



Kangchenjunga Landscape Feasibility Assessment Report



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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 Himalaya – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalisation 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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ICIMOD gratefully acknowledges the support of its core donors: the Governments of Afghanistan, Australia, Austria, Bangladesh, Bhutan, China, India, Myanmar, Nepal, Norway, Pakistan, Switzerland, and the United Kingdom.

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Published by

International Centre for Integrated Mountain Development
GPO Box 3226, Kathmandu, Nepal

ISBN 978 92 9115 480 7 (printed) 978 92 9115 481 4 (electronic)

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Nakul Chettri - cover, pp5, 6, 25, 27, 34, 44; Prabin Bhandari - pp13, 15, 16, 22; Rekha Rasaily - p19

Printed and bound in Nepal by

Hill Side Press (P) Ltd., Kathmandu, Nepal

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Note

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

Citation: ICIMOD, WCD, GBPNIHESD, RECAST (2017) *Kangchenjunga landscape feasibility assessment report*.
ICIMOD Working Paper 2017/9. Kathmandu: ICIMOD

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Foreword

The Kangchenjunga Landscape Conservation and Development Initiative (KLCDI) is a transboundary landscape programme that seeks to promote regional cooperation for the conservation and sustainable utilization of the rich biological and cultural resources and associated traditional knowledge within the Kangchenjunga Landscape (KL). This initiative is bringing together the governments of Bhutan, India and Nepal to manage the landscape through the 'ecosystem approach', as advocated by the Convention on Biological Diversity.

Challenges to both biodiversity conservation, as well as sustainable development in the KL are many, and they occur at local, national and transboundary levels. Many issues of concern, including but not limited to human-wildlife conflicts, unsustainable utilization/extraction of natural resources, deforestation and forest degradation, urbanization, declining crop productivity, unmanaged tourism, and solid waste issues, are common within the three countries. These issues are further intensified by global issues such as climate change, uncertain global markets, globalization, and data/knowledge gaps in the Hindu Kush Himalaya.

This Kangchenjunga Landscape Feasibility Assessment Report presents the current socioeconomic and ecological scenario of the landscape. It is based on the individual Feasibility Assessment Reports prepared through a consultative process by the three countries within the landscape, i.e., Bhutan, India and Nepal. This report also highlights the conservation and development priorities within the landscape, many of which can only be addressed through regional cooperation among the three countries.

Our sincere appreciation and gratitude are extended to all the national partners and other stakeholders who participated in the consultative process and contributed towards regional cooperation for the KLCDI. This feasibility assessment report is the first step towards implementing the Initiative. The initiative will foster national ownership as well as promote community-based conservation programmes for its sustainability. As the initiative progresses, it is expected that the participatory process of shared responsibility and differentiated approaches will further evolve, but we believe that, with transboundary cooperation and the ecosystem approach, we will be able to contribute to the well-being of women, men and children in the KL.

David J Molden, PhD
Director General
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Message from Bhutan



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4th April 2017

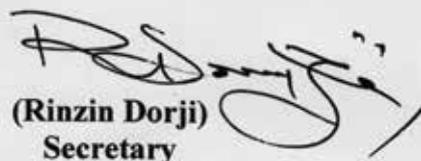
Message from Bhutan

The Royal Government of Bhutan (RGoB) is committed to the conservation of the nation's natural resources. This is being achieved through the tool of landscape conservation where the country's network of ten protected areas is linked by biological corridors, which together constitute 51 per cent of the country's total area. This protected area network hosts a wide diversity of floral and faunal species, including some that are endemic and some that are globally threatened. Many protected areas are also home to communities who are dependent on the natural resources, and in turn the ecosystems of these areas are shaped by the communities who live in them.

The western region of the country is part of the transboundary Kangchenjunga Landscape (KL) which also includes contiguous areas of India and Nepal. The three countries in this landscape share many ecological and socio-cultural attributes that also include conservation and development issues. It is hoped that by coming together through a regional forum in the KL, many opportunities can be taken advantage of to address the challenges facing communities and ecosystems in the landscape.

Through the Kangchenjunga Landscape Conservation and Development Initiative (KLCDI), we can work together to better conserve and manage the KL for sustaining ecosystem services that will improve livelihoods of local communities while building socio-cultural resilience to environmental changes.

This regional synthesis of the feasibility assessment reports of the three member KL countries is the first step in understanding the issues that are prevalent in the landscape at national, as well as transboundary levels. The Feasibility Assessment Report for Bhutan was prepared by the Department of Forests and Park Services and the Nature Conservation Division (formerly Wildlife Conservation Division). We commend ICIMOD for synthesizing the available information on the landscape and for making it available to a wider audience.


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Message from India



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Message from the Director GBPIHESD

As the nodal institution for implementing the Kangchenjunga Landscape Conservation and Development Initiative (KLCDI) in India, GB Pant National Institute of Himalayan Environment and Sustainable Development (GBPIHESD) has been collaborating with ICIMOD since programme inception in 2012 to take this programme forward. The Institute greatly appreciates the technical and financial support received from ICIMOD towards implementation of this programme.

Biodiversity and socio-economic assessment of the Kangchenjunga Landscape (KL) was the first step in implementing the KLCDI. In this context, the national Feasibility Assessment Report (FAR) for KL-India was prepared by GBPIHESD with technical inputs from numerous agencies, especially Department of Forest-North, West Bengal; Forest, Environment and Wildlife Management Department of Sikkim; The Mountain Institute (TMI); Wildlife Institute of India; Ecotourism Society of Sikkim (ECOSS); Ashoka Trust for Ecology and the Environment (ATREE); DLR-PRERNA; WWF Sikkim; and Sikkim University. We are happy that ICIMOD has appropriately incorporated the information from national FAR into this regional synthesis document.

KL-India covers an area of 14,061 sq.km with a population of 6.3 million people. While entire State of Sikkim is included in the landscape, parts of Darjeeling, Jalpaiguri and Alipurduar Districts of West Bengal contribute to KL. The landscape in India shares its boundary in the west with Nepal and in the east with Bhutan. In this landscape many conservation and development issues are transboundary in nature which can be addressed through a regional transboundary landscape platform.

This FAR Regional Synthesis of the KL presents relevant information on the target landscape through a regional perspective. The information included in the document would form a strong base for taking forward the priority programmes in the landscape.

(P.P. Dhyani)

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Message

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The landscape approach to biodiversity conservation and sustainable development is an important tool for achieving integrated conservation and development targets in Nepal. The Kangchenjunga Landscape is one of five landscape programmes currently being implemented in Nepal. In Nepal, this landscape covers an area of 5,190 sq.km extending over parts of Jhapa, Ilam, Panchthar and Taplejung Districts in the country's eastern region. With Mt. Kangchenjunga, the world's third highest mountain, as the symbolic icon of the landscape, the area is home to a wide variety of biological and natural resources, as well as a diversity of peoples and cultural heritage.

A number of landmark achievements are notable from the Kangchenjunga Landscape, Nepal. The Kangchenjunga Conservation Area in the northern part of the landscape is the only protected area that is currently under community management in Nepal. The country's first satellite-collaring of snow leopards was conducted in the high mountains of this landscape. The collected information indicates the use of transboundary landscape as the animal's habitat. Significant economic progress has started through the cultivation of high value cash crops such as cardamom and tea, and through rural tourism.

Despite these achievements, there are numerous challenges we face in the Landscape. The conflict between humans and wildlife is a pertinent issue that is challenging the livelihoods of both hill-residents, as well as communities living in the landscape. Many areas in the landscape continue to be inaccessible despite the implementation of numerous road projects. Such remoteness has implications for socio-economic development of local women and men, thereby raising the challenge of implementing programmes to enhance their livelihoods. Permanent and temporary outmigration of local women and men is also another important issue in the landscape.

The Kangchenjunga Landscape in Nepal shares its boundary with India in its eastern and southern borders, and many traits including landscape characteristics, culture, language, and livelihood strategies are similar in the two countries. Moreover, the two countries also share similar conservation and development challenges which can be effectively addressed through a transboundary approach.

The Ministry appreciates the work of ICIMOD in synthesising information from the member countries of Kangchenjunga Landscape which is presented in this report. We also thank Research Centre for Applied Science and Technology (RECAST), Tribhuvan University (TU), the national collaborating institution of the Kangchenjunga Landscape Conservation and Development Initiative, for preparing the national assessment report that served as one of the important reports for preparing this regional synthesis document. We are confident that this report will be a useful reference for developing programmes pertinent to the Kangchenjunga Landscape.

Prakash Mathema

Secretary

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Acknowledgements

ICIMOD would like to thank all the people who contributed to the preparation of this report. This publication is based on the individual country-level feasibility assessment reports prepared in a consultative manner within the KL, and all of those who contributed to the process are duly recognized in the individual country reports. We are grateful for your participation and inputs that have resulted in the development of this report.

ICIMOD would like to thank Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the Austrian Development Agency (ADA) for their financial support for the preparatory phase of the KLCDI. We also highly appreciate the support we have received from our partners in the KL countries: Wildlife Conservation Division, Department of Forests and Park Services, Ministry of Agriculture and Forests, Government of Bhutan; GB Pant National Institute for Himalayan Environment and Sustainable Development, Ministry of Environment, Forest & Climate Change, Government of India; Ministry of Forests and Soil Conservation, Government of Nepal; and Research Centre for Applied Science and Technology – Tribhuvan University, Nepal.

Acronyms and Abbreviations

B2C2	Bhutan Biological Conservation Complex
BMC	Biodiversity Management Committee
CBD	Convention on Biological Diversity
CDS	Conservation and Development Strategy
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CFUG	Community Forest User Group
COP	Conferences of Parties
DEM	Digital Elevation Model
DoF	Department of Forest (Nepal)
FAR	Feasibility Assessment Report
GBPNIHESD	GP Pant National Institute of Himalayan Environment and Sustainable Development (India)
GIS	Geographic Information System
GIZ	Deutsche Gessellschaft für Internationale Zusammenarbeit (formerly GTZ)
Gol	Government of India
GoN	Government of Nepal
GNHC	Gross National Happiness Commission (Bhutan)
IAP	Invasive Alien Species
IBA	Important Bird Area
ICIMOD	International Centre for Integrated Mountain Development
IPA	Important Plant Area
IUCN	The World Conservation Union
JFM	Joint Forest Management (India)
JKSNR	Jigme Khesar Strict Nature Reserve (formerly Toorsa Strict Nature Reserve)
KBR	Khangchendzonga Biosphere Reserve
KCA	Kangchenjunga Conservation Area
KL	Kangchenjunga Landscape
KLCDI	Kangchenjunga Landscape Conservation and Development Initiative
LoA	Letter of Agreement
MA	Millennium Ecosystem Assessment
MAP	Medicinal and Aromatic Plant
m	metre
MoFSC	Ministry of Forests and Soil Conservation (Nepal)
MoEFCC	Ministry of Environment, Forest & Climate Change (India)
MoU	Memorandum of Understanding
NGO	Non-Governmental Organization
NTFP	Non-Timber Forest Product
RCF	Regional Cooperation Framework
RECAST	Research Centre for Applied Science and Technology (Nepal)
RGoB	Royal Government of Bhutan
RSPN	Royal Society for Protection of Nature (Bhutan)
sq.km	square kilometre
TMI	The Mountain Institute
TU	Tribhuvan University
VDC	Village Development Committee (Nepal)
WB	World Bank
WCD	Wildlife Conservation Division (Bhutan) (now Nature Conservation Division)
WWF	World Wide Fund for Nature (also known as World Wildlife Fund)

Executive Summary

Background

The Kangchenjunga Landscape (KL) is a transboundary landscape that spreads from the Tarai-Duar lowlands of India and Nepal, across the midhills of western Bhutan, northeast India and eastern Nepal, to the high Himalayan region of India and Nepal. The dominant feature in the landscape is Mount Kangchenjunga, the world's third highest peak at 8,586 m. Kangchenjunga is considered sacred by local communities. The word 'Kangchenjunga' is a Sanskrit derivation of the Tibetan name 'Kangchenzodnga' (ཀངས་ཆེན་མཛོད་ལྗང་ལྷ་ Kangqênzön'nga), which translates as the 'Five Treasuries of Great Snow' (Snow [Rang], Big [Chen], Treasury [Zod], Five [Nga]). Among the Lepcha people, the mountain is known as *Chuthing bojjetpimgo*, while the Kirantis revere it as *Sewalungma*, i.e., the 'mountain to which we offer greetings.'

The KL spreads over an area of 25,085.8 sq.km; 56% of the area falls in India, 23% in Bhutan, and 21% in Nepal. Within an aerial distance of 166 km, there is an altitudinal range exceeding 8,000 m that includes five major physiographic zones: the Indo-Gangetic Plains to the south, the Sub-Himalayan and Lower Himalayan Ranges up to 3,000 m, the Greater Himalayan Zone, and the Tibetan Plateau. The northern region of the landscape is dominated by high mountains and glaciers, while the southern part comprises lowlands with high levels of human population pressures.

