CBD with integrated management of land, water, and living resources	Sustaining biodiversity structure and function and all types of ecosystem service	Improved access to resource management tools and technologies promoting sustainable management and use of resources at the community level
Ensure PAs are adequately comprehensive, representative, and relevant	Conservation and responsible use of biodiversity and recognition of customary and institution-based practices related to biodiversity resource management	Communities empowered and involved to manage the ecosystems on which their livelihoods depend
Promote ecological contiguity through connectivity and corridor development	Protection awareness for nationally, regionally, and globally important biodiversity areas, microclimatic habitats, and ecological niches	Optimal use of production landscape promotes increased productivity, thereby increasing income and food security; opportunities for crop diversification, and agroforestry innovations
Maintain the integrity of landmasses extending across national boundaries; take their multiple uses and functions into consideration through cross-sectoral planning, collaboration, and institutional capacity building	Ecological connectivity, and provision for species range extension through migration and dispersal; hence enhanced population gene pool and growth for species suited to specific ecological niches	Increased opportunity for communities to invest in conservation-linked livelihood options
Engage local communities in conservation for their socioeconomic development	Optimized sustainability of fragmented ecosystems or landscapes	Reduced rural economic burden through capacity building interventions and diversified income opportunities
Create opportunities for regional mechanisms based on common minimum criteria for building consensus among countries	Buffering effects against extreme weather conditions to increase resistance of natural and cultivated ecosystems	Technology transfer and strengthened socio-cultural bonds and wider institutional coordination
Regional cooperation for biodiversity and climate change knowledge generation and sharing	Management of large-scale changes across international borders giving greater flexibility in time and space for ecosystems to avoid reaching a 'tipping point'	Increased food security with enhanced biodiversity services
	Management of cross-border species range shift dynamics for effective adaptation	Revitalization of traditional knowledge and local adaptation practices
	Enhanced awareness of linkages between biodiversity, livelihoods, and climate change adaptation	Sustainable harvesting and use contribute to village savings and economy
	Collective understanding of ecosystem value and ownership of biodiversity assets through people's participation	Increased awareness of climate change risks with livelihood vulnerability and resilience
	Long-term monitoring of change and impacts	Improved understanding of building climate change resilience, stronger role of institutions at all levels
	Collective research and joint policy influence on biodiversity management and climate change adaptation	Coordinated effort for development of a regional adaptation programme
	Less conflicting strategies for biodiversity management and adaptation	

Incentive- and enterprise-based mechanisms

There are several proximate causes for loss of biodiversity, but some are rooted deep within the human socio-cultural and socioeconomic sectors and the immediate needs of people for biodiversity goods and services. Conservation involves both trade-offs and opportunity costs, and without appropriate incentives the current decline in biodiversity is likely to continue or even accelerate (EC 2008). Renewability, or the capacity to regenerate over time, is an important economic feature of biodiversity resources, and economics can play an important role in helping to capture the cost of failure to conserve renewable resources and in providing adequate incentives for their maintenance (Daily et al. 2000). Incentives can be both direct (as in payment for environmental services) or indirect in the form of enterprise-based conservation, in which resources are maintained to ensure the success of enterprises based on ecosystem services such as ecotourism, high value products, non-timber forest products, and other resources.

Ecosystems in the landscape provide public goods that generate tangible benefits for communities; they also provide many essential regulatory and supporting benefits such as carbon storage for mitigating climate change, ecotourism benefits, hydrological services, and provision of a reservoir of species and genetic diversity (MA 2005). Most of these benefits are not accounted for (de Groot et al. 2010) and many of the beneficiaries of the services do not contribute to the maintenance and management of the providing ecosystems (Costanza et al 1997). Although the way in which people use and manage biological resources will determine their future availability, communities are rarely compensated for maintaining vital ecosystem resources (ICIMOD 2011). Economic incentives are needed to ensure the safeguarding of natural resources. The European Commission has developed a framework for a green economy and payment for ecosystem services (PES) approach which recognizes the value of services to both the local and wider community, and this is generating interest in the valuation of ecosystem services and increased funding opportunities for biodiversity management (EC 2008). Incentives for maintaining natural resources can be positive (monetary or non-monetary) and negative (internalization of the cost of use of and/or damage to biological resources). Analysis of the value of ecosystems in the landscape, and development of appropriate PES mechanisms, can be a key to promoting ecological and socioeconomic resilience in the landscape (Rasul et al. 2011).

Governments in the HKH countries are working towards creating a conducive policy and institutional environment for such incentive-based mechanisms. A PES feasibility study carried out for a protected area in Nepal highlighted the need for review and development of supportive policies and a regulatory framework for adopting and implementing the PES mechanism (MoFSC 2012). Public awareness for building support of PES for protected areas is still in its infancy and requires further understanding and assessment of the roles and responsibilities of both beneficiaries and benefactors and the providers of the services.

One incentive-based mechanism agreed at the global level is REDD+: Reducing Emissions from Deforestation and Forest Degradation. The United Nations Framework Convention on Climate Change (UNFCCC) views adaptation and mitigation as separate strategies to respond to climate change; REDD+ is housed under the mitigation domain but it lies at the interface between adaptation and mitigation, since its implementation in the forestry sector leads to co-benefits for biodiversity conservation and improved livelihoods. The strengthening of the functions of the natural resource base increases the resilience capacity of the local populations that depend on the forest resources. A REDD+ policy can be taken as both a measure to mitigate emissions and as an adaptive strategy for rural mountain communities. Box 2 describes a REDD+ pilot initiative in Nepal as an example. Descriptions of REDD+ benefits at the local level have furthered the global REDD+ discourse and the process of developing REDD+ strategies at a national level (Skutsch et al. 2012).

The Endowment Fund for Human Wildlife Conflict Management (www.dofps.gov.bt/ncd) in Bhutan is another good example of an incentive-based mechanism supporting biodiversity management. The approach was initiated as a community-driven funding mechanism for the payment of cash compensation to villagers for damage caused by wildlife and was established as a tax-exempt entity overseen by the Bhutan Trust Fund for Environmental Conservation. The governing board ensures proper investment through involvement of community-based gewog environmental conservation committees (Wangchuck 2012). Creation of an endowment fund is a useful biodiversity

Box 2: ICIMOD's REDD+ pilot initiative in Nepal

ICIMOD, the Federation of Community Forestry Users, Nepal (FECOFUN), and Asia Network for Sustainable Agriculture and Bio-resources (ANSAB) have worked together with support from the Norwegian Agency for Development Cooperation (Norad) since June 2009 on a pilot REDD+ project in community forests in three watersheds in Nepal.

The initiative aimed to design and set up a pilot governance and payment system for emission reduction through sustainable forest management that benefits local and indigenous communities. The intention was to demonstrate the feasibility of the approach as a contribution to the development of a national REDD strategy for Nepal. Four main processes were involved:

- design of a forest carbon accounting system, including the establishment of a carbon data centre and registration system;
- building the capacity of communities, partners, and national REDD+ stakeholders to implement the carbon measurement process and adopt management practices that reduce leakage and degradation;
- developing a monitoring, reporting, and verification (MRV) system; and
- institutionalizing the first-ever Forest carbon Trust Fund, which is an equitable, fair and transparent system for distribution of accumulated REDD+ benefits operated by a multi-stakeholder advisory board which includes the government.

As of June 2011, the trust fund had distributed a total of USD 95,000 to representatives of community forest user groups (CFUGs) in three watersheds in Dolakha, Gorkha, and Chitwan districts.

Other countries are showing increasing interest in this approach and ICIMOD will share its learning from the initiative in Nepal to countries across the Hindu Kush Himalayas and spread awareness that REDD+ benefits from the global carbon market can be used to help sustain the livelihoods of local communities.

More details of the activities are given on the project website (www.communityredd.net).

management solution for devolving the issues related to human-wildlife conflict to the local level – 'directly into the hands of affected communities'. The funds can also be channelled towards community development through micro-financing and by building local capacity for human-wildlife conflict management and diversification of income generating activities.

Inclusive policy

Transboundary landscape management perspectives offer a useful policy solution at the regional level by providing a basis for developing an integrated management system targeting ecological processes that extend beyond individual national boundaries. The approach shows where synergies can be developed between climate change adaptation, mitigation, and biodiversity conservation and management for associated ecosystem services. It has the potential to create coherent win-win opportunities across countries in the landscape to addresses biodiversity and climate change issues in an integrated manner to effectively meet both sustainable development and biodiversity conservation and management goals. Table 2 summarizes the relevance of the transboundary landscape management approach to policy interventions at the global and national levels.

In addition, the landscape perspective creates opportunities for harmonization and synchronization of national sectoral policies for regional outputs. Such regionalization is necessary, as the drivers affecting biodiversity and people are not confined within national boundaries, and collective actions from different countries will be more comprehensive and less demanding in terms of resource investment.

Table 2: **Relevance of the transboundary landscape management approach to global and national policy interventions associated with biodiversity management and building ecological and socioeconomic resilience**

Policy interventions at global and national levels		Relevance of regional transboundary conservation landscape framework
Multilateral agreements	CBD	Increased diversity of landscapes and interconnected agricultural ecosystems, natural floodplains, forests, wetlands, and other ecosystems lead to enriched and sustained ecosystem services
		Addressing non-climatic pressures on biodiversity
		Conservation of habitat, ecosystem, species, and genetic diversity of wild and cultivated plants and domesticated livestock, leading to increased overall ability of ecosystems to adapt
		Strengthened protected areas network
	UNFCCC	Forest carbon stock conserved and enhanced
		Reduction of emissions from deforestation and forest degradation
		Sustainable land management leading to enriched carbon sequestration
		Increase environmental security through enhancing mitigation and adaptation co-benefits
	MDGs	Socio-cultural co-benefits due to increased participation of people in conserving resources they value and depend on
		Opportunities for recreation and protection of cultural and traditional knowledge
		Potential for economic co-benefits through income generating activities based on diversified conservation-linked livelihood options
		Enhanced food security through diversified land use management and diversification of crops and food products
National climate policies	NAPAs and other climate change and biodiversity-based policies	Complementary to national forest conservation and sustainable forest management programmes
		Conservation of agricultural diversity and economically important food, hence building of food security and community economic resilience
		Protection against extreme weather events and their impact on biodiversity and livelihoods
		Conservation of traditional and indigenous knowledge, innovations, and practices related to biodiversity conservation and sustainable use
		Regional understanding of climate change vulnerability, impacts, and adaptation practices across the countries
		Opportunity for collaborative research and monitoring, particularly related to ecosystem services, livelihood options, and climate change scenarios

Note: CBD = Convention on Biological Diversity; UNFCCC = United Nations Framework Convention on Climate Change; MDGs = Millennium Development Goals; NAPA = National Adaptation Programme of Action

Notwithstanding the benefits, the initial processes and steps towards regional cooperation can be time consuming and require continuous dialogue among participating countries in order to develop a common minimum agenda for cooperation and regional actions. The Bhutan Climate Summit held in 2011 provides an example of regionalization of climate change adaptation actions through policy interventions (Box 3).

At the global level, the major policy influence with regard to climate change and biodiversity has been the push to create an interface between mitigation and adaptation. This resulted in broadening of the scope of REDD mitigation measures to 'REDD+', which includes conservation of forests and improved livelihoods of communities from the use of forest resources as adaptation co-benefits. The landscape approach provides incentives to link CBD's Programme of Work on Protected Areas and Forests with UNFCCC's REDD+ plus mechanism. At the national level, the majority of countries in the HKH region have developed national adaptation plans of action (NAPAs), and India and China

Box 3: Bhutan Climate Summit 2011

The countries that share the HKH region agree that climate change is a shared problem and that adaptation must be a regional agenda that demands a holistic and inter-sectoral approach. The Bhutan Summit was a pioneer action towards building a regional approach to climate change adaptation for the eastern Himalayan region.

At the 'Climate Summit for Living Himalayas – Bhutan 2011', held in November 2011 in Thimphu, Bhutan, Bangladesh, Bhutan, India, and Nepal formulated a 10-year road map towards a regional adaptation plan of action. The key thematic concerns addressed by the adaptation plan are ensuring energy security and enhancing alternative technologies; securing the natural freshwater systems of the Himalayas; ensuring food security and securing livelihoods; and securing biodiversity and ensuring its sustainable use. Details in each of these thematic areas reflect the cross-disciplinary issues of climate change. The summit brought clear insight into developing regional adaptation policy options that facilitate the adaptability of vulnerable systems in the eastern Himalayas and reverse the trend of increasing vulnerability.

Further details are available at www.bhutanclimatesummit.org.bt/main/index.php

have national climate change action plans in place. As initial tools, NAPAs were formulated to articulate countries' priority vulnerabilities to climate change according to sector, and propose plans and projects to address these priorities. Several countries are taking up national gap analysis on forests and protected areas to prepare national strategies for implementing REDD+ schemes.

Conservation policies in the HKH region have slowly evolved from the original approach of protecting charismatic species; through habitat, ecosystem, and landscape conservation; to people-oriented conservation approaches (Sharma et al. 2010), in which conservation efforts are directed towards participatory approaches with decentralized governance for biodiversity management within the context of a larger landscape (GoI 2008; GoN/MoFSC 2006). Sharma et al. (2010) and Desai et al. (2011) provide descriptions of this shifting policy paradigm in the eight countries of the region, and the impacts on the implementation of international conventions such as the CBD and the Millennium Ecosystem Assessment (MA).

Capacity building, knowledge development, and networking

In order to understand the implications and respond appropriately to the impacts of drivers of change in a landscape, it is necessary to generate long-term data records for environmental, ecological, and socioeconomic variables and carry out analyses of change dynamics and trends. The IPCC (2007a,b) identified the HKH as a 'data deficit' region where basic climatic and hydro-meteorological data are either not readily available or not reliable. The state of current knowledge on the impact of climate change in the HKH underlines the issues of scarcity of hydro-meteorological data and data related to the role of black carbon particles, the scientific knowledge gap on the impacts on biodiversity, and the unclear trends and extent of impact on livelihoods, health, and wellbeing of people, as well as the need for climate resilient natural resources governance, policies, and development strategies (Singh et al. 2011). There is an urgent need to reduce the scientific uncertainty related to the future climate change scenario and the extent of its impact on key sectors, and to carry out integrated vulnerability assessments and other climate change modelling-based research. It is equally vital to gain a clear understanding of community-based vulnerability and people's response to all kinds of changes, including those driven by climate change. Such knowledge will provide the basis for understanding people's needs, developing the capacity of people and ecological systems to respond to change, identifying the limitations of planned resources management and adaptation measures, and developing conducive policies, institutions, and processes to enhance the adaptive capacities of communities (Macchi 2011; Macchi et al. 2011).

Increasing the resilience of biodiversity and human systems at the landscape level requires knowledge, methods, tools, and technologies that incorporate interdisciplinary approaches and demands interventions that simultaneously decrease the vulnerability and enhance the adaptive capacity of the system. Transboundary landscape perspectives open up avenues for collaborative research to fill these interdisciplinary scientific data gaps, as shown, for example, in the integrated vulnerability assessment of the eastern Himalayas (Box 4). Understanding of climate change science built through collaborative research and data generation at the regional level will facilitate evidence-based policy development both nationally and globally. To promote such collaboration, for example, the Cancun Agreements at the sixteenth Session of the Conference of the Parties to the UNFCCC (COP 16) call for the establishment of regional-level centres of excellence on climate change adaptation information.

Institutional strengthening is fundamental for capacity building, not only to generate data and information but also to enhance cooperation at various levels. Assessment of national institutions is needed in order to realize and build their capacity and effectiveness in addressing climate related risks and evaluating the cost of climate change adaptation. While the governments of the HKH region are ensuring that biodiversity management, adaptation, and mitigation measures are integrated into the wider development agenda, they will need to consider empowering the stakeholders (institutions and individuals) at all levels in order to create an enabling environment for equal partnership and participation for enhancing resilience (Hannah 2009).

Gender integration

Gender is a key dimension in sustainable livelihoods and the sustainable conservation, management, and use of biodiversity resources (Rocheleau and Edmunds 1997; Nightingale 2006). Women and men have complementary knowledge and perceptions of their natural environment and the biodiversity around them as a result of gender differences in functions, responsibilities, needs, social relations, behaviours, resource accessibility, ownership, and awareness. Gender and social differences, which are location-specific and socially constructed and can be changed, strongly influence the way women and men experience environmental and socioeconomic changes, their responses in adaption to the impacts, and their potential to influence decision-making related to ecosystem management. It is essential that gender issues, outcomes, gaps, and the perspectives of both women and men

Box 4: Climate change impact and vulnerability assessment in the eastern Himalayas

ICIMOD carried out a vulnerability assessment for the eastern Himalayas between July 2007 and December 2008. The assessment explored the impact and future projections of changing climate conditions and showed critical linkages between biodiversity, ecosystem functioning, ecosystem services, drivers of change, and human wellbeing. It confirmed the region's vulnerability to climate change as a result of the interplay of several different drivers of change.

Climate scenarios were constructed using data generated from recent model runs at regional and global levels. The trends and projections covered changes in both the primary climate change drivers and the climate system responses. The study indicated that the magnitude of change increased with elevation for both temperature and precipitation trends. For biodiversity, the study looked at details of species level range and abundance shifts, life cycle changes, evolutionary effects, and landscape-level changes. The threat to biodiversity was found to be acute with the majority of ecosystems affected and several species and habitats at risk. Alpine ecosystems, as a result of their narrow elevation range, and lowland riverine habitats were identified as particularly vulnerable. It is also important to look at the impacts of climate change on wetlands, the frequency of hazards, and hydrology, and the implications for water resources. Increased surface air temperature and changes in precipitation and evapotranspiration were all found to influence the water resources in the region. The impacts of climate change on livelihoods and people's wellbeing were also studied. Agricultural production was identified as an area of serious impact with both positive and negative effects on crop production.

Details of the study, individual reports, and a summary of the results are provided by Tse-ring et al. (2010).

are integrated into ecosystem-based research, management, and policy interventions. Such integration helps to enhance understanding of the elements of gender differences such as access, control, use, and benefits of the resources, and to realize the often underrecognized contribution of women to sustainable biodiversity management and sustaining ecosystem services and food security for the family (Shakya et al. 2010).

Transboundary landscape perspectives consider biodiversity management as a social, political, and gendered process in which social relations based on gender, caste/ethnicity, class, culture, age, marital status, and social status determine the extent of women's and men's access to, control over, and use of natural resources including biodiversity (Rocheleau and Edmunds 1997; Lama and Buchy 2003; Momsen 2007). The CBD, while it clearly recognizes the role of women in conservation and sustainable use of biodiversity and their meaningful participation at all levels of policymaking and implementation related to biodiversity management, also highlights the need for effective participation in adaptation processes of women, men, indigenous peoples (IPs), and poor and socially marginalized groups who primarily depend on biodiversity resources for their livelihoods, as well as the need to ensure their rights to the access, use, and benefits of ecosystems as important dimensions of ecosystem-based adaptation (CBD undated; 2009a,b). It is essential, therefore, to incorporate gender and social equity perspectives into the ecosystem-based adaptation approach and weight the three aspects of management and incentive-based mechanisms, policy, and knowledge and capacity development with gender sensitive indicators, as summarized in Table 3.