Socioeconomic Features

More than 7.2 million people live in the KL, 87% of whom live in KL-India, 11% in KL-Nepal and 2% in KL-Bhutan. Females make up 48.8% of the total population in the landscape. The cultural landscape is a mosaic of several ethnic and social groups, and a number of ethnic groups only inhabit areas in or around the KL: these include the Lepcha communities of Sikkim and Darjeeling in KL-India, eastern Nepal, and southwestern parts of KL-Bhutan; the Lhop (Doya) community of the Amo Chhu Valley in KL-Bhutan; and the Walungpas of Olangchung Gola of Taplejung district in KL-Nepal.

Agriculture is an important livelihood strategy in the KL, and includes subsistence agriculture, cash crop production, shifting cultivation practices, and organic farming, among others. Among the major cash crops, large cardamom, tea, non-timber forest products, ginger and mandarin orange are quite common. Animal husbandry is an integral part of farming systems in the landscape, with livestock providing dairy products, meat, draught power, and farmyard manure. Livestock rearing practices include both stall-feeding, as well as transhumance, where families move with their livestock to higher pastures in the summer and lower valleys in the winter. Trade, and particularly cross-border trade, is an age-old practice among communities in the KL. Local *bazaar* markets, known as *haats*, which are conducted on a weekly or fortnightly basis, provide farmers an opportunity to sell and showcase their agricultural products, along with handicrafts and other items. Tourism is another important economic activity in the landscape. It provides various opportunities for tourism products including, but not limited to nature tourism, village home stays, adventure travel, pilgrimage, culture and heritage, tea tourism, and flori-tourism. Migration, both internal (i.e., mostly from rural to urban centres) and external, particularly to Gulf countries, for employment is a growing phenomenon in the KL, and remittance has become an important feature of the rural economy. Floriculture is another growing economic activity in the landscape; it involves such species as *Rhododendron*, *Primula*, *Gladiolus* and *Lillium*. Other economic activities of people living within the KL include textile production; handicraft making such as carpet weaving, bamboo weaving, wood-working; knitting; and food processing.

A large number of people live in the KL. Between one-fifth to half of the population live in absolute poverty, which is defined as being unable to afford the basic human needs like nutrition, education and medical services. Determinants of poverty in the KL include limited assets and liabilities (small landholdings, high land fragmentation, small numbers of livestock), household composition (high dependency rate, female headed households), and social status (ethnic groups/socially marginalized groups, literacy levels of household members, literacy level of household head, among others).

Ecological Features

Forests, which occupy almost 45% of the total area in the KL, are characterized by both the Indo-Malayan Realm of Southeast Asia (e.g., *Dipterocarpus*, *Shorea* and *Terminalia* species), as well as the Palearctic Realm of Eurasia (e.g., conifers such as spruce, fir and larch, and deciduous broadleaf taxa such as birch, alder and willow). Rangelands, which account for 20% of the landscape, can be classified as subtropical rangelands (between 1500 and 2000 m), temperate pasturelands (between 2,000 and 3,500 m), and alpine/subalpine pasturelands (occurring up to 4500 and 5000 m). High altitude pasturelands are used as summer grazing areas for yak and sheep. Rangelands in the KL are especially significant in terms of transboundary conservation. Aquatic ecosystems, which occupy 0.4% of the landscape, are characterized by rivers (significant among which are the Toorsa (Amo Chu) and Raidak (Wang Chu) in KL-Bhutan, Teesta and Rangit in KL-India, and Tamur and Kankai-Mai in KL-Nepal) and wetlands – many of which are significant for both cultural as well as ecological purposes. Agricultural ecosystems, which occupy 17% of the landscape, support a high diversity of crops along various altitudinal gradients. Many of the agricultural systems have traditionally integrated crops, forests and livestock.

The KL is extremely rich in floral diversity, with more than 4,500 species of plants including orchids, rhododendrons, wild edible plants, non-timber forest products, and medicinal plants of high value. Of particular significance is the occurrence of more than 40 species of rhododendron, which are native to the Eastern Himalaya. The *Rhododendron* genus is considered a keystone species because of its ecological significance in the habitat where it occurs. The landscape is also home to 169 mammal species and 582 bird species. Key mammal species of the lowlands are the Bengal tiger, one-horned rhinoceros and Asian elephant; key mammals of the midhills are red panda, takin and clouded leopard; while snow leopard, musk deer, Himalayan black bear, Tibetan antelope and blue sheep are the important species of the high mountains.

Many floral and faunal species are threatened in the KL as a result of habitat loss, poaching, excessive harvesting, and climate change, among other reasons. At least 44 plant species are threatened at the global or national level, while 17 mammals and 14 birds are globally threatened and included in IUCN's Red List of threatened species. In particular, four birds are critically endangered: Baer's pochard (*Aythya baeri*), white-rumped vulture (*Gyps bengalensis*), and slender-billed vulture (*Gyps tenuirostris*), and red-headed vulture (*Sarcogyps calvus*).

There are globally recognized elements in the KL. Of the 25 terrestrial ecoregions in the Eastern Himalaya, nine are found in the KL, dominant among which are the Eastern Himalayan broadleaf forests (31% of the landscape), followed by Tarai-Duar savanna and grasslands (16%) and Eastern Himalayan alpine shrub and meadows (11%). The landscape falls within the Himalaya, one of the 36 Global Biodiversity Hotspots. One Ramsar Site occurs in the landscape – Mai Pokhari in Ilam District of KL-Nepal. There are 22 Important Bird Areas, and at least 11 Important Plant Areas for medicinal plants. There are also 19 protected areas in the landscape under various management regimes. As most of these protected areas occur in isolation, seven conservation corridors have been proposed in order to connect these important habitats in the landscape.

Conservation and Development Issues and Priorities

The KL faces a number of conservation and development challenges which are driven by underlying issues of change: climate change, demographic change, transboundary governance and heterogeneous policies. Common to these drivers of change are gaps in knowledge on these issues, and the impact of these drivers on gender equity. These drivers of change lead to loss or degradation of habitat for flora and fauna while further increasing human-wildlife conflicts, as well as transboundary conflicts, and reducing the value of ecosystem services. The long-term impacts of these changes include biodiversity (and agrobiodiversity) loss, reduced ecosystem productivity, and reduced adaptive capacity for both humans and other organisms.

Community perceptions on environmental issues and climate change indicate that the weather has changed throughout the landscape. Local women and men have been experiencing increased temperature, irregular rainfall patterns, prolonged dry season, changes in the snowing season, and less snowfall. This has resulted in numerous ecological changes such as the occurrence of new plant (particularly weed) and bird species, emergence of new pests and crop diseases, and drying up of water sources. As a result, communities are increasingly being exposed to more risks and hazards including crop failures, landslides and soil erosion.

Conservation and development issues in the KL occur at local and national levels, as well as at the transboundary level. Major local and national issues of concern include wildlife poaching, human-wildlife conflict, unsustainable extraction of natural resources, pastureland management, and inadequacy of formal institutions to deliver services, solid waste, and knowledge gaps. At the transboundary level, major issues include illegal cross-border trade; transboundary movement of people, livestock and wildlife; illegal and unsustainable extraction of natural resources; and the tea industry and its associated impact on human health and the ecosystem well-being. The variation on conservation priority, complementarity in policies and lack of regional cooperation also add challenges.

The three participating countries have made significant progress for conservation in terms of protected areas designation, community based conservation initiatives, and enterprise based conservation and development initiatives. The organic mission of Sikkim, tourism in Sikkim and Darjeeling (India) and Ilam (Nepal), and community based conservation in Nepal have been in the limelight as examples of best practices. However, differences in governance structure and capacity, priority for conservation and variance in policy pose challenges in addressing conservation goals at the regional level.

The KL is globally significant in terms of biodiversity and conservation, but it is also home to more than seven million people who share many socio-cultural characteristics, who face similar development and conservation challenges, and who derive numerous ecosystem benefits from the landscape. This Kangchenjunga Landscape Feasibility Assessment Report (FAR) thus identifies the following priorities: ensuring human well-being through the maintenance of ecosystem functions and services in the landscape, with special focus on transboundary ecosystems management, equitable governance of natural resources, and improving local livelihoods by promoting crops such as large cardamom, ginger and tourism using tested tools such as value addition, REDD+ and ecotourism; increasing the resilience of communities and ecosystems so that they can better adapt to environmental changes through the use of integrated landscape approaches for improved ecosystem productivity, and reduction of human-wildlife conflicts; monitoring changes in key aspects of biodiversity and ecosystem services so that we can predict future changes in the context of local, regional and global vulnerabilities; and improving cooperation among KL member countries for sustainable ecosystem management that contributes to both livelihood benefits, as well as to global conservation priorities.

Introduction

Background

Since the 1980s, the management of protected areas has evolved from a species-based approach to a community-based conservation approach (Sharma & Chettri, 2005; Bajracharya et al., 2007; Chettri & Shakya, 2008). Moreover, there is now more focus on going beyond the boundaries of isolated protected areas to capture the range of biological and ecological processes and landscapes across administrative and national borders. Building on the 'ecosystem approach' outlined in the Convention on Biological Diversity (Secretariat to the CBD, 2004), ICIMOD has identified six strategic transboundary landscapes for promoting transboundary biodiversity conservation, ecosystem management and sustainable development: Kailash Sacred Landscape, Hindu Kush-Karakoram-Pamir, Everest, Kangchenjunga, Far-Eastern Himalaya, and Cherrapunjee-Chittagong Hill Tracts (Chettri et al., 2009). Each of these landscapes has its own unique characteristics, but they share common challenges that require regional cooperation for biodiversity conservation and ecosystem management.

Mount Kangchenjunga, the world's third highest mountain at 8,586 m, is a sacred mountain for the many communities living in the region. Kangchenjunga (कञ्चनजङ्घा *Kanchanjanghā*) is a Sanskrit derivation of the Tibetan name 'Kangchenzodnga' (གངས་ཚོན་འཛོལ་ལྷ་ *Kangqênzön'nga*). While 'Kanchenjunga' translates as 'Golden Thigh' (Golden [Kanchen], Thigh [junga]), 'Kangchendzonga' translates as the Five Treasuries of Great Snow (Snow [Rang], Big [Chen], Treasury [Zod], Five [Nga]) (Chhoden 1932). The Tibetan name refers to the five high summits in which the mountain range culminates. The five treasuries are highlighted in the Tibetan scriptures known as Lama Gongpa Du-pa (12 volumes) as: i) salt, ii) gold and turquoise, iii) holy books and wealth, iv) military weapons, and v) crops and medicines (Chhoden, 1932). The Sikkimese people revere the deity that resides in Kangchendzonga, and a religious festival called *Pang Lhabsol* is celebrated in her honour every year on the 15th day of the 7th month on the Tibetan calendar (corresponding to September on the Gregorian calendar). The mountain is known as *Chuthing bojetpimgo* among the Lepcha people of Sikkim. The Kirantis revere Kangchenjunga as *Sewalungma*, i.e., the 'mountain to which we offer greetings'.

Kangchenjunga is a sacred mountain among many communities in the landscape



The KL covers the southern half of the area surrounding Mount Kangchenjunga and spreads across eastern Nepal, Darjeeling and Sikkim in India, and western Bhutan. The KL is one of the richest among the Himalayan ‘biodiversity hotspots’ (WWF & ICIMOD, 2001; Mittermeier et al., 2004) and is an important transboundary area for biodiversity conservation (Chettri et al., 2009). The landscape hosts many threatened animal species such as snow leopard (*Panthera uncia*), Bengal tiger (*Panthera tigris*), Asian elephant (*Elephas maximus*), red panda (*Ailurus fulgens*), and takin (*Budorcas taxicolor*), as well as many threatened plant species such as kutki (*Neopicrorhiza scrophulariiflora*) and endangered species of rhododendrons – *R. leptocarpum*, *R. niveum* and *R. sikkimense* (Rana 2008).

ICIMOD’s engagement in the KL dates as far back as 1997 when it supported the first regional consultation on the conservation of the Kangchenjunga Mountain Ecosystem (Rastogi et al., 1997). This was followed by additional research on gap analysis and biodiversity assessments in the region. Subsequently, ICIMOD initiated the KL programme in 2002 to encourage cooperation among the governments of Bhutan, India and Nepal for sustainable management of the KL. Thereafter, a series of national and regional consultations were held: national consultations in Nepal, India and Bhutan in 2003; a regional technical experts consultation workshop on Developing a Transboundary Conservation Landscape in the Kangchenjunga Complex in May 2004; and a regional technical workshop on policy framework for Cooperation and Implementation of Convention on Biological Diversity in the KL in June 2006 (Chettri et al., 2009). Significant achievements during this phase include: generation of baseline information and the understanding of transboundary issues in the landscape; delineation of six potential conservation corridors that link nine protected areas in the landscape (Chettri et al., 2008); fostering regional partnerships among the three countries in the landscape; and development of a Framework for Implementation of the Convention on Biological Diversity in the KL (Sharma et al., 2007).