In the context of cumulative impacts from multiple drivers of change, including men's out-migration and globalization, understanding of gender issues and opportunities allows us to define management and policy options that recognize the differential adaptive capacity of women and men and to identify factors that constrain or facilitate their access to livelihood assets (ICIMOD 2009c). For example, in the HKH region, the majority of women engage in small-scale agricultural production in order to secure food for their families. Too much and too little water caused by climate variability affect both agriculture and natural resource production and may eventually force women to work harder and longer to secure food, water, firewood, forage, fodder, and other resources (Nellemann et al. 2011). Similarly, degradation of pasture affects women's livestock-related activities by increasing the amount

Table 3: **Indicators for integrating gender into the three pillars of ecosystem-based adaptation to facilitate equitable socioeconomic and ecological resilience in landscapes**

Management interventions/incentive-based mechanisms	Inclusive policy	Capacity building and knowledge development
Understanding of socioeconomic, resource governance, legal, gender, and environmental contexts in a landscape	Extent of inclusiveness and gender provisioning in legislation, policy, and policy implementation strategies	Opportunity for participation
Women's participation in decision-making related to resources management planning and implementation	Women's inclusion, voice, and influence in institutions, decision-making bodies, and the policy-making process	Women's access to information, appropriate technology, extension services, and infrastructure
Inclusion of gender needs and gender equity provisions in management plans and guidelines	Provision of gender budgeting and gender expertise in natural resource management institutions	Women's access to education and outreach
Equity in sharing of resources and opportunities	Gender impact analysis of policies	Women's platforms for exposure, networking, and development of leadership skills
Women's access to ecosystem services based on financial incentives and other benefits		Gender disaggregated data
Inclusion of gender-specific indicators in planning, monitoring, and evaluation		Gender and social indicators in the baseline information, methodology, and survey of biodiversity and good practices
Documentation of gender differentiated vulnerability, indigenous knowledge-base, and adaptation capacity		Includes time-use data on biodiversity and environment conservation to assess change in the gender division of labour
Land ownership and rights		Qualitative gender case studies
Gender division of labour		Gender analysis, auditing, learning, and advocacy
		Awareness materials in local, as well as international, languages

of time that has to be spent in collecting water and fodder for animals (Ridgewell et al. 2007). However, policy decisions over such resource management practices and land rights, possession of productive assets, and access to information, technology, and infrastructure often fail to consider gender issues.

Assimilating gender perspectives into the ecosystem approach makes us more conscious of the impact of gender in defining roles and responsibilities, the division of labour, needs, knowledge, and inequalities, and the differences inherent in the unequal power relations between men and women in terms of resource use and access. This can help to improve the livelihoods of resource dependent social groups and results in improved gender positive impacts from interventions related to biodiversity resource management. In addition, it helps to strengthen the capacity of grassroots institutions to plan, implement, and monitor gender responsive biodiversity conservation and management programmes and transform women's economic, social, and decision-making power, while recognizing their contribution to ecosystem management. Gender integration provides a way to acknowledge the different roles that women and men play in resources planning and management, and to create opportunities that enhance women's exposure, networking, knowledge, and skills and give them a platform to share their concerns, needs, and indigenous and other knowledge. Ultimately it facilitates gender responsive policy solutions to promote equitable ecosystem-based adaptation and improvement of livelihoods.

A Regional Mechanism to Optimize Resilience in Transboundary Landscapes

The framework for transboundary landscape management provides a basis for developing programmes that optimize social and ecological resilience in transboundary landscapes – in other words ensuring and supporting livelihoods while conserving biodiversity resources and sustaining ecosystem services. In order to do this, it is necessary to develop a regional mechanism to facilitate cooperation among the countries sharing the landscape and enable them to develop an appropriate and effective regional programme.

The proposed regional mechanism is outlined in Figure 4. The mechanism is designed to enable creation of the political will for and ownership of a transboundary landscape approach; to provide a basis for generating an enhanced knowledge base and collective wisdom; and to support development of a joint programme to facilitate actions for biodiversity management and sustainable development across the entire landscape. The various steps involved are described in more detail in the following sections.

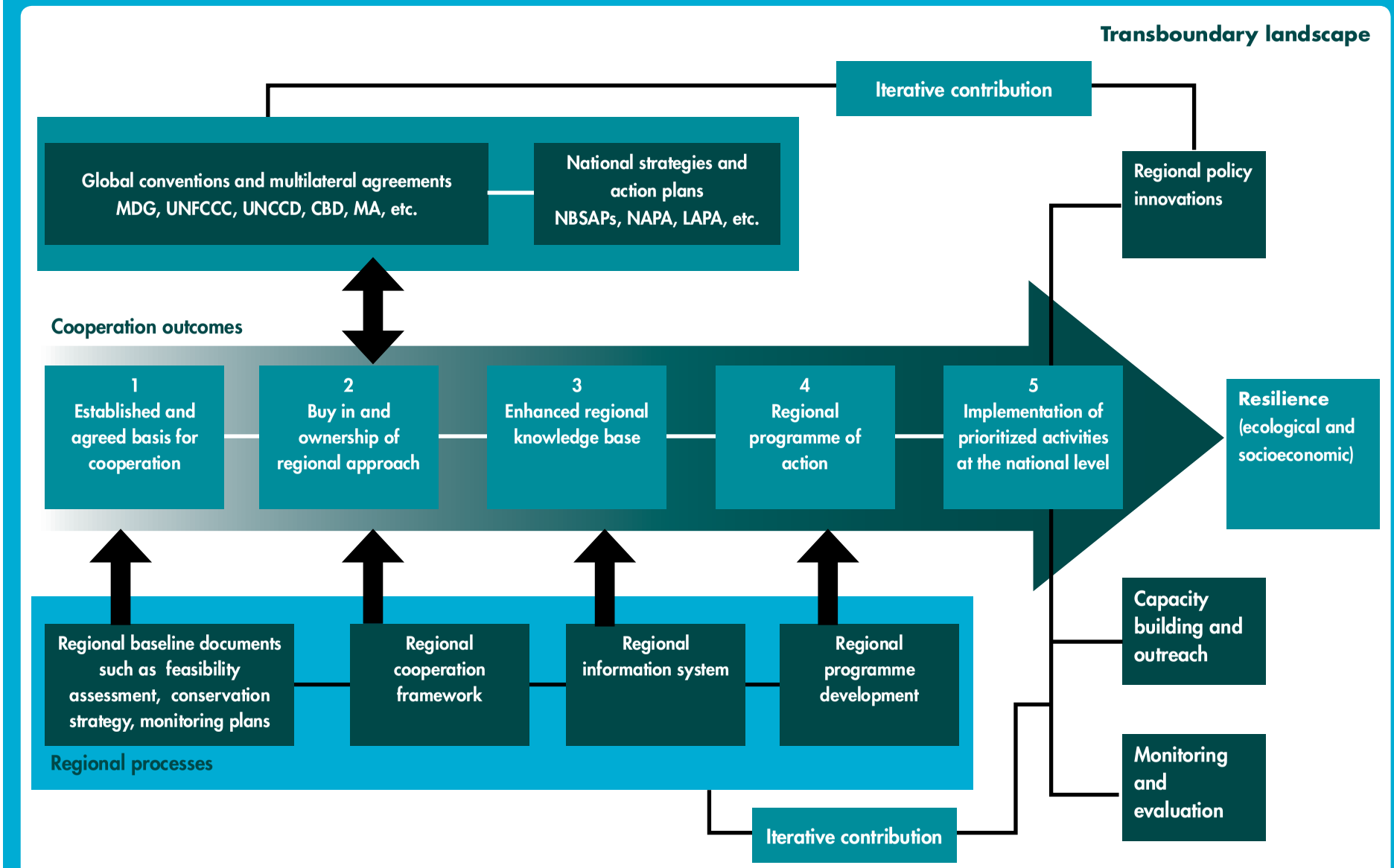
Establishing an agreed basis for cooperation

Consensus building among countries for a regional transboundary initiative is a gradual and iterative process that calls for several tiers of regional and national consultations, dialogues, and collective brainstorming on elements such as defining the boundary of the landscape, setting a regional goal and objectives, and defining regional and national level activities. This step requires wide participation of stakeholders and planning and coordination to establish the basis for cooperation among the countries. Several tangible outputs need to be developed in the form of baseline documents such as feasibility studies, conservation strategies, and environmental monitoring strategies in order to explore and capture geographical, ecological, historical, and cultural linkages among the countries sharing the landscape and to identify constraints, prospects, and opportunities for the regional initiative.

The Kailash Sacred Landscape Conservation Initiative (Box 5) provides a good example of the process of building cooperation among the countries sharing a transboundary landscape, in this case China, India, and Nepal.

A policy analysis of the state of biodiversity conservation with reference to meeting the CBD 2010 targets (Chettri et al. 2012) and of implementation of the CBD in the HKH countries (Desai et al. 2011) can also help to link global instruments with regional approaches to establish a basis for cooperation among nations, and to develop appropriate regional policy measures that complement national level governance. Such an analysis highlights the progress made by countries in terms of the actions taken to implement global conventions; indicates the capacity and limitations in countries to comply with meeting the targets of such conventions; and indicates the efforts needed

Figure 4: Outline of a regional mechanism to facilitate ecological and socioeconomic resilience



Note: MDG = Millennium Development Goals; UNFCCC = United Nations Framewoprk Convention of Climate Change; UNCCD = United Nations Convention to Combat Desertification; CBD = Convention on Biological Diversity; MA = Millennium Ecosystem Asssessment; NBSAP = National Biodiversity Stratgies and Action Plan; NAPA = National Adpatation Programme of Action; LAPA = Local Adaptation Plan of Action

Box 5: Building an understanding of landscape elements among countries for the Kailash Sacred Conservation Landscape Initiative

The Kailash Sacred Landscape Conservation Initiative (KSLCI) is a collaborative effort of ICIMOD, the United Nations Environment Programme (UNEP), and regional partners in the countries of China, India, and Nepal, which share the landscape. The process of building a consensus in support of the Initiative began with the countries producing individual target area delineation reports that helped demarcate the actual boundary of the landscape (ICIMOD 2010b). The geographical, environmental, ecological, cultural, and socioeconomic heterogeneity was then captured through a comprehensive baseline feasibility assessment carried out by the individual countries. Various national institutions (government, non-government, and community) were involved in the process. The results were drawn from a variety of sources including field research, rapid surveys, secondary information, interaction programmes among experts, stakeholder consultations, focus group discussions, and on-site community consultations. The country reports were used to develop a regional feasibility assessment report that presented a comparative analysis of the country documents and the overall status of resources, environmental degradation, and cultural integrity in the landscape, together with an identification of gaps and priorities and a policy-enabling environment for promoting the regional (transboundary) initiative (Zomer and Oli 2011). Details of the KSLCI are given at www.icimod.org/ksl.

at the regional level to address challenges that call for building political will for collaborative action among countries.

Building ownership of a regional approach

The participation and involvement of a wide range of stakeholders during the elaborate baseline documentation phase creates a shared ownership among the individual countries of the resources and responsibilities for promoting and influencing the regional biodiversity management outcomes in the landscape. This leads to refining, through consensus, key policy guidelines that supplement the efforts of individual countries to address cross-sectoral and transboundary issues and promote regional actions. The political 'buy-in' of the regional approach is facilitated by the formulation of a regional cooperation framework (RCF) and its adoption through a lead institutional anchor in each country. The RCF supports the harmonization of biodiversity conservation and climate change approaches and strategies and plans in the individual countries that contain the landscape. It also allows individual nations to assess pre-existing stressors and sectoral vulnerabilities, and to evaluate priority interventions for promoting sectoral goals such as conservation, environmental security, sustainable development, poverty reduction, and gender equity.

Box 6: The regional cooperation framework for implementation of the Kailash Scared Landscape Conservation Initiative

A draft regional cooperation framework (RCF) for the landscape was prepared using the landscape delineation report, regional feasibility assessment, regional conservation strategy, and regional comprehensive environmental monitoring strategic plan as a base. The goal of the draft was 'to promote and facilitate transboundary biodiversity and cultural conservation, ecosystem management, sustainable development, and climate change adaptation within the Kailash Sacred Landscape (KSL) through regional cooperation and the development and enhancement of the regional biodiversity and environmental knowledge base'. The RCF document delineates the process for realizing the objectives of the RCF and outlines the principles to be followed and the regional mechanisms to be established in order to achieve the goals, thereby promoting regional landscape conservation. The RCF helps to bring clarity on policy issues and gaps in the management of landscape elements within the countries, and helps in identifying basic principles for strengthening regional cooperation for transboundary biodiversity management (Zomer and Oli 2011).

The RCF adopted for the Kailash Sacred Landscape provides a good example; it outlines the essential elements agreed by the three countries involved for enhancing the process of regional cooperation (Box 6).

Enhancing the scientific knowledge base at a regional level

A regional platform needs to be created to support improved sharing of data, information, and knowledge as well as analysis and synthesis for regional policy innovation and programme development. The RCF creates an enabling environment for countries and other regional and global players to be part of this knowledge development process. The platform enables countries to recognize the broader context in which biodiversity loss and environmental change occurs, and then to develop plans and policies to address the issues in an integrated manner. Supported by regional capacity building for transboundary biodiversity management and long-term environmental monitoring, the regional information sharing platform helps enhance scientific understanding of regional environmental change processes and their consequences for biodiversity, people, and other sectors through comparable data generation and standardization of methodologies.

The comprehensive environmental monitoring strategic plan (Box 7) developed for the KSLCI exemplifies the need for a common framework for building regional and national capacity for knowledge generation through long-term research and comparable data and information generation and sharing and for enhancing scientific and technical cooperation.

Box 7: The regional comprehensive environmental monitoring strategic plan (CEMSP) for the Kailash Sacred Landscape

The regional comprehensive environmental monitoring strategic plan (CEMSP) for the Kailash Sacred Landscape integrates information from the individual country CEMSP reports and highlights the regional aspects and transboundary dimensions and opportunities for long-term monitoring. It is based on the principles of integration with national efforts; involvement of a wide range of stakeholders; relevance to the regional conservation strategy; promotion of regional learning, knowledge exchange, and open data sharing; identification of a set of environmental and ecological indicators; and establishment of permanent long-term monitoring pilot sites. The Kailash Sacred Landscape CEMSP provides the basis for strengthening environmental monitoring and long-term ecological research in the landscape, and is expected to enhance existing monitoring efforts by the individual countries sharing the landscape. The main objective is to provide a standard sampling frame to capture a variety of environmental, geographical, climatic, ecological, and socioeconomic parameters. The parameters defined in the CEMSP are in coherence as far as possible with internationally accepted protocols, measures, and standards developed by global organizations and networks such as the World Meteorological Organization, Global Climate Observation System, Global Terrestrial Observing System, World Climate Research Programme, World Glacier Monitoring Service, Global Biodiversity Information Facility, Global Change and Mountain Regions (GLOCHAMORE) Research Strategy, and Global Mountain Biodiversity Assessment.

The Kailash Sacred Landscape CEMSP advocates for a participatory, facilitative, and coordinating role for the regional institutes to identify knowledge gaps, delineate standardized methods, harmonize protocols for sampling, and support the data sharing and exchange mechanisms. The key thematic areas included in the CEMSP are climate, land use change, cryosphere, water resources, ecosystem functions and services, biodiversity and ecosystems, risks and hazards, health outcomes affecting humans and livestock, mountain economies, and society and environmental change. The CEMSP framework is expected to ensure the availability of systematic, comparable datasets among the countries that can be used for developing effective policy solutions for conservation, adaptation, and development issues in the landscape, as well as for effective monitoring of regional interventions and community-based environmental monitoring.

Developing a regional programme of action

The RCF is used as a planning tool for developing both quick 'no regret' solutions and long-term strategies to help ecosystems and people respond to and cope with changes, and become more resilient to future change. The RCF provides scope for countries to integrate inter-sectoral strategies, including gender and other cross-cutting issues, and other resources management instruments into the regional planning framework. Capacity building activities such as exchange of technological measures and sharing of knowledge and best practices are an integral component of regional programme development, as are awareness raising processes such as exchange and exposure visits at different levels. The key to developing a regional programme of action lies in analysing and translating the knowledge base into materials for awareness raising, for policy innovations, for informed decision making, and for promoting action on the ground.

Implementation of prioritized action among countries

Implementation of prioritized action requires the formulation of country-specific projects and plans under the regional programme of action that translates the goal of transboundary landscapes into actions on the ground, integrating them as a part of countries' national strategic policies and plans, thus formalizing them within the national mandate. Some of the actions adopted by countries to facilitate ecological and socioeconomic resilience in different landscapes in the HKH are described in the following sections.

Developing conservation corridors to promote integrated PA management

Development of conservation corridors connecting PAs has been piloted in the Kangchenjunga landscape (Box 8). The conservation corridors established in the landscape enhance connectivity between the mosaic of protected area habitats and provide essential habitat contiguity for several ecosystems extending across the landscape, allowing spatial flexibility for distribution shifts along elevation gradients and horizontal species movement (Chettri and Shakya 2010; Chettri et al. 2007, 2011). Such arrangements complement the national level protected area system while aiding the development of biodiversity management plans that facilitate ecological resilience and adaptation processes across regional and international boundaries (Wangchuck 2007). In the context of climate change, corridors provide a way for ecosystems and people to cope with stresses brought about by climate and other drivers of change (Worboys et al. 2010). Preliminary assessment for the identification of conservation corridors using habitat modelling of some wild ungulates and mammals showed the prospects for connecting habitats between two PAs in the Brahmaputra-Salween landscape, and thus enhancing ecosystem management across the larger landscape (Shakya et al. 2011).

Bhutan has a formalized network of national parks, wildlife sanctuaries, nature reserves, and biological corridors called the Bhutan Biological Conservation Complex (B2C2), which is designed to increase the interconnectedness between habitats for long-term ecological sustainability. The corridors both allow the movement of wildlife between otherwise isolated PAs and support the management of low intensity land uses such as agriculture and community forests (MoA 2002)

Interventions focused on ecosystems and species

Landscape conservation interventions must be complemented by promoting participatory and institution-based management interventions targeting the management of major ecosystems such as forests, rangelands, wetlands, and agricultural land. In addition, while the formal means of protection in the form of reserves and protected areas provides an infrastructure for the protection of natural biodiversity, sectoral interventions such as restoration of degraded lands, agroforestry innovations, integrated watershed management, community-based forest management, and rangeland co-management are also necessary to facilitate ecosystem-based adaptation at the landscape level (Galatowitsch et al. 2009). Actions that reduce pressure on species of significance (for example, keystone, flagship, umbrella, vulnerable, and economically important species) from other drivers of change must

Box 8: Conservation corridors in the Kangchenjunga landscape

ICIMOD is promoting the development of six conservation corridors in the Kangchenjunga landscape. The objective is to promote habitat connectivity in order to maintain the ecological integrity needed to support the long term survival of species while building community capacity for economic interventions. The six conservation corridors link nine PAs to create a stretch of contiguous landscape between protected and unprotected areas. The corridors are intended to supplement the conservation role of the protected areas and to enable people to be part of the biodiversity management process. The corridors allow the use of biodiversity resources for the community through allowing multiple land use types and promoting conservation-linked livelihood opportunities. The corridors in the Kangchenjunga landscape have the following functions:

- **Facilitate implementation of CBD's ecosystem approach by maintaining ecological integrity over a larger landscape** – The corridors in the Kangchenjunga landscape are increasing people's engagement in biodiversity resources management and influencing their access to and sustainable use of the resources.
- **Aid in dispersal and migration of species** – The corridors expand the biogeographic range of species such as red panda, musk deer, Asian elephant, and snow leopard, and aid seasonal movement.
- **Allow multiple land use types and various forms of biodiversity governance** – Unlike in PAs, corridors in the Kangchenjunga landscape are managed through multiple land use types that functionally link the fragmented natural landscape with land uses that people use and modify.
- **Increase socioeconomic resilience by recognizing people's need for biodiversity and encouraging sustainable use** – Conservation action in the corridors is supplemented by community prioritized nature-based livelihood options such as operating forestry nurseries, off-season vegetable farming, ecotourism, and agroforestry innovations.
- **Facilitate intersectoral policy coordination and development of regional mechanisms** – The corridors provide the three countries with a basis for discussing conservation issues that transcend the political boundaries. A regional cooperation framework for implementation of the Convention on Biological Diversity has been developed jointly to harmonize national actions for transboundary biodiversity management, scientific and technical cooperation, Information exchange and sharing, and regional guidelines and soft legal measures (Sharma et al. 2007).
- **Promote collaboration for action research** – A compendium of action research has been produced that provides information on biodiversity and socioeconomic perspectives, ecosystem services, conservation threats, and challenges (Chettri et al. 2008b).

also be applied to promote adaptation of biodiversity at all levels. Species level understanding about which species and population systems are likely to be the most affected and how their evolutionary capacity may be enhanced is also included in the key information needed to successfully manage biodiversity under the changing climate scenario (Lawler 2009).