Rationale

Although there have been significant achievements in biodiversity conservation in the KL, the region continues to face numerous issues that are both local and transboundary in nature. Earlier interventions by ICIMOD in the landscape used the ‘bottom-up’ approach, which was not effective in addressing transboundary issues. In order to address these issues, the Kangchenjunga Landscape Conservation and Development Initiative (KLCDI) was initiated as a collaboration between partner institutions from Bhutan, India and Nepal, with facilitation and technical support from ICIMOD, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and Austrian Development Agency (ADA). The objectives of the preparatory phase of the Initiative are to:

- Prepare a regional feasibility assessment report, conservation and development strategy, and a comprehensive environmental and socioeconomic monitoring plan
- Prepare a Regional Cooperation Framework (RCF) for conservation and management of the rich biological diversity, vibrant cultural heritage, and vital ecosystem services through transboundary ecosystem management and participatory approaches that foster human well-being
- Enhance cooperation among participating countries with a common goal of conservation and sustainable development within the landscape

Three nodal agencies have been identified in Bhutan, India and Nepal for implementing the preparatory phase of KLCDI:

- **Bhutan:** Wildlife Conservation Division (WCD), Department of Forests and Parks Services, Ministry of Agriculture and Forests, Government of Bhutan
- **India:** GB Pant National Institute of Himalayan Environment and Sustainable Development (GBPNIHESD), Gangtok, Sikkim, supported by the Ministry of Environment, Forest & Climate Change (MoEFCC), Government of India
- **Nepal:** Research Centre for Applied Science and Technology (RECAST), Tribhuvan University (TU), supported by the Ministry of Forests and Soil Conservation (MoFSC), Government of Nepal

Scope and Coverage

This Kangchenjunga Landscape Assessment Report (FAR) is a synthesis of the three national FARs from Bhutan, India and Nepal, and additional literature review relevant to the landscape. The national FARs of the three countries were prepared by the three nodal agencies respectively – WCD, GBPNIHESD and RECAST – with support from national stakeholders. The reports included the following components:

- Delineation of the KL at the country level
- Assessment of the physical and socioeconomic features of the landscape
- Assessment of the biological features from the perspective of ecosystem services
- Analysis of existing resource governance systems
- Analysis of community perceptions on biodiversity, cultural values, and environmental and climate change trends
- Review of existing policies and enabling environment
- Identification of major issues and research gaps in the landscape
- Identification of conservation and development priorities for the landscape and
- Needs analysis at the country level in order to develop the Conservation and Development Strategy (CDS).

This synthesized regional FAR is prepared with a special focus on the following issues:

- Boundary delineation of the KL with approval from country focal institutions
- Assessment of various aspects of the landscape with special emphasis on transboundary issues: physical, socioeconomic and biological features; policy and governance systems; community perceptions; drivers of change; and research gaps
- Identification of conservation and development priorities in the landscape, which will contribute towards developing the CDS, which in turn will support the preparation of the RCF for KLCDI.

Methodology

The process leading up to the preparation of the KL FAR (Figure 1) included the start-up phase, several national stakeholder consultations (Box 1), extensive research in each of the three KL countries, and two regional consultation workshops (Box 2). As part of the start-up phase, ICIMOD signed Letters of Agreement (LoAs) with the Gross National Happiness Commission (GNHC), Bhutan in August 2013, with RECAST, Nepal in August 2013, and with GBPNIHESD, India in November 2013. The country FARs were prepared by the three nodal agencies between January and September 2014. Information from the three country reports was subsequently synthesized by ICIMOD with a special focus on transboundary issues in the landscape.

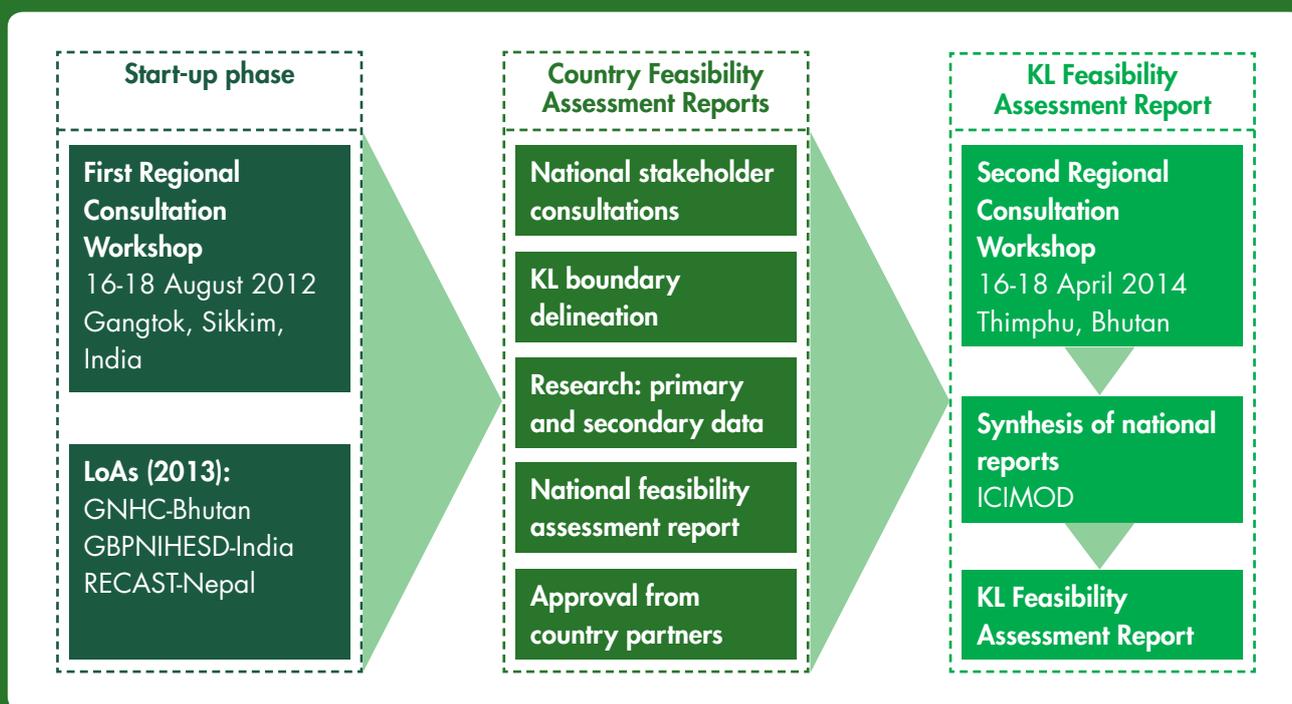
Literature review

Literature review of both published and unpublished reports was conducted. There is a fair amount of published literature on the biodiversity of the KL, but available information on the socioeconomic situation and climate is not extensive. In addition to published manuscripts, unpublished reports, including management plans of protected areas, reconnaissance reports, project reports, and unpublished theses were also reviewed.

Agreeing on milestones and timelines for KLCDI during the First Regional Consultation in August 2012 in Gangtok, Sikkim, India



Figure 1: Flowchart indicating major activities for the preparation of Kangchenjunga Landscape Feasibility Assessment Report



Box 1: National consultations on KLCDI

KL Bhutan

A national consultation meeting was held in Thimphu, Bhutan, on 5 August 2013. During this meeting, the process for delineating the corridor between Jigme Khesar Strict Nature Reserve and Phibsoo Wildlife Sanctuary was discussed, along with the process of preparing the FAR. This meeting was immediately followed by field level consultations in Gedu, Samtse and Haa.

KL India

The first national consultation (inception) meeting was organized from 28-29 January 2014 in Gangtok, Sikkim. Criteria for boundary delineation, process for the preparation of FAR, CDS, and RCF, and planning for programme implementation were discussed. The second national consultation meeting was organized on 9 April 2014 in Gangtok, Sikkim. The progress made on FAR preparation for KL India was presented, and participants highlighted additional issues and gaps in the FAR.

KL Nepal

A national stakeholders' workshop was conducted jointly by RECAST, MoFSC and ICIMOD on 20 March 2014 in Kathmandu, to present and discuss the draft FAR prepared by RECAST. Feedback on the draft FAR was provided by participants, who represented various relevant sectors of the Government of Nepal, NGOs and INGOs.

Box 2: Regional consultations on KLCDI

First Regional Consultation Workshop, Gangtok, Sikkim, India (16-18 August 2012)

The overall objective of this workshop was to provide a common platform to share the progress made in the KL, discuss key challenges, and agree on the future course of action to implement KLCDI. During this workshop, all three KL countries reached agreement on the milestones and timelines for developing the FARs, CDS, the Comprehensive Environmental Monitoring Plan and the RCF.

Second Regional Consultation Workshop, Thimphu, Bhutan (16-18 April 2014)

During this workshop, the boundaries of the target landscape were finalized; the national FARs were shared and reviewed; draft guidelines and key elements for the preparation of the CDS (excluding the Comprehensive Environmental Monitoring Plan) were agreed upon; and the workplan and timelines for implementation of remaining activities were reviewed. The three KL member countries – Bhutan, India and Nepal – also formalized their agreement for the transboundary KLCDI programme.

Field consultations

Field consultations were conducted by teams consisting of experts, researchers and practitioners from various institutes and civil society organizations. Consultations were held at community, district and state levels and included government officials, civil societies, community level interactions, and key informant interviews. The consultations covered issues of livelihoods and development, conservation, ecosystem management, climate change, and potential areas of work for the proposed initiative. Representatives of different communities were consulted to acquire information on forests, grasslands, grazing and agricultural practices, traditional knowledge on bioresources, cultural values, policies and customary laws, and local people's perceptions of conservation, development and climate change. Rapid assessment surveys were also conducted in the field to generate both qualitative and quantitative data for validation of inventories of floral and faunal species.

Geospatial analysis

Geospatial analysis was done using the UTM Zone 44 R coordinate system and WGS 84 map datum. Each KL country used the publicly available SRTM 90 m Digital Elevation Model (DEM) dataset (available at <http://srtm.csi.cgiar.org>) as a common base map in order to ensure coherence of the final regional transboundary delineation. After receiving the final delineation of national level KL boundary, ICIMOD re-projected the SRTM 90 m data delineation of the final regional KL boundary.

Confluence of the Teesta and Rangit Rivers in KL-India





Ensuring the supply of ecosystem services can contribute to building resilience among local communities

Description of the Kangchenjunga Landscape

Boundary Delineation

Criteria for boundary delineation

The process of technical delineation of the KL took the inputs and suggestions of partner countries into consideration while also keeping in view their geopolitical priorities and issues of concern. The thematic areas for boundary delineation included ecology and conservation, livelihoods and development, and planning and management criteria (Table 1). Within these thematic areas, additional criteria were used with particular reference to each country in the landscape.

Table 1: **Criteria used for boundary delineation**

Thematic area	Criteria
Ecology and conservation	<ul style="list-style-type: none"> • Transboundary ecosystem contiguity and ecosystem services • Eco-climatic zones and environmental gradients • Key biodiversity areas including migratory habitats, biodiversity corridors, Important Bird Areas, Important Plant Areas • Protected areas, wetlands (including Ramsar Sites), and other conservation priority areas • Watershed and river basin coverage for headwater areas of major rivers originating from the landscape • Habitat ranges of endemic, indicator, and/or threatened species
Livelihoods and development	<ul style="list-style-type: none"> • Livelihood linkages with conservation and development • Culturally significant sites including pilgrimage routes • Existing and potential tourism areas • Vulnerability to globalization, migration, and other drivers of change • Urbanization and infrastructure development • Human-wildlife conflict affected areas • Indigenous knowledge, access and benefit sharing
Planning and management	<ul style="list-style-type: none"> • Areas vulnerable to shocks and stresses • Areas that are currently or potentially under threat from the conservation perspective