In the Karakoram-Pamir Landscape, China and Pakistan have signed an agreement to jointly address the conservation and development challenges for the naturally connected landscape and to set up an international Nature Park in order to protect the flagship Marco Polo sheep species and other endangered species that inhabit adjoining protected areas in the two countries (ICIMOD 2012). The formal regional initiative is in a preparatory phase, during which a regional framework document will be developed between the countries and other regional and international organizations. The regional programme will be implemented according to the RCF that is being developed, which will also take into account the geo-political sensitivity in the two countries. Rangeland co-management will play a significant role in this landscape in addressing the concerns of ethnic pastoral communities with regard to pastureland and livestock management. The protected areas have been traditionally used by the semi-nomadic and nomadic pastoral communities who, with few other livelihood options available, mainly depend on the rangeland ecosystem for grazing livestock (Khan 2011).

Development of infrastructure for comparable data generation

The landscape approach also greatly increases the scope for infrastructural support to strengthen the climate observation and monitoring mechanisms for generating high quality and comparable data across wider climate sensitive sectors. For example, the regional cooperation framework for the Kailash Sacred Landscape Conservation Initiative has provisions for collaborating on long-term environmental monitoring, and the three countries involved have drafted a comprehensive environmental monitoring strategic plan. The emergence of climate change as a major challenge in the landscape is leading to an immediate need for substantive climate-related data. India and China have already established mechanisms for generating climatological data, whereas in Nepal, the infrastructure available to produce comparable data is much more limited. ICIMOD is supporting the Government of Nepal, with the Department of Hydrology and Meteorology as the lead institution, in establishing eight automated weather stations and three hydrological stations in Far Western Nepal. Once functional, the stations will record and relay data at 30-minute intervals, providing the crucial time-series data needed for climate modelling and other research in the landscape.

Promotion of conservation-linked livelihood options

Conservation-linked livelihood opportunities offer useful solutions for communities in transboundary landscapes to diversify their livelihood options. Several options are being promoted in the HKH region, for example beekeeping, ecotourism and homestay development, cultivation of medicinal and aromatic plants, organic farming, nursery development, production of bio-briquettes, and micro-enterprise development based on non-timber forest products. The options are being promoted through targeted training implemented by the collaborating country partners. Such interventions are crucial in providing motivation for the conservation of biological resources and sustaining the services from ecosystems.

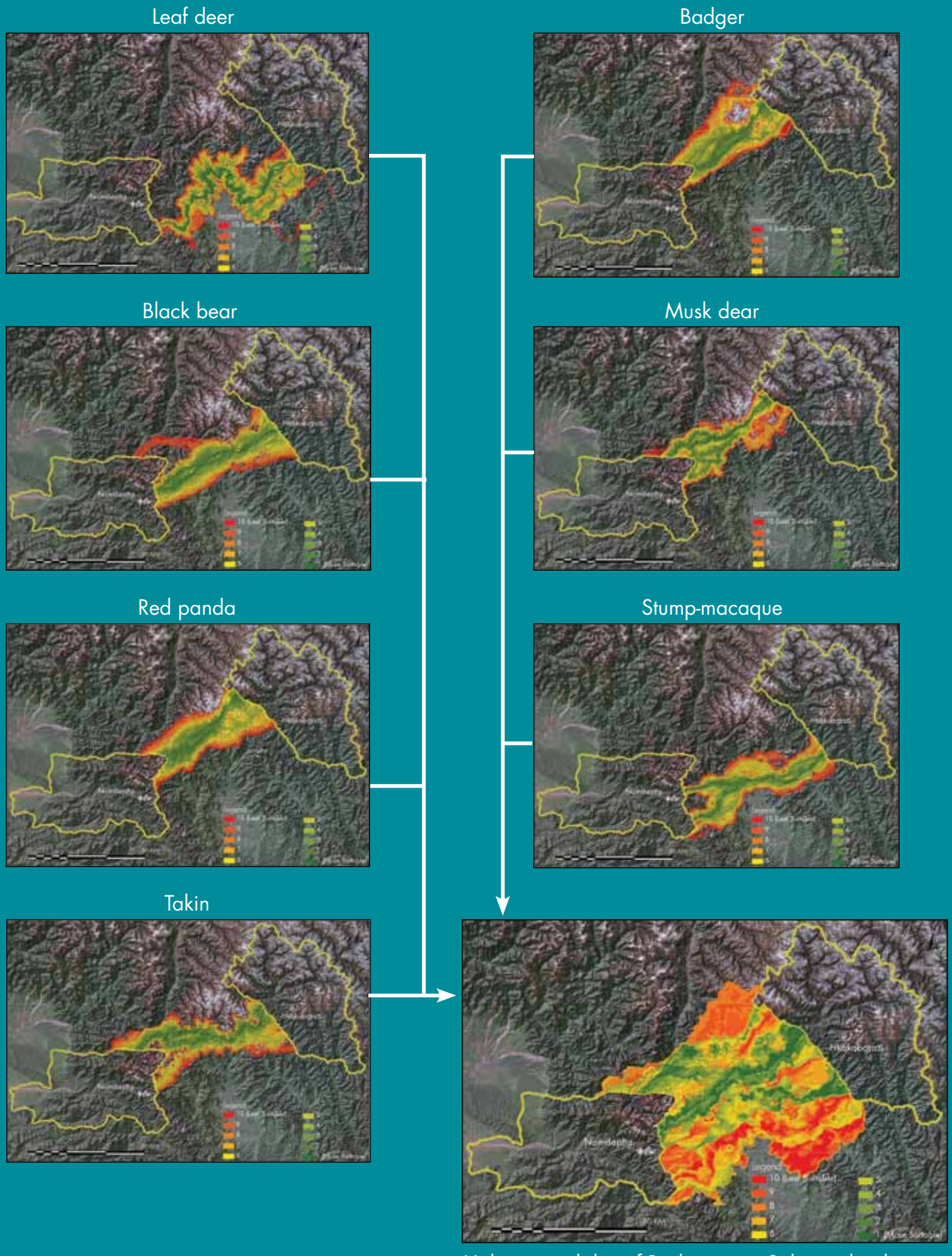
Filling the biodiversity knowledge gap in some of the PAs

The most common concern of the countries sharing the transboundary landscapes in the HKH region is the lack of basic biodiversity information from the protected areas. For example, in the Kangchenjunga landscape, 7 of the 15 protected areas had very little basic data on their flora and fauna. Creating a framework and methodologies for rapid biodiversity assessment is an essential part of the knowledge development process. The process creates opportunities for primary field-based surveys as well as allowing collation and review of existing information from secondary sources.

Assessing land use land cover change and potential corridor mapping

Geographic information systems (GIS) and remote sensing have evolved as enabling technologies with exponential growth in their applications in diverse areas. Remarkable advances have been made in these technologies and tools in recent times that provide new dimensions for integration, analysis, and communication of divergent sources of information for decision making. Geospatial analysis of land cover change in the transboundary landscapes has been very useful in determining common patterns in land use dynamics across the Kangchenjunga, Kailash, and Brahmaputra-Salween landscapes. This has enabled the identification of management processes and governance mechanisms. For example, the land use/cover change analysis done for the Kangchenjunga landscape for the years 1977, 2000, and 2010 helped develop understanding of the change in land use patterns, to identify priority areas for biodiversity management interventions, to determine areas for potential corridor development, and to assign conservation priorities to different habitats and species. In the Brahmaputra-Salween landscape, ICIMOD attempted a preliminary corridor identification analysis based on habitat suitability models for species such as leaf deer, takin, badger, stumped tailed macaque, black bear, red panda, and musk deer. Different GIS factors such as habitat patches and movement resistance were used for habitat models (Figure 5). This research offered a valuable basis for including areas outside protected areas in some kind of management framework and also provided opportunities for scientific collaboration among the countries sharing the transboundary landscape.

Figure 5: Use of a habitat suitability model for identifying potential corridor habitats outside protected areas in the transboundary Brahmaputra-Salween landscape



Developing a framework for valuation of ecosystem services

ICIMOD has developed an assessment framework to identify, and to some extent quantify, the ecosystem goods and services provided by protected areas, corridors, and landscapes; the framework presents the concept of economic valuation and the methodologies available for quantifying goods and services in economic terms in the mountain context, together with their limitations (Rasul et al. 2011). A preliminary qualitative and economic assessment was carried out in the Kangchenjunga landscape of the ecosystem services provided by the protected areas, corridors, and landscape, using household surveys in villages located in the PA watersheds. The preliminary study highlighted the dependence of local communities on surrounding ecosystems, how populations living near the PAs and corridor areas are directly influenced by ecosystem goods and services, and how communities are drawn more towards tangible provisioning services than towards non-tangible cultural, regulating, and supporting services. Valuation of the ecosystem services can help raise awareness of the importance of the services and stimulate support for appropriate measures for conservation (Pant et al. 2012).

Exposure visits and cross country learning

Stakeholders at all levels (policy makers, scientists, and communities) can benefit greatly from first-hand exposure to landscape elements and cross-cultural learning experiences at both the national and regional level. These exposure opportunities need to be created in the form of visits and meetings. Technical capacity should be built through specific training, for example, on the use of participatory tools for assessing community perception to climate change and ecosystem services, and on publishing rapid biodiversity assessment and biodiversity data.

Developing a platform for information exchange and data sharing

One of the major thrusts, and benefits, of regional transboundary landscape management initiatives is the facilitation of improved access to data and information from secondary literature and primary research related to individual projects. ICIMOD has developed a Hindu Kush Himalayan Conservation Portal (www.icimod.org/hkhconservationportal) based on the three principles of conservation commons: open access, mutual benefit, and proper accreditation. The portal is a regional repository of biodiversity and conservation-related information from regional transboundary landscapes and PAs. It both provides a platform for sharing biodiversity information among the countries, and facilitates standardization of database development for biodiversity conservation at the landscape level. Species data resources have been standardized using the global Darwin core standardization promoted by the Global Biodiversity Information Facility (GBIF).

Monitoring and evaluation mechanism

The monitoring mechanism implies the need for the creation of regional bodies to facilitate participation and coordination among the various actors and stakeholders within a shared (transboundary) landscape for knowledge development, for development of joint regional initiatives, and for implementation of prioritized actions on the ground to enhance ecological and socioeconomic resilience. The mechanism will also ensure that the principles of the RCF are followed and that countries have ownership of the process involved in the transboundary landscape biodiversity management initiatives. A regional coordinating body, with representation from all major stakeholders, is needed for implementation to enhance regional cooperation among the countries and facilitate implementation of the RCF. Similarly, a regional working group will help guide implementation activities in the individual countries, including identifying specific capacity building needs and knowledge generation and awareness raising activities.

Impact pathways

The impact pathways approach uses the analysis of a historical scan of outputs and outcomes of regional programmes. In particular, it analyses the theory of change, that is contributions made to the change process and their significance for impacts related to institutional capacity building, policy change, and technology transfer and knowledge development. The approach analyses outcomes as changes in the knowledge, behaviour, skills,

relationships, and actions of individual institutions, groups, and organizations as a result of the use of specific outputs from a regional programme. The impacts are the result of outcomes that influence changes among the partners with whom the programme directly interacts (Ashby and Ahmad 2008). This approach is used in the implementation of the transboundary landscape framework to assess the likely outcomes of particular actions and identify leverage points for activities.

Conclusion

Transboundary landscape management is an integrated approach to biodiversity management that recognizes the needs of people to use the resources in the landscape for their livelihoods, and acknowledges the contribution of communities, both women and men, to resource management. The approach helps ecosystems to be resilient to change, while developing the socioeconomic resilience of the people in the landscape. In a transboundary landscape, more than one country is involved in managing the landscape elements. Integrated biodiversity management, policy innovations, knowledge development, capacity building, and incentive-and enterprise-based mechanisms must be considered simultaneously by all the countries sharing the landscape. Building a common regional approach requires cooperation among countries, and support from global conventions. Development of this cooperation is a gradual and iterative process that relies on buy-ins from all the countries. The framework described in this paper can be used to guide the development of transboundary landscape management in the HKH region. The success of pilot activities indicate that the proposed framework is an effective instrument for guiding landscape management approaches.

References

Anderson, AB; Jenkins CN (2006) *Applying nature's design. Corridors as a strategy for biodiversity conservation*. New York: Columbia University Press

Ashby, J; Ahmad, F (2008) *ICIMOD's outcome and impact pathways worksheet*, unpublished note submitted to ICIMOD, Kathmandu, Nepal, for use by ICIMOD's strategic regional programmes)

Bennett, G; Mulongloy, KJ (2006) *Review of experience with ecological networks, corridors and buffer zones,* CBD Technical Series No 23. Montreal, Canada: Secretariat of the Convention on Biological Diversity

Bennett, AF (2003) *Linkages in the landscape. The role of corridors and connectivity in wildlife conservation* (2nd edn). Gland, Switzerland: The World Conservation Union (IUCN)

Brooks, TM; Mittermeier, RA; da Fonseca, GAB; Gerlach, J; Hoffmann, M; Lamoreux, JF; Mittermeier, CG; Pilgrim; JD; Rodrigues, ASL (2006) 'Global biodiversity conservation priorities.' *Science* 313: 58–61

CBD (2009a) *Review of literature on the links between biodiversity and climate change – Impacts, adaptation, and mitigation*, Technical Series No. 42. Montreal: Secretariat of the Convention on Biological Diversity.

CBD (2009b) *Connecting biodiversity and climate change mitigation and adaptation*: *Report of the second Ad Hoc Technical Expert Group on Biodiversity and Climate Change*, Technical Series No. 41. Montreal, Canada: Secretariat of the Convention on Biological Diversity

CBD (2004) *Decision VII/15, Biodiversity and Climate Change*. Montreal, Canada: Secretariat of the Convention on Biological Diversity

CBD (undated) *CBD Ecosystem Approach*. Montreal, Canada: Secretariat of the Convention on Biological Diversity. http://www.cbd.int/ecosystem/ (accessed 17 September 2012)

Chappe, S; Harrison, M; Spalding, M; Lysenko, I (2005) 'Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets.' *Philosophical Transactions of the Royal Society of Biology* 360:443–55

Chaulagain, NP (2006) *Impacts of climate change on water resources of Nepal: The physical and socioeconomic dimensions. MSc Thesis*, Universität Flensburg, Flensburg, Germany

Chettri, N; Shakya, B (2008) 'Species to landscape: A paradigm shift in biodiversity conservation through people's participation and policy reform.' In Rasul, G; Karki M (eds), *Policy priorities for sustainable mountain development: Proceedings and selected papers from the regional policy workshop*, September 18–20, 2006, pp 131–141 (CD ROM). Kathmandu, Nepal: ICIMOD

Chettri, N; Shakya, B (2010) 'Conservation connectivity in transboundary landscapes.' In *Biodiversity and climate change: Achieving the 2020 targets*, Abstracts of posters presented at the 14th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity, 10–21 May 2010, Nairobi, Kenya, Technical Series No. 51, pp 42–44. Montreal, Canada: Secretariat of the Convention on Biological Diversity

Chettri, N; Sharma, E; Shakya, B; Bajracharya, B (2007) 'Developing forested conservation corridors in the Kangchenjunga landscape, eastern Himalaya.' *Mountain Research and Development* 27(3): 211–214

Chettri, N; Shakya, B; Thapa, R; Sharma, E (2008a) 'Status of protected area system in the Hindu Kush-Himalaya: An analysis of PA coverage.' *International Journal of Biodiversity Science and Management* 4(3):164–178

Chettri, N; Shakya, B; Sharma, E (2008b) *Biodiversity conservation in the Kangchenjunga landscape*. Kathmandu, Nepal: ICIMOD

Chettri, N; Sharma, E; Thapa, R (2009) 'Long term monitoring using transect and landscape approaches within the Hindu Kush-Himalayas.' In *Proceedings of the International Mountain Biodiversity Conference,* 16–18 November 2008. Kathmandu, Nepal: ICIMOD

Chettri, N; Sharma, E; Shakya, B; Thapa, R; Bajracharya, B; Uddin, K; Oli, KP; Choudhary, D (2010) *Biodiversity in the eastern Himalayas: Status, trends and vulnerability to climate* changes, Climate change impact and vulnerability in the eastern Himalayas – Technical Report 2. Kathmandu, Nepal: ICIMOD

Chettri, N; Shakya, B; Sharma, E (2011) 'Facilitating regional cooperation through development of conservation corridors in the Khangchendzonga Landscape.' In Arrawatia, ML; Tambe, S (eds) *Biodiversity of Sikkim – Exploring and conserving a global hotspot,* pp 529–542. Gangtok, Sikkim: Information and Public Relations Department, Government of Sikkim

Chettri, N; Sharma, E; Zomer, R (2012) Changing paradigm and post 2010 targets: Challenges and opportunities for biodiversity conservation in the Hindu Kush Himalayas. *Tropical Ecology* 53(3): 245–259

Costanza, R; d'Arge, R; de Groot, RS; Farber, S; Grasso, M; Hannon, B; Limburg, K; Naeem, S; O'Neill, RV; Paruelo, J; Raskin, RG; Sutton, P; van den Belt, M (1997) 'The value of the world's ecosystem services and natural capital.' *Nature* 387: 253–260

Daily, GC; Söderqvist, T; Aniyar, S; Arrow, K; Dasgupta, P; Ehrlich, PR; Folke, C; Jansson, A; Jansson, B; Kautsky, N; Levin, S; Lubchenco, J; Maeler, K; Simpson, D; Starrett, D; Tilman, D; Walker, B (2000) 'The value of nature and the nature of value.' *Science* 289: 395–96

Dawson, TP; Jackson, ST; House, JI; Prentice, IC; Mace, GM (2011) 'Beyond predictions: Biodiversity conservation in a changing climate.' *Science* 332: 53–58

de Groot, RS; Alkemade, R; Braat, L; Hein, L; Willemen, L (2010) 'Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making.' *Ecological Complexity* 7(3): 60–272

Desai, BH; Oli, KP; Yongping, Y; Chettri, N; Sharma, E (2011) *Implementation of the Convention on Biological Diversity: A retrospective analysis in the Hindu Kush–Himalayan countries*. Kathmandu, Nepal: ICIMOD

Dudley, N; Stolton, S; Belokurov, A; Krueger, L; Lopoukhine, N; Mackinnon, K; Sandwith, T; Sekhran, N (eds) (2010) *Natural solutions: Protected areas helping people cope with climate change*. Gland, Switzerland, Washington DC, and New York, USA: IUCN-WCPA, TNC, UNDP, WCS, The World Bank, WWF

EC (2008) *The economics of ecosystems and biodiversity (TEEB), an interim report*. Brussels, Belgium: European Commission

Eriksson, M; Xu, J; Shrestha, AB; Vaidya, RA; Nepal. S; Sandstrom, K (2009) *The changing Himalayas. Impact of climate change on water resources and livelihoods in the greater Himalayas*. Kathmandu, Nepal: ICIMOD

Galatowitsch, S; Frelich, L; Phillips-Mao, L (2009) 'Regional climate change adaptation strategies for biodiversity conservation in a mid-continental region of North America.' *Biological Conservation* 142: 2012–2022

GoI (2008) *National Action Plan on Climate Change*. New Delhi, India: Government of India

GoN/MoFSC (2006) *Sacred Himalayan Landscape (SHL) Strategic Plan: 2006–2016*. Kathmandu, Nepal: Ministry of Forests and Soil Conservation, Government of Nepal