Methodology

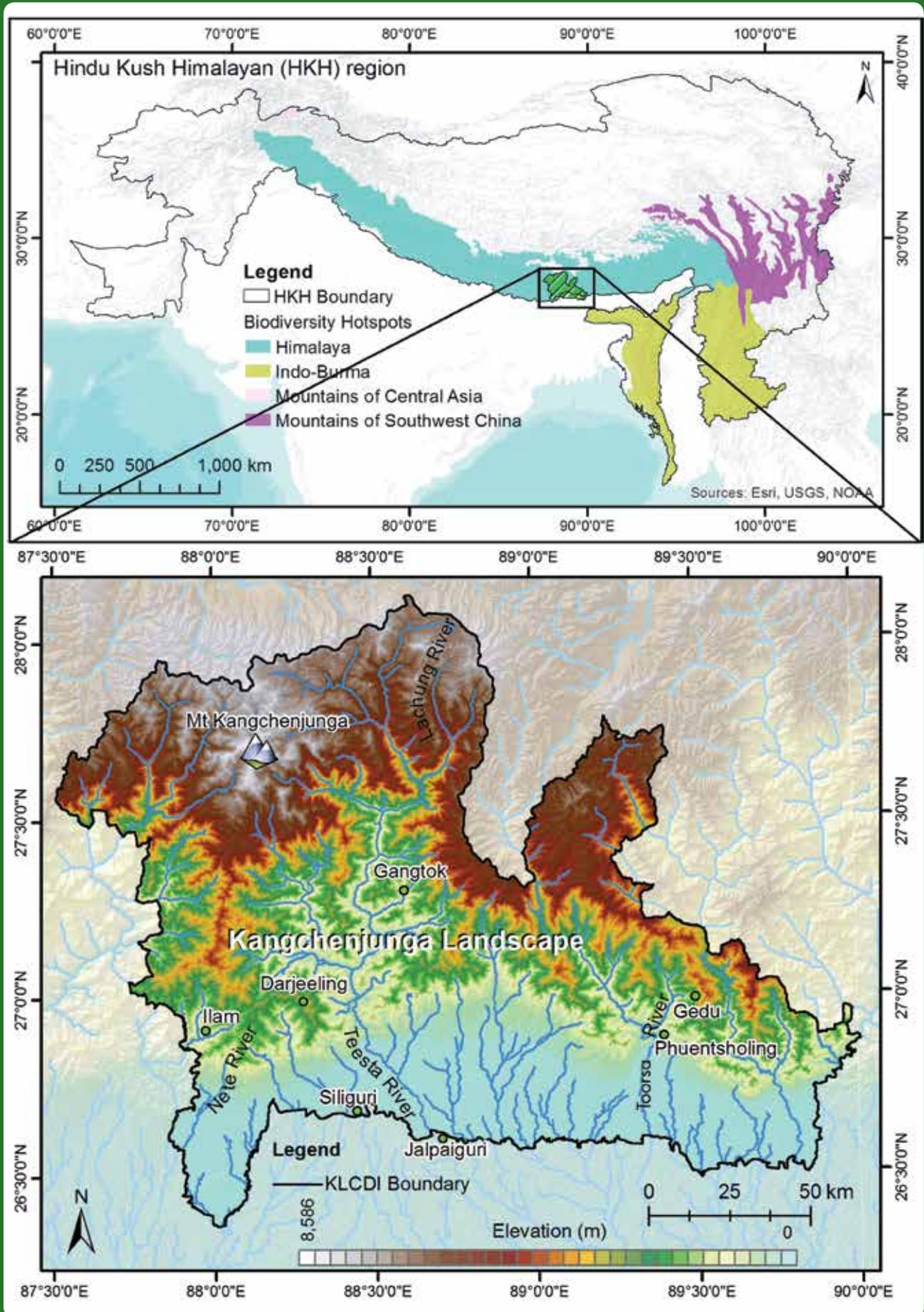
The process of boundary delineation of the KL was initiated by ICIMOD in 2002 (Chettri et al., 2007). At the time, the landscape included 14 protected areas connected by 6 potential corridors based on the contiguity of forests, natural history, and the community's knowledge about the use of these corridors by wildlife. These corridors were then validated through baseline studies and remote sensing and geographical information system (GIS) tools.

Using the above landscape delineation as a base, the three nodal agencies in Bhutan, India and Nepal further conducted in-depth analysis of their respective landscape boundaries with support from ICIMOD. The process involved literature review, analysis of the boundary delineation criteria, and stakeholder consultations at local and national levels. The boundary delineation process was both participatory as well as iterative (ICIMOD, 2015).

KL boundary

The KL is a transboundary landscape that spreads from the Tarai-Duar lowlands of Bhutan, India and Nepal, across the midhills of western Bhutan, north-eastern India and eastern Nepal, to the high Himalayan region of India and Nepal (Figure 2). Elevations in the landscape range from a low of 40 m in India (Jalpaiguri) to the highest point of Mount Kangchenjunga at 8,586 m (Table 2). The landscape covers a total area of 25,085.8 sq.km with its boundary coordinates at 26° 21' 40.49" and 28° 07' 51.25" latitude and 87° 30' 30.67" and 90° 24' 31.18"

Figure 2: The Kangchenjunga Landscape in the Hindu Kush Himalaya



longitude. It is home to approximately 7.2 million people of numerous ethnic and social groups.

The KL is part of the Himalaya Biodiversity Hotspot (Mittermeier et al., 2004), and it represents nine ecoregions (Olson et al., 2001): Brahmaputra Valley semi-evergreen forests; Eastern Himalayan alpine shrub and meadows; Eastern Himalayan broadleaf forests; Eastern Himalayan subalpine conifer forests; Himalayan subtropical broadleaf forests; Himalayan subtropical pine forests; Lower Gangetic plains moist deciduous forests; Tarai [Terai]-Duar grasslands and savannas; and Yarlung Tsangpo arid steppe.

KL – Bhutan

The KL in Bhutan (Table 3 and Figure 3a) covers a total area of 5,833.8 sq.km with the major features being one protected area – Jigme Khesar Strict Nature Reserve – and one corridor within the Bhutan Biological Conservation Complex (B2C2). The KL-Bhutan landscape includes portions of five dzongkhangs – Haa, Chukha, Samtse, Dagana, and Paro. Elevations in the landscape range from 95 m to 5,640 m. There are five ecoregions in the landscape: Eastern Himalayan alpine shrub and meadows; Eastern Himalayan subalpine conifer forests; Himalayan broadleaf forests; Himalayan subtropical broadleaf forests; and Tarai-Duar savanna and grasslands. The population in KL-Bhutan is 150,902 (PHCB, 2005) and there is no permanent settlement in Jigme Khesar Strict Nature Reserve.

KL – India

At 14,061.7 sq.km, KL-India represents the largest proportion of the KL (Table 3 and Figure 3b). It includes all of the state of Sikkim (four districts), and parts of Darjeeling and Jalpaiguri Districts¹ in the state of West Bengal. Within Darjeeling 12 blocks of 4 sub-divisions are included in the landscape, while within Jalpaiguri 13 blocks of 3 sub-divisions are included. Elevations in KL-India range from 40 m at Jalpaiguri to 8,586 m of Mt Kangchenjunga in Sikkim. Nine ecoregions are represented in the landscape: Brahmaputra Valley semi-evergreen forests; Eastern Himalayan alpine shrub and meadows; Eastern Himalayan broadleaf forests; Eastern Himalayan subalpine conifer forests; Himalayan subtropical broadleaf forests; Himalayan subtropical pine forests; Lower Gangetic Plains moist deciduous forests; Tarai-Duar grasslands and savannas; and Yarlung Tsangpo arid steppe. The KL-India is also the most populated with more than 6 million people residing in the landscape.

KL – Nepal

The KL in Nepal extends from Taplejung District in the north, through Panchthar and Ilam Districts, to Jhapa District in the south (Table 3 and Figure 3c). It covers a total area of 5,190 sq.km and includes 23 VDCs in Taplejung District, 14 VDCs in Panchthar District, 25 VDCs and 2 Municipalities in Ilam District, and 23 VDCs and 5 Municipalities in Jhapa District. The lowest point in KL-Nepal is Jalthal (60 m) in Jhapa District, while the highest point is Mt Kangchenjunga in Taplejung District. There are six ecoregions in the landscape – Eastern Himalayan alpine shrub and meadows; Eastern Himalayan broadleaf forests; Eastern Himalayan subalpine conifer forests; Himalayan subtropical broadleaf forests; Himalayan subtropical pine forests; and Tarai-Duar grasslands and savannas. These are important habitat for several threatened species of plants and animals. Mai Pokhari in Ilam District is the only Ramsar Site in the KL. The landscape is home to 771,934 people of whom 70% reside in the landscape region within Jhapa District alone.

Table 2: **Basic attributes**

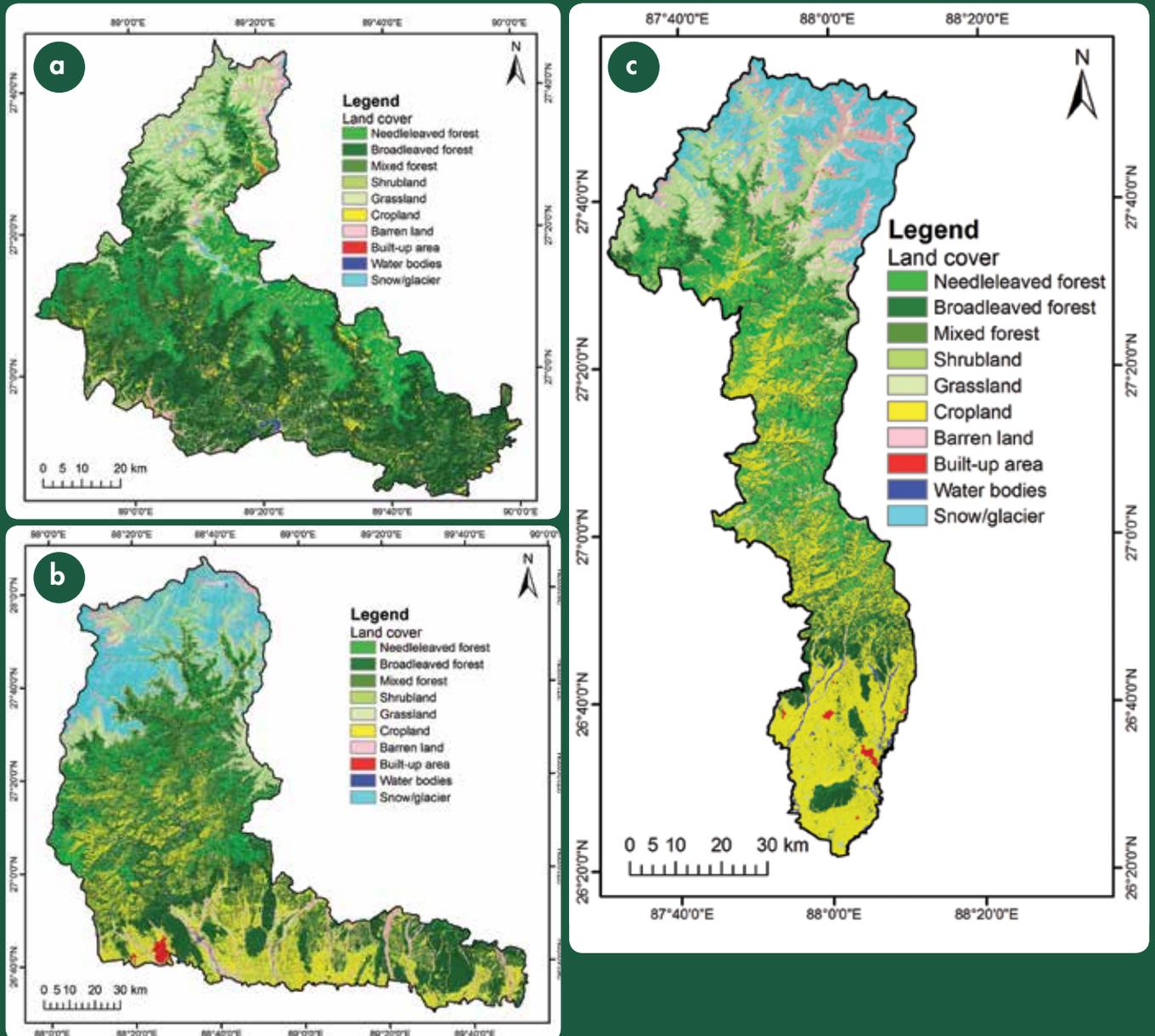
Total area (sq.km)	25,085.8
Elevation range (m)	40–8,586
Slope (d)	0–76
Ecoregions found within landscape	9
Biodiversity Hotspot	1
Population	7.25 million

Table 3: **Basic attributes of KL member countries**

	KL-Bhutan	KL-India	KL-Nepal
Total area (sq.km)	5,833.8	14,061.7	5,190
% of total area	23	56	21
Elevation range (m)	95–5,640	40–8,586	60–8,586
Ecoregions (number)	5	9	6
Population (persons)	150,902	6,325,457	771,934

¹ At the time of preparing the Feasibility Assessment Report of KL India, Jalpaiguri District was further bifurcated into Jalpaiguri and Alipurduar Districts (extraordinary Government Notification No. 634-PAR (AR)/O/2R-4/12, Kolkata). All information on Jalpaiguri District included in this report is from the pre-bifurcation period.

Figure 3: Country-wise delineated areas for the Kangchenjunga Landscape (a-Bhutan, b-India and c-Nepal)



Physical and Socioeconomic Features

General physiographic features

The KL includes five major physiographic zones within an aerial distance of 166 km: the Indo-Gangetic Plains to the south, the Sub-Himalayan and Lower Himalayan Ranges up to 3,000 m, the Greater Himalayan zone, and the Tibetan Plateau. The altitudinal range is extremely wide and exceeds 8,000 m (Figure 4). Almost 26% of the landscape lies at elevations less than 1,500 m, and another 22% occurs above 5,000 m (Table 4). A cross-section of the KL indicates the high level of heterogeneity in elevation gradient (Figure 5). The lower elevations

Table 4: Classification by elevation zone

Elevation (m)	Area (sq.km)	% Area
<50	20.7	0.1
50 to 1,500	6,373.5	25.4
1,500 to 2,500	4,361.3	17.4
2,500 to 4,000	4,209.2	16.8
4,000 to 5,000	4,503.5	17.9
5,000>	5,617.6	22.4
Total	25,085.8	100.0

Figure 4: Elevation map

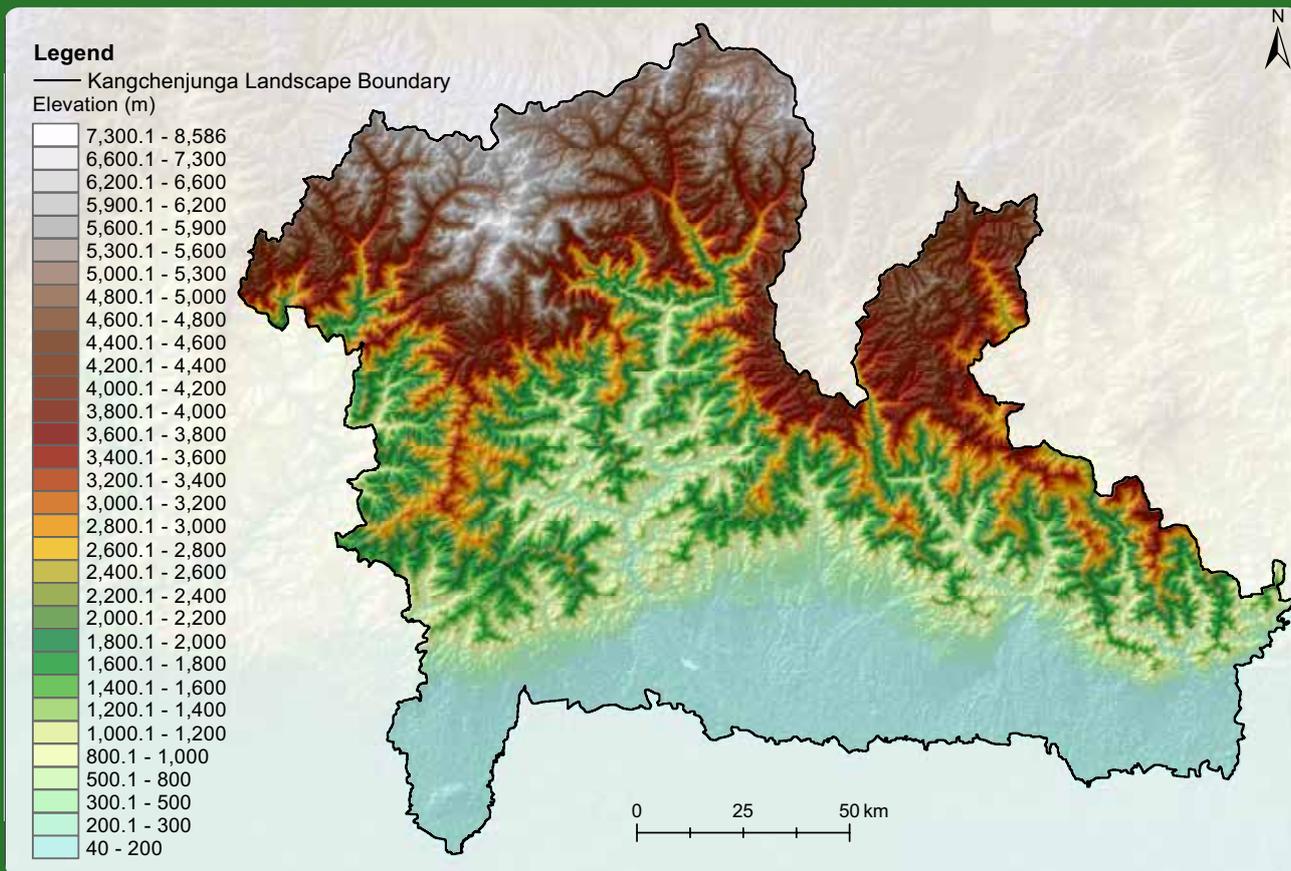
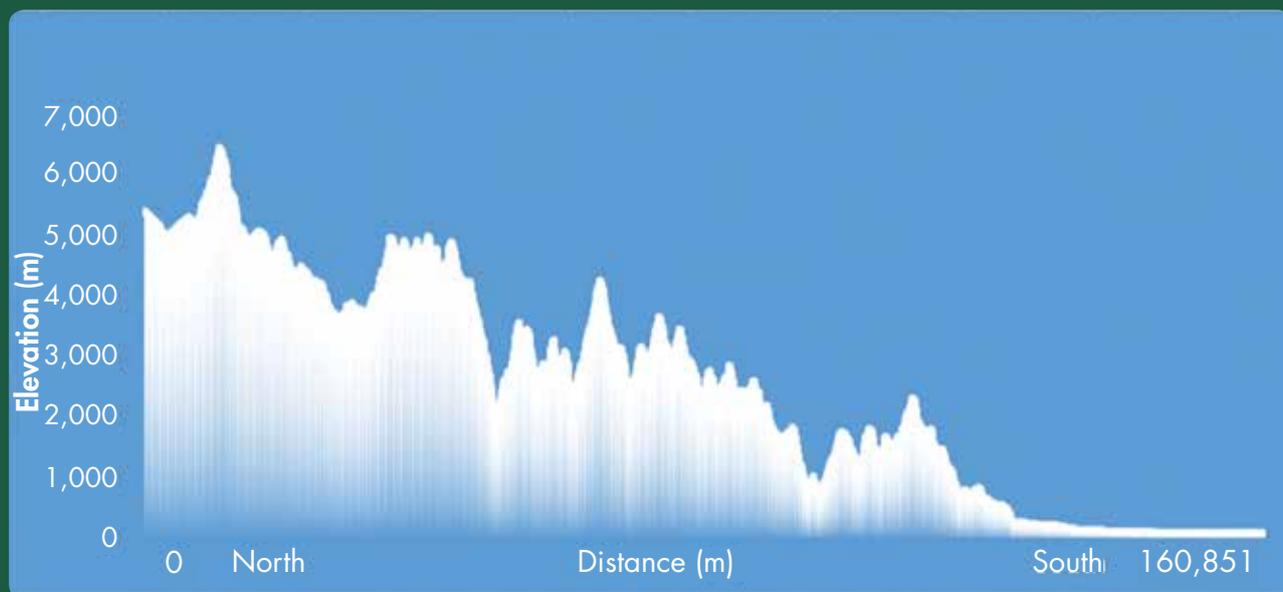


Figure 5: Cross-section of a north-south elevation profile



of the landscape have high levels of anthropogenic pressure – these areas are highly cultivated, population density is extremely high, and the rate of urbanization is also very high. The northern elevations of the landscape are dominated by glaciers and high mountains, which are significant not just for biophysical reasons, but also because of their socio-cultural importance (Table 5).

Mount Kangchenjunga is the dominant feature of the KL. At 8,586 m, it is the third highest mountain in the world. The mountain is revered by the local indigenous communities. Showing respect to its sacred status, the first climbers of Mt Kangchenjunga – Joe Brown and George Band – stopped short of the summit on 25 May 1955. Four glaciers radiate from the peak and drain into three major rivers in the region: the Zemu Glacier in the north-east and Talung Glacier in the south-east drain into the Teesta River in India, while the Yalung Glacier in the south-west and Kangchenjunga Glacier in the north-west drain into the Arun and Koshi Rivers in Nepal.

Table 5: **Major mountain peaks**

Peak	Altitude (m)	Country	Significance
Kangchenjunga Main	8,586	India & Nepal	Sacred among Lepchas, Buddhists and Kiratis
Kangchenjunga West (Yalung Khang)	8,505	Nepal	
Kangchenjunga South	8,494	India & Nepal	
Kangchenjunga Central	8,482	India & Nepal	
Kangbachen	7,903	Nepal	
Kumbhakarna (aka Jannu)	7,710	Nepal	Sacred among Kiratis
Kabru	7,412	India & Nepal	
Kirat Chuli	7,365	Nepal	
Siniolchu	6,888	India	Described by Douglas Freshfield (1903) as ' <i>...the most beautiful snow mountain in the world.</i> '

Climate

The KL can be divided into two main climatic zones: the subtropical climate zone in the lowlands extending up to the mountainous region below 3,000 m, and the tundra type climate above 3,000 m. Climate in the KL is heavily affected by the summer monsoon winds that come from the Bay of Bengal and South China Sea. The rainy season falls between June and September with 80% of the annual precipitation occurring during these months. Topography also plays a major role in determining localized climate within the landscape. South-facing slopes receive higher precipitation than other areas within the landscape.

Population and demography

There are more than 7.2 million people residing in the landscape (Table 6), 87% of whom reside in KL-India. Females constitute 48.8% of the total population. In KL-Bhutan, there are 29,157 households with an average household size of 4.7, while in KL-Nepal there are 174,484 households with an average household size of 4.4.

The cultural landscape is a mosaic of several ethnic and social groups. Communities of both Indo-Aryan and Tibeto-Burman lineage are found in the landscape. Indo-Aryan communities consist of Brahmin/Chhetri and Dalit groups, while the Tibeto-Burman communities include ethnic groups such as Limbu, Rai, Magar, Sherpa, Walung, Gurung, Tamang, Majhi, Tharu, Lepcha, Sunuwar, Dhimal, Bhote, Newar, and Ngalops. In KL-India, ethnic groups such as Lepcha, Bhutia, Chumbipa, Dophthapa, Dukpa, Kagatey, Sherpa, Tibetan, Tromopa and Yolmo are categorized as Scheduled Tribes, while the socially disadvantaged groups of Kami, Damai, Lobar, Majhi and Sarki fall under the Scheduled Castes category. A number of ethnic groups are found only in or around the KL: these include the Lepchas of Sikkim and Darjeeling in India, eastern Nepal, and southwestern parts of Bhutan; the Lhop (Doya) community living in the Amo Chhu Valley

Table 6: **Demographic analysis**

	Population		Households	
	Total	% Female	Total number	Average size
KL	7,248,293	48.8		
KL-Bhutan	150,902	45.3	29,157	4.7
KL-India	6,325,457	48.8	NA	NA
KL-Nepal	771,934	52.4	174,484	4.4

NA: data not available

of Bhutan; and the Walungpas of Olangchung Gola in Taplejung District of Nepal. Hinduism, Buddhism, Islam, Kirat and Christianity are major religions in the landscape, while Jainism, Sikhism and Bön are practised to a lesser extent.

Gender and social inclusion

Issues of gender and social inclusion are important for conservation and development programmes in the KL because of their implications for social equality and poverty reduction. Throughout the landscape, women and other social and ethnic groups are disadvantaged in terms of education, employment, socioeconomic status, access to and control of natural resources, and decision making. Even in Bhutan, which is generally regarded as a country with a high level of gender parity compared to other countries in South Asia, there are subtle and hidden forms of gender discrimination (HELVETAS-Bhutan, 2010).

In the KL, women's literacy rates are consistently lower than men's: 53% for women and 73% for men in KL-Bhutan; 62% for women and 74% for men in KL-India; and 68% for women and 82% for men in KL-Nepal. Social and cultural norms within the landscape affect the opportunities available to women. For example, in Darjeeling District of KL-India, both girls and boys are given equal preference and opportunity in education, but this is not the case in Sikkim and Jalpaiguri (Gurung, 1999). Access to higher education is also lower among women than among men. In KL-Nepal, only 7.6% of women (% of population above 5 years of age) have a School Leaving Certificate (SLC) compared to 8.7% of men, and less than 1% of women have a graduate degree compared to 1.7% of men.

Gender differences in user roles and decision making in natural resources management can also be seen in the landscape. A study in India indicated that 75% of people who collect non-timber forest products (NTFPs) were women and 100% involved in NTFP processing were women, but their inclusion in Joint Forest Management (JFM) committees was less than 10% (Sarkar & Das, 2002). Similarly, in Nepal, although women contribute a large share of the labour for forest and biodiversity conservation in community forests, they represent only 22% of the executive bodies of Community Forestry User Groups (CFUGs) (DoF, 2012). Socially marginalized groups, such as Dalit women and poor non-Dalit women, are further excluded from decision making and benefit sharing in community forests (Lama & Buchy, 2002; Malla et al., 2003; Nightingale, 2006). In KL-Bhutan, the government acknowledges that despite the significant role of women in the use and conservation of NTFPs, their involvement is generally low in the designing, planning, and implementing of forestry policies, and there is limited understanding of the roles, knowledge, aspirations and contributions made by women towards NTFP management (SFD, 2008).