Hannah, L (2009) 'A global conservation system for climate change adaptation.' *Conservation Biology* 24(1): 70–77

Heller, NE; Zavaleta, ES (2009) 'Biodiversity management in the face of climate change: A review of 22 years of recommendations.' *Biological Conservation* 142: 14–32

ICIMOD (2009a) *Mountain biodiversity and climate change*. Kathmandu, Nepal: ICIMOD

ICIMOD (2009b) *Regional experience sharing consultation on the landscape approach to biodiveristy conservation and management in the eastern Himalayas: Towards developing the Brahmaputra Salween landscape*, Consultation workshop report. Kathmandu, Nepal: ICIMOD

ICIMOD (2009c) *Local responses to too much and too little water in the greater Himalayan Region*. Kathmandu, Nepal: ICIMOD

ICIMOD (2010a) *Kailash Sacred Landscape Conservation Initiative: Developing a transboundary cooperation framework for conservation and sustainable development in the greater Mt. Kailash region of China, India, and Nepal,* project flyer. Kathmandu, Nepal: ICIMOD

ICIMOD (2010b) *Kailash Sacred Landscape Conservation Initiative: Developing a transboundary cooperation framework for conservation and sustainable development in the greater Mt. Kailash region of China, India, and Nepal,* Target Area Delineation Report. Kathmandu, Nepal: ICIMOD

ICIMOD (2011) *Protected areas and payment for ecosystem services, A feasibility study in Shivapuri-Nagarjun National Park, Nepal*, information sheet. Kathmandu, Nepal: ICIMOD

ICIMOD (2012) *Towards developing the Karakoram-Pamir Landscape – Report of the regional consultation to develop the future strategic programme for biodiversity management and climate change adaptation*, ICIMOD Working Paper 2012/3. Kathmandu, Nepal: ICIMOD

IPCC (2007a) *Climate change 2007: The scientific basis*, Working Group I contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Cambridge, UK: Cambridge University Press

IPCC (2007b) *Climate change 2007: Impacts, adaptation and vulnerability*, Working Group II. contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Cambridge, UK: Cambridge University Press

Jodha, NS (2011) *HKH mountain systems: Process of change, constraints and opportunities.* Paper presented at the Authors Workshop for the Regional Report on Climate Change in the Hindu Kush Himalayas: the State of Current Knowledge, 18–19 August 2011, ICIMOD, Kathmandu, Nepal

Khan, AA (2011) *Significance, history and future of Sino-Pak collaboration for the socio-ecological development of Karakorum Pamir Landscape with focus on adjoining protected areas*, process document for discussion submitted to ICIMOD, Kathmandu, Nepal

Koerner, C (2009) 'Climate change in the mountains – Who wins and who loses?' *Sustainable Mountain Development* 55: 7–9 (ICIMOD periodical)

Lama, A; Buchy, M (2003) 'Gender, class, caste and participation: The case of community forestry in Nepal.' *Indian Journal of Gender* 9(1): 27–41

Lawler, JJ (2009) 'Climate change adaptation strategies for resources management and conservation planning.' *Ann. N. Y. Acad. Sci.* 1162: 79–98

Lovejoy, TE (2005) 'Conservation with a changing climate.' In Lovejoy TE; Hannah, L (eds), *Climate change and biodiversityy,* pp 325–328. New Haven, CT, USA: Yale University Press

MA (2005) *Ecosystems and human wellbeing: Synthesis* (Millennium Ecosystem Assessment). Washington DC: Island Press

Macchi, M (2011) *Framework for community-based climate vulnerability and capacity assessment in mountain areas.* Kathmandu, Nepal: ICIMOD

Macchi, M; Gurung, AM; Hoermann, B; Choudhury, D (2011) *Climate variability and change in the Himalayas; Community perception and responses*. Kathmandu, Nepal: ICIMOD

Mawdsley, JR; O'Malley, R; Ojima, DS (2009) 'A review of climate change adaptation strategies for wildlife management and biodiversity conservation.' *Conservation Biology* 23(5): 1080–1089

McNeely, JS (2008) 'A new paradigm of managing protected areas in the 21st Century.' In Bajracharya, SB; Dahal, N (eds), *Shifting paradigms in protected area management.* Kathmandu, Nepal: National Trust for Nature Conservation

Messerli, B (2009) 'Biodiversity, environmental change and regional cooperation in the Hindu Kush-Himalayas.' *Sustainable Mountain Development* 55: 3–6 (ICIMOD periodical)

MoA (2002) *Biodiversity Action Plan for Bhutan 2002*. Bangkok, Thailand: Keen Publishing Co. Ltd: Ministry of Agriculture, Royal Government of Bhutan

MoFSC (2012) *Sustainable financing mechanism for landscape conservation: Existing practices and future prospects.* Kathmandu, Nepal: Ministry of Forest and Soil Conservation, Western Terai Landscape Complex Project

Mool, P (2009) 'Glaciers in the Hindu Kush-Himalaya.' In Kohler, T; Maselli, D (eds), *Mountains and climate change – From understanding to action,* p 29. Berne, Switzerland: Geographica Bernensia, with support from the Swiss Agency for Development and Cooperation (SDC).

Momsen, JH (2007) 'Gender and biodiversity: a new approach to linking environment and development.' *Geography Compass* 1/2 (2007): 149–162

Nellemann, C; Verma, R; Hislop, L (eds) (2011) *Women at the front line of climate change: Gender risks and hopes,* a rapid response assessment. Arendal, Norway: GRID-Arendal, United Nations Environment Programme

Nightingale, AJ (2006) *The nature of gender: Work, gender and environment*, Institute of Geography Online Paper Series GEO-030. Edinburgh, Scotland: University of Edinburgh

Parmesan, C; Yohe, G (2003) 'A globally coherent fingerprint of climate change impacts across natural systems.' *Nature* 421:37–42

Pant, KP; Rasul, G; Chettri, N; Rai, KRR; Sharma, E (2012) *Value of forest ecosystem services: A quantitative estimation from the Kangchenjunga landscape in eastern Nepal*. Kathmandu, Nepal: ICIMOD

Rasul, G; Chettri, N; Sharma, E (2011) *Framework for valuing ecosystem services in the Himalayas,* ICIMOD Technical Report. Kathmandu, Nepal: ICIMOD

Ramakrishna, RN; Keeling, CD; Hashimoto, H; Jolly, WM; Piper, SC; Tucker, CJ; Myneni, RB; Running, SW (2003) 'Climate driven increases in global terrestrial net production from 1982–1999.' *Science* 300: 1560–1563

Ridgewell, A; Mamo, G; Flintan, F (2007) 'Gender and pastoralism.' In *Rangeland and Resource Management in Ethiopia*, Vol 1, pp 4–14. Addis Ababa, Ethiopia: SOS Sahel Ethiopia

Rocheleau, D; Edmunds, D (1997) 'Women, men and trees: Gender, power and property in forest and agrarian landscapes.' *World Development* 25(8): 1352–1371

Root, TL; Price, JT; Hall, KR; Schneider, SH; Rosenzweig, SH; Pounds, JA (2003) 'Fingerprints of global warming on wild animals and plants.' *Nature* 421: 57–60

Schild, A (2008) 'The case of the Hindu Kush-Himalayas: ICIMOD's position on climate change and mountain systems.' *Mountain Research and Development* 28: 328–331

Schild, A; Sharma, E (2011) 'Sustainable mountain development revisited.' *Mountain Research and Development* 31: 237–241

Shepherd, G (ed) (2008) *The ecosystem approach: Learning from experience*. Gland, Switzerland: IUCN

Shakya, B; Bhattarai, B; Leduc B (2010) *Gender mainstreaming in biodiversity conservation and management in the Hindu Kush Himalayan region*, Information Sheet. Kathmandu, Nepal: ICIMOD

Shakya, B; Uddin, K; Chettri, N; Bajracharya, B; Sharma, E (2011) 'Use of geo-spatial tools in the management of potential habitats outside the protected areas in the transboundary Brahmaputra Salween landscape.' In *Contribution of ecosystem restoration to the objectives of the CBD and a healthy planet for all people*, Abstracts of posters presented at the 15th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity, 7–11 November 2011, Montreal, Canada, Technical Series No. 62, pp 98–100. Montreal, Canada: Secretariat of the Convention on Biological Diversity

Sharma, E; Chettri, N (2005) 'ICIMOD's transboundary biodiversity management initiative in the Hindu Kush-Himalayas.' *Mountain Research and Development* 25(3): 280–283

Sharma, UR; Yonzon, PB (2005) *People and protected areas in South Asia*. Kathmandu, Nepal: Resources Himalaya Foundation, and IUCN World Commission on Protected Areas, South Asia, Bangkok

Sharma, E; Chettri, N; Gurung, J; Shakya, B (2007) *The landscape approach in biodiversity conservation: A regional cooperation framework for implementation of the Convention on Biological Diversity in the Kangchenjunga landscape*. Kathmandu, Nepal: ICIMOD

Sharma, E; Chettri, N; Oli, KP (2010) 'Mountain biodiversity conservation and management: A paradigm shift in policies and practices in the Hindu Kush-Himalayas.' *Ecological Research* 25: 909–923

Sherpa, LN; Peniston, B; Lama, W; Richard, C (2003) *Hands around Everest: Transboundary cooperation for conservation and sustainable livelihoods*. Kathmandu, Nepal: ICIMOD

Singh, SP; Bassignana-Khadka, I; Karky, BS; Sharma, E (2011) *Climate change in the Hindu Kush-Himalayas: The state of current knowledge*. Kathmandu, Nepal: ICIMOD

Skutsch, MM; Karky, BS; Rana, EB; Kotru, R; Karki, S; Joshi, L; Pradhan, N; Gillani, H; Joshi, G (2012) Options for payment mechanisms under national REDD+ programmes, ICIMOD Working Paper 2012/6. Kathmandu, Nepal: ICIMOD