Livelihood and Economic Activities

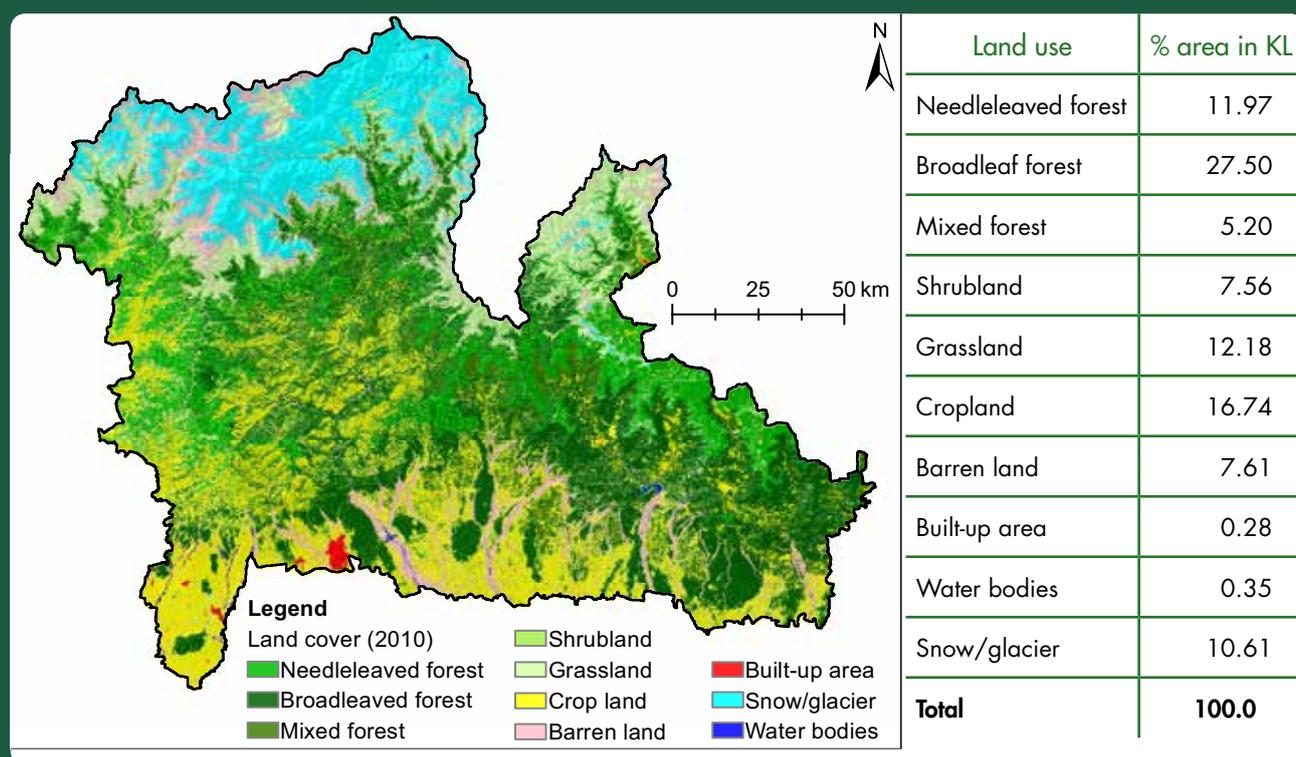
Land use pattern

Land cover data (2010) indicates the following land use patterns in the KL: 44.7% of the total landscape is forests, 19.7% is rangelands, 16.7% is agricultural land, 10.6% is under snow and glacier, 7.6% is barren, and 0.6% is composed of water bodies and built-up areas (Figure 6). Forests include coniferous, broadleaf and mixed forests, while rangelands include shrublands and grasslands. The higher elevations of the landscape are mostly covered by snow and ice, while the lower elevations are intensively cultivated. Forests cover the majority of the landscape area in KL-Bhutan (70%), while 41% of KL-India and 26% of KL-Nepal are forested. Croplands represent a significant land use feature in KL-Nepal (26%) and KL-India (18%), indicating higher levels of population pressure or intensive agriculture in these countries. Extensively built up areas in the landscape occur in the southern lowland belt and correspond to the larger cities of Alipurduar, Dhupguri, Jalpaiguri, Malbazar and Siliguri of KL-India, Samtse in Bhutan, and Bhadrapur, Birtamod, Damak, Kakarbhitta and Surung of KL-Nepal.



One of the many ethnic groups occurring in the landscape is the Limbu community

Figure 6: Land use map



Livelihoods and economic activities

Agriculture

Agriculture, particularly subsistence agriculture, is an important livelihood strategy for residents in the KL (Sharma et al., 1992). Major agricultural crops grown in the landscape are rice, millet, maize, wheat, buckwheat and potato. While rice is the major crop grown at lower elevations, at higher elevations potato is the main crop. In KL-Bhutan, the Bhutanese red rice is grown up to an elevation of 3,500 m. Cropping patterns are largely dependent on the elevation and the availability of irrigation facilities. In river valleys at lower elevations, crops are grown during three seasons in a year, while in other parts, they are grown twice a year. At higher elevations, shifting agriculture (also known as slash-and-burn agriculture or rotational agroforestry) is practised particularly on steep slopes and is known as 'khorija' or 'bhasme' in Nepali (Kerkhoff & Sharma, 2006). Maize was the major crop grown on slash-and-burn sites, but it is presently being replaced by the more economically lucrative chiraito (*Swertia chirayita*) (Bhatt, 2007). Organic farming is being promoted in some areas of the landscape with a view to promoting livelihoods while conserving the ecosystems and the services they provide (see Box 3).

Box 3: State Organic Mission, Sikkim

On 15 August 2010, the Government of Sikkim launched State Organic Mission with the objective of making Sikkim a 'fully organic state' by 2015. The Sikkim State Organic Board, constituted in 2003, is leading the mission and has prepared a road map for certification, marketing, human resource development, and sustenance of organic enterprises. The mission is also supported by a 2003 policy ban on chemical fertilizers, insecticides, and pesticides. By converting Sikkim into an 'organic state', the mission aims to promote livelihoods of its residents while conserving the natural environment of the state.

Source: GBPNIHESD (2014)

Of particular significance in the KL is the diversity of 'under-utilized' or 'lesser-known' crops. While these crops are important in determining food security, particularly for poor people and for people who live in high elevations, they also have higher adaptive capacity and are more resilient to pests, diseases and climate change (Subba, 2002). Generations of farmers have used indigenous technologies to develop more than 250 species of such crops which are currently grown in the landscape. In KL-India, farmers currently grow more than 32 landraces of rice, eight landraces of maize and nine landraces of finger millet (Table 7).

Table 7: **On-farm crop diversity in traditional farming systems in KL-India**

Crop	Local name	Landraces in current use
Rice <i>Oryza sativa</i>	<i>dhan</i>	Ghyya, takmaru, phudugey, bachhi, lalbachhi, sanu-bachhi, timmurey, marshi, nangkatwa, krishnabhog, tulashi, bagheytulasi, faramey-tulashi, sikrey, tsungthanegey, kalchanti, mansaro, taprey, nuniya, kataka, dudhkalam, champasari, bangi, jhapaka, phaudel, thulo attey, maili attey, sanu attey, kanchi-attey, kalomarshi, bhotangey, chirankhey
Maize <i>Zea mays</i>	<i>makai</i>	Seti, rato, panheli, kali, pangri, himali, murali, farashi
Finger millet <i>Eleusine species</i>	<i>kodo</i>	Pangdur, mudkey, chamligey, bhadaurey, kattikhey, mangshirey, panchaunley, nangkatwa, tangsere
Buckwheat <i>Fagopyrum species</i>	<i>phaper</i>	Mithey, titey, kere, yapha, tambong
Wheat <i>Triticum aestivum</i>	<i>gahu</i>	Tho, mashi, si, toksongsi
Barley <i>Hordeum vulgare</i>	<i>jau</i>	Jau, uwa, hoski, tingshi
Pulses/beans and legumes	<i>Dal/simi and bori</i>	Dal: pahenli, masyam, rahari, rajma, khesari, gahat, arhar, kauchhey, dudhey matar, hadey matar Simi: gheu, singtamey, sadamey, harey, borungey, montulal, Nepali, hiundey, bakuley Bori: gheu, khostey, soshta, tune, kalo
Chili <i>Capsicum annum</i>	<i>khorsani</i>	Sanhili, akabarey, dalley, lamchey, bhindey, dhindey, jirey
Citrus <i>Citrus species</i>	<i>Suntala/jamir/kagatey</i>	Suntala, kagati, nimbu, nibuwa, bimirow, bhogatey, sunkhotro, phoksey, kali jyamir, jyamir, kamal, naietey jyamir, chaksi, muntala

Source: GBPNIHESD (2014)

Cash crops

Cash crops are an important source of income in the KL. Some of the major cash crops in the region include large cardamom (*Amomum subulatum*), tea (*Camellia sinensis*), ginger (*Zingiber officinale*), broom grass (*Thysanolaena maxima*), and mandarin orange (*Citrus reticulata*). Cardamom is a high-value low-volume crop grown across the landscape, from eastern Nepal, Sikkim and Darjeeling of India to western Bhutan. It has contributed significantly to the socioeconomic development of the landscape (Sharma et al., 2000). Many traditional rice terraces have been converted into cardamom plantations, and the geographical coverage of cardamom has expanded (Sharma et al., 2009b; Partap et al., 2014). The region is also a major supplier of cardamom that reaches the global spice market (Sharma et al., 2000). Moreover, the shade trees grown in these plantations have improved the availability of fuelwood in these areas.



Large cardamom is an important cash crop grown in the Kangchenjunga Landscape

Tea is one of the most popular, cheap and second most consumed beverages in the world. Global tea production has exceeded 4 million tonnes and the trend is continuously increasing with an annual growth rate of 1.9% for black tea and 3.8% for green tea. Tea production is projected to reach 3.14 million tonnes for black tea and 1.57 million tonnes for green tea by 2017 (Hajra & Yang, 2015). Globally, the brand 'Darjeeling Tea' is a synonym for high quality tea, while Ilam Tea and Sikkim Tea are also making their impact in the global tea industry. It is estimated that the tea industry in Darjeeling alone employs almost 250,000 people in the landscape. Ginger, mandarin orange and broom grass are other major crops grown and marketed in the region, apart from cinchona, turmeric, areca nuts, and fruits including apple, pineapple and guava.



Argeli (*Edgeworthia gardneri*) is a non-timber forest product that is used to produce hand-made paper

Non-timber forest products and medicinal and aromatic plants

The KL is well known for NTFPs and medicinal and aromatic plants (MAPs), especially the high altitude areas of Singhalila range, north and west Sikkim and western Bhutan. A total of 739 species of NTFPs used by the local people of the KL are reported in the reviewed literature (Upreti et al., 2016). Of these, the highest number of NTFPs is documented from India (377 species), followed by Nepal (363) and Bhutan (245). Although the reported species are used for 24 different purposes, medicinal and edible plants are the most frequently used NTFP categories in the landscape. Medicinal plants are used in 27 major

ailment categories, with the highest number of species being used for gastro-intestinal disorders. Although the KL harbors many potential NTFPs, trade of NTFPs is nominal, indicating lack of commercialization due to limited market information. Unsustainable harvesting and lack of marketing are the major constraints for sustainable management of NTFPs in the landscape despite promising policy provisions.

Animal husbandry

Animal husbandry is an integral part of farming systems in the KL. Livestock provide dairy products, meat, draft power, and farmyard manure. Common types of livestock in lower and midhill elevations are cows, buffaloes, mules, horses, goats, sheep, pigs and fowl, while yaks and their crossbreeds play a significant role in the livelihoods of higher elevation communities. Milk production has become one of the major economic activities in the KL and subsequently a number of dairy cooperatives have also been established. In KL-India, fish rearing is a prominent practice among the Bengali people whose staple diet includes fish. Also of particular significance is the *Nublang* cattle breed, which is indigenous to the Haa Sangbeykha region of KL-Bhutan (Box 4).

Box 4: *Nublang*: indigenous cattle breed of KL-Bhutan

Nublang is the native cattle breed of Bhutan with its origins in Haa Sangbeykha of KL-Bhutan. The word *Nub* means west and *Lang* is a general term for male cattle. The female counterpart of the breed is called *Thrabum*.

The *Nublang* is linked with the legendary lake – *Nub Tshonapata* – located on the western mountain ranges of Haa above Nakha village in Sangbeykha Geog. Legend has it that a cow herder generously provided food and night shelter to a troubled *Tshomen* (mermaid or water spirit) of *Nub Tshonapata*. In gratitude, the *Tshomen* promised that he would be rewarded for his generosity with a bull. A few days later, as promised, the cow herder saw a weak bull heading towards his herd. The herder took good care of the bull, which produced many offspring. Soon the *Nublang* breed became popular and widespread in the region, and Sangbeykha Geog was renowned for the best *Nublang* breed in the Kingdom of Bhutan.

The *Nublang* is adapted to a wide range of agro-climatic conditions (between 250 m and 2800 m). It is disease resistant, has good foraging abilities, and survives under adverse nutritional conditions. The average daily milk yield of a *Nublang* cow is 3.5 liters from forest grazing alone without any concentrate feed. These qualities make the *Nublang* the most suitable animal for the extensive to semi-extensive cattle production system in Bhutan. It is also the main base population for cross breeding with exotic cattle breeds such as Jersey and Brown Swiss.

Currently, the *Nublang* has come under intense threat of dilution from hybridization with *Mithun* and other introduced cattle breeds. A recent survey in Haa Sangbeykha recorded an alarmingly low number of *Nublans* – only 697 – in its place of origin. Conserving the *Nublang* is therefore critical for safeguarding an important indigenous bioresource, which in turn may affect the livelihoods of local communities.

Source: SA PLPP (2009)

While stall-feeding is a common practice among communities at lower elevations, higher elevation communities practice transhumance, where they move with their livestock to higher pastures in the summer and lower valleys in the winter. For example, the pastoral community of KL-Bhutan's Haa region has three distinct types of large ruminant production systems: *lanor* (transhumant yak system in alpine and temperate region); *thanor* (migratory cattle in temperate and subtropical regions); and *yuelnor* (sedentary livestock rearing system in rural and semi-urban settlements). The yak herding communities of Haa practice transhumant migration between their summer pastures in alpine regions and winter pastures in temperate regions, some of which fall under the jurisdiction of other *dzongkhags* such as Paro and Samtse. Yaks usually graze inside Jigme Khelsor Strict Nature Reserve, while *thanor* graze in the Reserve only during summer months. *Yuelnor* graze year round in the Reserve's buffer zone. The high altitude rangelands in the Reserve are communally owned by Bji, Eusu and Katsho gewogs and managed through their customary rules and regulations.

In KL-Nepal, transhumance is mainly practised in the high altitude areas of Ilam District bordering India; Memeng, Chyangthapu and Phalaicha VDC of Panchthar District; and all northern VDCs of Taplejung District. The typical migration cycle begins from subtropical grazing areas in mid-March and reaches temperate pastures by mid-May. *Pahadi* (temperate) livestock remain in these pastures until the end of September, while *lekhali* (subalpine) livestock are moved to higher pastures by the beginning of October when both types of livestock are brought down to lower pastures. However, with the establishment of protected areas in the transborder areas of KL-Nepal and KL-India, livestock herders from both countries are facing problems in moving their herds within traditional grazing sites (Chaudhary et al., 2015).

Trade

Trade, particularly cross-border trade, is an age-old practice among communities in the KL. In the past, highland communities would barter milk products, medicinal plants, and salt (brought from Tibet) with grains and sugar from lowland communities. Today people trade food items, wool, clothes, livestock, medicinal plants/NTFPs, and wildlife products on different scales. For example, in KL-Nepal, trade occurs both within the country and through cross-border routes (Figure 7).

Both legal and illegal forms of trade take place in the landscape. The metropolis of Siliguri in Jalpaiguri District, West Bengal of KL-India, is a major trade hub for both legally and illegally traded items. Illegally traded items generally include non-timber forest products, medicinal and aromatic plants, and wild animals and/or their parts (Paudel, 2010). Some illegally traded wildlife parts seized from KL-Nepal were butterflies, rhino beetles, pangolin scales, and tiger skin (NCDC, 2010).

Local bazar markets, also known as *haats*, are a common feature in the KL. These are conducted on a weekly or fortnightly basis, and they offer local farmers an opportunity to showcase their agricultural products while earning income through their sales. Products on sale include fresh produce, cereals, as well as handicrafts.

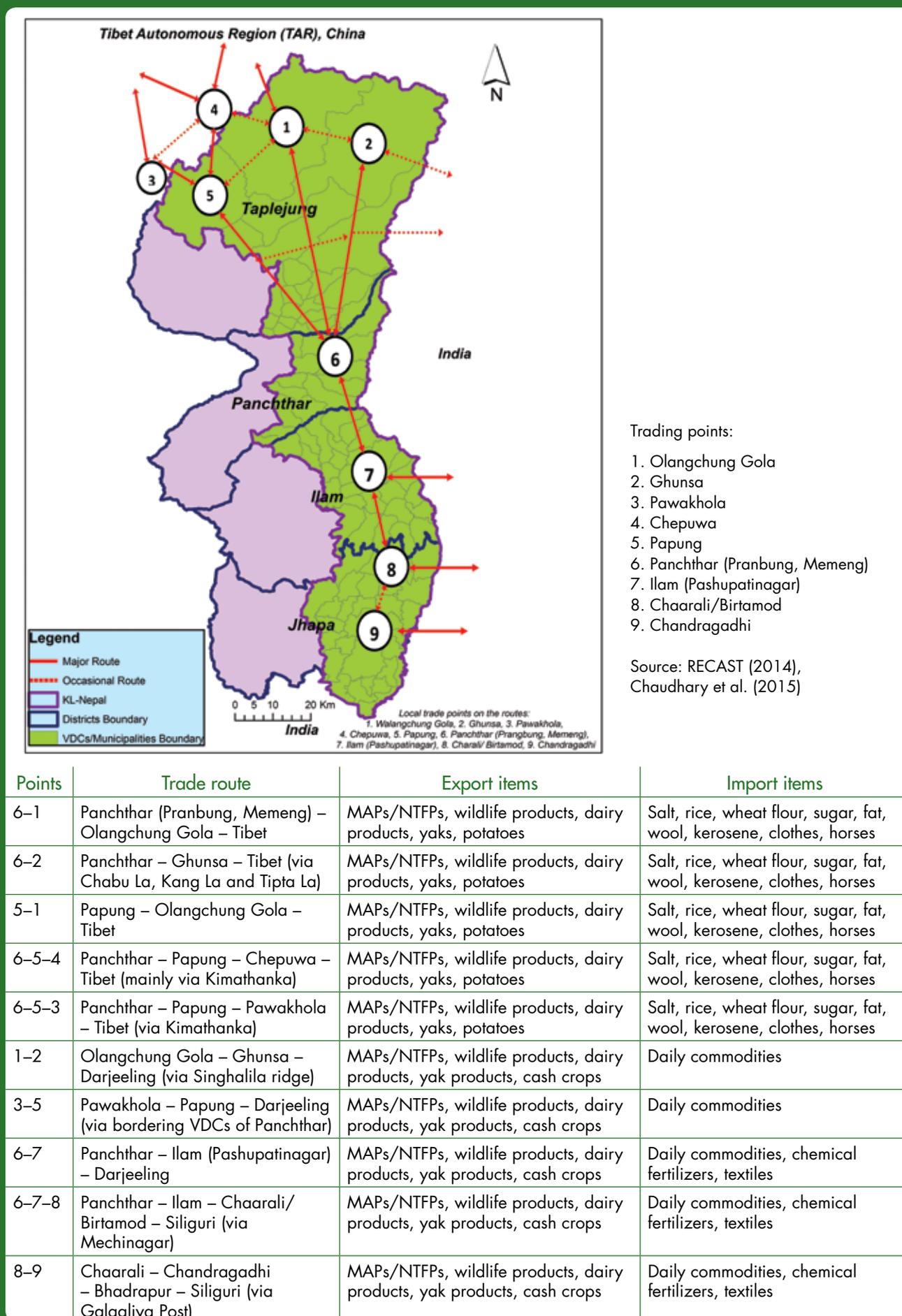


Local markets provide opportunities for sale of agricultural and dairy products

Tourism

Tourism is an important economic activity in the KL. It provides livelihood opportunities for a large number of people (Rai & Sundriyal, 1997; Maharana, 2000; Maharana et al., 2000) both locally, as well as nationally and internationally. Various tourism products are available in the landscape: nature tourism, trekking, eco-tourism, wilderness tourism, village/rural homestay, adventure travel, pilgrimage, culture and heritage, tea tourism, and flori-tourism, among others. In addition to Mt Kangchenjunga and other high mountain peaks, there are many other tourism destinations in the landscape:

Figure 7: Major trade routes in KL-Nepal



KL-Bhutan: Haa valley, Jigme Khesar Strict Nature Reserve.

KL-India: Darjeeling Himalayan Railway (a World Heritage Site); Tiger Hill in Darjeeling; tea estates of Darjeeling and Sikkim; the Dooars and wildlife tourism in the lowland protected areas of Jalpaiguri District; sacred sites in Darjeeling and Sikkim; Darjeeling Zoological and Botanical Park; Mirik Lake; Himalayan Mountaineering Institute in Darjeeling; Khangchendzonga National Park in Sikkim.

KL-Nepal: Temples and historical artifacts in Jhapa District; tea gardens and Mai Pokhari in Ilam District; Pathibhara temple in Taplejung District.

In 2012, the recorded number of domestic and foreign tourists who visited the KL was more than 550,000. Approximately 3,000 foreign tourists visited Haa Dzongkhag in KL-Bhutan (TCB, 2013), more than 585,027 tourists (including 4.5% of foreign tourists) visited Sikkim in KL-India (Gol, 2013), and 635 foreign tourists trekked in Kangchenjunga Conservation Area of KL-Nepal (GoN, 2013).

In 1899 the concept of transboundary tourism was first put into practice in the KL by a mountaineering expedition team led by the explorer and mountaineer Douglas Freshfield (Freshfield, 1903; Lhatoo, 1994). Freshfield's team began their journey in Darjeeling, passing through the Teesta valley by way of Gangtok, Chungtang and Lachen, and headed north to Zemu Glacier. They then travelled through the Lhonak valley and crossed into Nepal through the Jongsong La (6,145 m). In Nepal, they descended by the Kangchenjunga Glacier to the village of Ghunsa (3,414m) and explored the western face of the Kangchenjunga massif, before returning to Sikkim via the Khang La (5,034 m) and travelling back to Darjeeling.

Today, the most popular transboundary tourism destination in the landscape is the Singhalila region, which hosts more than 8,000 tourists annually (Pradhan et al., 2014). The Singhalila ridge geopolitically divides the countries of India and Nepal, and one of the most popular transboundary trekking routes is from Manebhanjyang (KL-Nepal) to Sandakphu (KL Nepal and India), Phalut (KL-India) and Rimbick (KL-India). This route passes through the natural habitat of the red panda in the landscape.



The picturesque Haa valley is one of several tourism destinations in Bhutan

Migration and remittance

One of the major livelihood strategies, particularly in KL-Nepal, is migration for employment. During the past decade, many youth in KL-Nepal have migrated to foreign countries for employment. The Census of 2011 showed that 129,746 women and men were absent from the four KL-Nepal districts, and youth migrating for foreign employment constitute a large portion of this absent population. Remittances from foreign employment are an important feature of the rural economy. There is also internal migration from remote areas of the districts to urban and semi-urban centres for better livelihood opportunities.

Other economic activities

The residents of the KL are engaged in a range of other economic activities including textile production, especially traditional textiles; handicraft making – carpet weaving, bamboo weaving, wood working; production of lokta paper; knitting – woolen products including shawls, bags, clothes; and food processing and packaging – pickles, jams, dried foods, among others. Some of the renowned products from the KL include the 'Tibetan' carpets produced in KL-India (Darjeeling and Sikkim) and KL-Nepal (Taplejung), traditional *dhaka* textiles of KL-Nepal (Panchthar and Taplejung), and bamboo products from KL-Bhutan.



Locally grown flowers for sale in Sikkim

Floriculture is another growing economic activity in the landscape, particularly in KL-India. Economically significant floral species include *Gladiolus*, *Anthurium*, *Lillium*, *Primula*, *Rhododendron* and orchids. Sikkim’s Department of Horticulture is making a concerted effort to turn the floriculture sector into an export-oriented industry.

Livelihoods-related local institutions

There are several institutions that contribute towards the livelihoods of women and men in the KL. Traditional community institutions include the *kiduk* of Olangchung Gola in KL-Nepal, community forest user groups, and mother groups in KL-Nepal.

Cooperatives are also important in the landscape, particularly as they provide their members loans at low interest rates and without collateral. Among the many types of cooperatives operating in the landscape are agriculture, beekeeping, coffee, communications, consumers, dairy, electricity, fruits and vegetables, herbal, multi-purpose, savings and credit, and tea cooperatives.

Poverty in the KL

The World Bank (2000) defines poverty as ‘pronounced deprivation in well-being’. Poverty can be categorized as ‘relative poverty’, i.e., having fewer goods than others within a society, or ‘absolute poverty’, i.e., being unable to afford the basic human needs like nutrition, education and medical services. Using the concept of absolute poverty, between one-fifth to half of the population in the KL live below the poverty line (Hunzai et al., 2011). Within the landscape, poverty incidence is highest in the Himalayan region of West Bengal in KL-India and in the eastern hills of KL-Nepal (Table 8). Determinants of poverty in the KL include limited assets and liabilities (small landholdings, high land fragmentation, small livestock numbers), household composition (high dependency rate, female headed households), and social status (ethnic groups/socially marginalized groups, literacy levels of household members, literacy level of household head, among others).