Spehn, E; Koerner, C (2009) 'Biodiversity in mountains: A natural heritage threatened by climate change.' In Kohler, T; Maselli, D (eds) (2009) *Mountains and climate change – From understanding to action*. Berne, Switzerland: Geographica Bernensia, with support from the Swiss Agency for Development and Cooperation (SDC)

Tse-ring, K; Sharma, E; Chettri, N; Shrestha, A (eds) (2010) *Climate change vulnerability of mountain ecosystems in the eastern Himalayas,* Climate change impact and vulnerability in the eastern Himalayas – Synthesis report. Kathmandu, Nepal: ICIMOD

Truscott, AM; Soulsby, C; Palmer, SCF; Newell, L; Hulme, PE (2006) 'The dispersal characteristics of the invasive plant *Mimulus guttatus* and the ecological significance of increased occurrence of high-flow events.' *Journal of Ecology* 94:1080–1091

WWF; ICIMOD (2001) Ecoregion-based conservation in the eastern Himalaya: Identifying important areas for biodiversity conservation. Kathmandu, Nepal: WWF Nepal

Wangchuck, S (2007)'Maintaining ecological resilience by linking protected areas through biological corridors in Bhutan.' *Tropical Ecology* 48(2): 176–187

Wangchuck, S (2012) *The Endowment Fund for Human Wildlife Conflict Management in Bhutan*, Spring 2012 update. Thimphu, Bhutan: Wildlife Conservation Division

Worboys, GL; Francis, W; Lockwood, M (eds) (2010) *Connectivity conservation management: A global guide*. London, UK: Earthscan

Xu, J; Grumbine, RE; Shrestha, A; Eriksson, M; Yang, X; Wang, Y; Wilkes, A (2009) 'The melting Himalayas – Cascading effects of climate change on water, biodiversity and livelihoods.' *Conservation Biology* 24(3): 520–530

Zomer, R; Oli, KP (eds) (2011) *Kailash Sacred Landscape Conservation Initiative: Feasibility Assessment Report*. Kathmandu, Nepal: ICIMOD

Annex

Potential impacts of drivers of change on biodiversity structure, function, and services

Level of biodiversity	Impacts		
	Structure	Function	Services
Ecosystem	Changes in habitat Changes in vegetation cover and level of dominance (e.g., increase in shrubland, decrease in forest and grassland) Changes in ecotone Reduced extent of climate sensitive ecosystems such as wetlands and riverine habitats	Initial increase followed by a decrease in net productivity with loss of beta diversity Increase in productivity of some species such as exotic, invasive species Changes in water and mineral cycles Changes in food web pattern Altered biotic interactions at different trophic levels such as plant-pollinator, and predator-prey relationships Reduced groundwater Lower water table in peatlands	Habitat of some species diminished – ecological shift Increased incidence of drought/ wildfires/insect epidemics Decreased ecosystem health (growth of unpalatable species) Loss of pioneer species with consequences for the ecological succession/sequestration process Successional shift – may result in loss of the existence/option value of the particular ecosystem
Species	Localized changes such as cold-adapted species that find it hard to survive and are outcompeted by more tolerant species Decrease in species abundance Variation in species composition and assemblages Increase in invasive species	Movement restricted Phenology changed Changes in distribution pattern – range and abundance shifts, species displacement Effects on demography Increased mortality from drought, floods, diseases, insects, and pests	Loss of native species and emergence of new community assemblages Growth of exotic, weedy species Loss of habitat-restricted species such as herpetofauna and ephemeral stream species
Genes	Less time for maintaining genetic level changes or gene pools	Lower adaptive capacity Limited genetic variation and phenotypic advantages	Loss of wild relatives of important crop plants Loss of traditional upland varieties of rice and other indigenous crop varieties

Sources: Koerner, 2009; CBD 2004, 2009b; Chappe et al. 2005; Heller and Zavaleta 2009; IPCC 2007b; Lovejoy 2005; Parmesan and Yohe 2003; Ramakrishna 2003; Root et al. 2003; Spehn and Koerner 2009; Truscott et al. 2006; Chettri et al. 2010; Chaulagain 2006

Glossary

Adaptation	Adjustment in natural or human systems to a new or changing environment. Various types of adaptation can be distinguished including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Adaptive capacity	The general ability of institutions, systems, and individuals to adjust to potential change or damage, especially climate change (including climate variability and extremes), to take advantage of opportunities, or to cope with the consequences
Agrobiodiversity	The diversity of plants, insects, and soil biota associated with cultivated systems
Agroforestry systems	Mixed system of crops, cash crops, and trees providing wood, non-wood products, food, fuel, fodder, and shelter
Biodiversity	The variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are a part; includes diversity within species, between species, and between ecosystems
Capacity building	A process of strengthening or developing well-equipped and able human resources, institutions, organizations, or networks in order to enhance their performance
Climate change	Climate change refers to any significant change in the measures of climate lasting for an extended period of time. It includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer.
Community-based	Instituted or run by communities and formalized through participatory approaches
Corridor	Used here in the sense of "a relatively narrow strip of native vegetation between two remnant habitat patches such as protected areas, which may be either a mostly or partially degraded landscape or a still intact landscape falling outside the premises of the protected areas" (Warboys 2010). Depending on their function (Anderson and Jenkins 2006), corridors can be described as biodiversity corridors, i.e., large scale landscape linkages synonymous with landscape corridors; corridor networks, i.e., systems of corridors running in different directions; dispersal corridors, which promote movement or migration of specific species or groups of species, often called simply 'corridors'; ecological corridors, which maintain and restore ecological services; and habitat corridors, which are linear strips of native habitat linking two larger blocks of the same habitat, the purpose being complementary to that of ecological and dispersal corridors. In terms of the structural elements (Bennett and Mulongloy 2006), corridors can be linear (e.g., forest strip, river); stepping stones (small patches of habitat that individuals use during movement for shelter, feeding, and resting); or interlinked matrices (various forms of connectivity that allow individuals to survive during the movement between habitat patches). In terms of the origin (Bennett 2003), corridors can be classified as disturbance habitat corridors (e.g., roads, railway lines); natural habitat corridors (e.g., streams and riparian zones following topographic or environmental contours); or planted habitat corridors.
Deforestation	Conversion of forest into non-forest land use
Degradation of ecosystem	A persistent reduction in the capacity of an ecosystem to provide ecosystem services

Driver of change	Any natural or human-induced factor that directly or indirectly causes a change in a system
Ecological communities	An assemblage of species occurring in the same space and time, often linked to biotic interaction such as competition and predation
Economic incentives	Instruments that affect costs and benefits of alternative action and make biodiversity conservation activities financially more attractive
Economically important species	Species that are harvested and used for economic benefit
Ecosystem	Any natural unit or entity including living and non-living parts that interact to produce a stable system through cyclic exchange of materials
Ecosystem approach	A strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. An ecosystem approach is based on the application of scientific methodologies at the level of biological organization; it encompasses the essential structure, processes, functions, and interactions between organisms and their environment. It recognizes that humans are an integral component of many ecosystems (CBD undated).
Ecosystem condition	The capacity of an ecosystem to function and yield services to benefit people and other inhabitants
Ecosystem function	An intrinsic ecosystem characteristic related to the set of conditions and processes whereby an ecosystem maintains its integrity (such as primary productivity, food chain, and biogeochemical cycles); ecosystem functions include processes such as decomposition, production, nutrient cycling, and fluxes of nutrients and energy
Ecosystem services	The benefits that people obtain from ecosystems, including provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling, that maintain the conditions for life on Earth. The concept 'ecosystem goods and services' is synonymous with ecosystem services.
Flagship species	Species that elicit a strong and positive emotional response
Habitat fragmentation	A process during which larger areas of habitat are broken into a number of smaller patches of smaller total area, isolated from each other by a matrix of habitats unlike the original habitat
Incentive mechanism	measures that lower transaction costs by facilitating trust building and learning as well as rewarding collaborations and conflict resolution
Indicator species	Species that have a highly specific niche or narrow ecological tolerance; are characteristic of a specific biotic community, successional stage, or substrate; or are reliably found under a certain set of circumstances, but not under others
Keystone species	Species that play a disproportionate role in determining major ecosystem functions or properties (e.g., trophic relationships, community structure, hydrological flow, successional patterns, disturbance cycles)
Land cover	The physical coverage of land, usually expressed in terms of vegetation cover or lack of it
Land use	Use of land for a certain purpose such as settlement, agriculture, or irrigation

Landscape	An area of land that contains a mosaic of ecosystems, including human-dominated ecosystems, together with the culture and traditions that have shaped the area historically
Landscape elements	Geographical, ecological, and socioeconomic patterns and processes in a landscape including variables that describe landscape structure and functions
Landscape management	An approach of maintaining or restoring the composition, structure, function, and services of different ecosystem types through intersectoral (ecological, environmental, socio-cultural, and economic) interventions, with the shared vision of achieving broader conservation, climate change adaptation, and development objectives
Landscape perspective	A view that examines the effect of response variables such as abundance, distribution, and processes that extend beyond the local habitat oriented situation
Mitigation	A human intervention to reduce the human impact on the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks
Planned adaptation	Adaptation that is the result of a deliberate policy decision, based on awareness that conditions have changed or are about to change
Protected area	A clearly defined geographical space recognized, dedicated, and managed through legal or other effective means to achieve the long-term conservation of nature with associated ecosystem services and cultural values
Resilience	A capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social wellbeing, the economy, and the environment
Species diversity	Biodiversity at the species level, often combining aspects of species richness, their relative abundance, dominance, and dissimilarities
Umbrella species	Species that require large blocks of relatively natural or unaltered habitat to maintain viable populations
United Nations Framework Convention on Climate Change (UNFCCC)	This Convention sets an overall framework for intergovernmental efforts to tackle the challenges posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership; 189 countries have ratified it.
Valuation	The process of expressing value for particular goods or service, usually in terms of monetary measures, but also accented through non-tangible, existence, or option value-based measures
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed; its sensitivity; and its adaptive capacity
Vulnerable species	Species that have small populations; exist in highly fragmented habitats and are poor dispersers; have narrow or highly specialized niches; and are vulnerable to human activities

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