Table 8: Population living below poverty line

Country	Region	% of population
KL-Bhutan	Western Bhutan	17
KL-India	Himalayan West Bengal	56
	Sikkim	22
KL-Nepal	Eastern mountains	25
	Eastern hills	50

Source: Hunzai et al. (2011)

Ecological Features

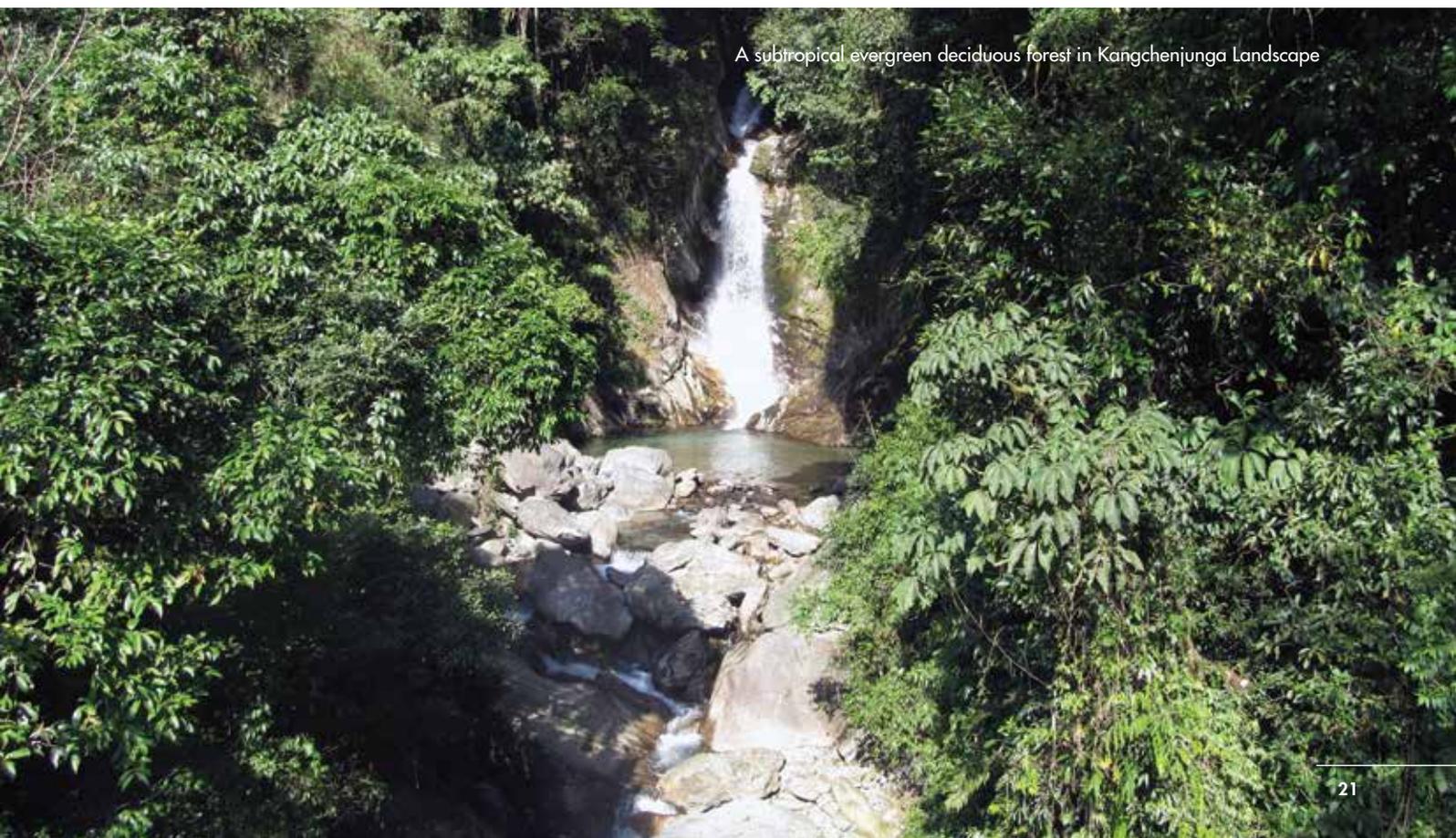
Ecosystems and vegetation

Forest ecosystems

Forests occupy 44.7% of the total area in the KL (Figure 6). They occupy 69.5% in KL-Bhutan, 41.0% in KL-India and 26.4% in KL-Nepal. A variety of forest types occur in the landscape ranging from tropical to subalpine forests (Table 9). These forests are characterized by both the Indo-Malayan Realm of Southeast Asia (e.g., *Dipterocarpus*, *Shorea* and *Terminalia* tree species), as well as the Palearctic Realm of Eurasia (e.g., conifers such as spruce, fir and larch, and deciduous broadleaf trees such as birch, alder and willow) (CEPF, 2005).

Table 9: Forest types

Altitudinal zone	Forest type	Characteristic species
Tropical (below 1,000 m)	<ul style="list-style-type: none"> • Tropical riverine evergreen/deciduous forest • Tropical moist evergreen/deciduous forest • Tropical moist mixed forest • Tropical dry evergreen/deciduous forest 	<i>Shorea robusta</i> , <i>Lagerstroemia parviflora</i> , <i>Bombax ceiba</i> , <i>Cycas pectinata</i> , <i>Dillenia pentagyna</i>
Subtropical (1,000–2,000 m)	<ul style="list-style-type: none"> • Subtropical riverine evergreen/deciduous forest • Subtropical moist evergreen/deciduous forest • Subtropical moist mixed forest • Subtropical dry evergreen/deciduous forest 	<i>Schima wallichii</i> , <i>Castanopsis tribuloides</i> , <i>Macaranga pustulata</i> , <i>Machillus odoratissima</i>
Warm temperate (2,000–2,500 m)	<ul style="list-style-type: none"> • Warm temperate riverine evergreen/deciduous forest • Warm temperate moist evergreen/deciduous forest • Warm temperate moist mixed forest • Warm temperate dry evergreen/deciduous forest 	<i>Castanopsis tribuloides</i> , <i>Ilex dipyrrena</i> , <i>Quercus lamellosa</i> , <i>Quercus semecarpifolia</i> , <i>Lithocarpus pachyphylla</i>
Cool temperate (2,500–3,000 m)	<ul style="list-style-type: none"> • Cool temperate riverine deciduous forest • Cool temperate moist evergreen forest • Cool temperate moist mixed forest • Cool temperate dry evergreen forest 	<i>Abies spectabilis</i> , <i>Betula utilis</i> , <i>Rhododendron arboreum</i> , <i>Acer</i> sp.
Subalpine (3,000–4,000 m)	<ul style="list-style-type: none"> • Subalpine riverine evergreen forest • Subalpine deciduous forest • Subalpine moist evergreen forest • Subalpine moist deciduous forest • Subalpine dry evergreen forest 	<i>Abies spectabilis</i> , <i>Tsuga dumosa</i> , <i>Betula utilis</i> , <i>Acer</i> sp., <i>Larix griffithiana</i> , <i>Rhododendron barbatum</i> , <i>Juniperus indica</i>



A subtropical evergreen deciduous forest in Kangchenjunga Landscape

Rangelands

Rangelands in the KL occupy 19.7% of the total area. They occupy 20.2% in KL-Bhutan, 18.0% in KL-India and 23.9% in KL-Nepal. The meadows that characterize the KL rangelands have been traditionally used by both wild and domestic herbivores (Tambe, 2007), and they are highly important areas in terms of transboundary conservation (Pei & Sharma, 1998; HMGN/MFSC, 2002; Biswas & Mathur, 2003). These rangelands can be classified as: i) subtropical rangelands located between 1,500 and 2,000 m; ii) temperate pasturelands (Nepali: *lekali kharka*) between 2,000–3,500 m; and iii) alpine/subalpine pasturelands (Nepali: *himali kharka*) that occur up to 4,500 m–5,000 m in some places (Oli, 2003). The high altitude pastures are used mainly for summer grazing, the temperate rangelands are used by both transhumant herders and by stall feeders, and the subtropical rangelands are used extensively in the winter months (Singh & Sundriyal, 2005). The temperate rangelands are heavily grazed throughout the year and are particularly exposed to habitat degradation due to invasion by unpalatable species (Oli, 2003; Gurung, 2006).

Rangelands in the KL are also important because they are rich in MAPs (Tambe & Rawat, 2009; Chettri & Sharma, 2011). High-value medicinal plants such as *Dactylorhiza hatagirea*, *Neopicrorhiza scrophulariiflora*, *Nardostachys grandiflora* and *Aconitum palmatum* are found in the KL rangelands. While some MAP species are traded in large quantities, others are used at the household level (Chettri & Sharma, 2011).



Temperate pasturelands used for yak grazing in the Singhalila range of Nepal

Aquatic ecosystems

Aquatic ecosystems in the KL include only freshwater ecosystems. Freshwater ecosystems occupy 0.35% of the total area of the landscape. It occupies 0.5% in KL-Bhutan, 0.2% in KL-India, and 0.6% in KL-Nepal. This ecosystem includes pools, ponds, lakes, streams, rivers and wetlands. The major rivers in the landscape include the Toorsa (Amo Chu) and Raidak (Wang Chu) in KL-Bhutan, Teesta and Rangit in KL-India, and Tamur and Kankai-Mai in KL-Nepal (Table 10 and Figure 2).

Wetlands in the landscape are significant for both ecological and sociocultural reasons (Table 11) (Jain, 2000). Many wetlands are habitats for endemic and threatened species of flora and fauna. They are also sacred sites where pilgrims of various religions visit every year (Maharana, 2000). Mai Pokhari in Ilam, KL-Nepal, the only Ramsar site in the KL, is a wetland of international significance. It was designated as a Ramsar site (No. 1850) in 2008. Wetlands in the landscape are particularly vulnerable to ecosystem disturbances, including invasion by exotic species of plants (e.g., *Cryptomeria japonica* in Mai Pokhari, Nepal) and fishes, decrease in water level as a result of changes in land use patterns, pollution, and unsustainable management.

Table 10: Major rivers

River	Country	Characteristics
Toorsa (Amo Chu)	Bhutan	Originates from Tibet and flows to Bhutan. Important tourism destination.
Raidak (Wang Chu)	Bhutan	Tributary of the Brahmaputra River that flows through Bhutan, India and Bangladesh. Supports hydropower project (Chukha Hydel Plant).
Teesta	India	Largest and longest river in KL-India. Emanates from the Teesta Khangse Glacier. Flows from Sikkim to Jalpaiguri.
Rangit	India	Originates from Rathong Glacier. Receives many tributaries on its way to Teesta including Rimbi, Kalej, Rishi, Rothak Rammam and Manpur Khola.
Tamur	Nepal	Major river flowing through KL-Nepal. Originating from Kangchenjunga Glacier.
Kankai Mai	Nepal	Major river originating from Sandakphu flowing through Ilam and Jhapa Districts. Rain-fed river.

Table 11: Important wetlands

Wetland	Area (ha)	Altitude (m)	Country	Significance
Nub Tshonapatra	28	4,073	Bhutan	One of the most revered and renowned lakes in Bhutan. High cultural value for Buddhists. Proposed Ramsar Site.
Jigmi Langtsho	82.15	3,897	Bhutan (Paro)	Rich biodiversity and strong sociocultural value. Important tourist destination. Proposed Ramsar Site.
Teesta Water Reservoir	700		India (NB*)	Adjacent to Mahananda Wildlife Sanctuary. Habitat for endangered and migratory avifauna.
Fulbari Barrage	500		India (NB)	Habitat for migratory birds.
Narthali Wetland	5		India (NB)	Remnant of the Rydak River. Important habitat for water birds and aquatic fauna. Habitat for winter migratory birds.
Gurudongmar Lake	40	5,210	India (Sikkim)	One of the highest lakes in the world. Sacred lake for Buddhists and Sikhs.
Chholhamu Lake		5,300	India (Sikkim)	Highest lake in India. Source of water for the River Teesta.
Tsomgu (Changu) Lake	22	3,780	India (Sikkim)	Important tourist destination. Sociocultural value.
Khecheopalri	3.79	1,700	India (Sikkim)	Resting place for trans-Himalayan migratory birds. Sacred lake for Buddhists and Hindus.
Singjema Lake	25.23	4,671	Nepal	Habitat for three endemic plant species: <i>Aconitum staintonii</i> , <i>Cotoneaster staintonii</i> , <i>Cremathodium nepalense</i> . Sacred lake for Buddhists.
Timbung Pokhari	-	4,343	Nepal	Sacred lake for Buddhists, Hindus, and Kirantis.
Mai Pokhari	12	2,100	Nepal	Ramsar Site (No. 1850) declared 28 Oct 2008. Cloud forest ecosystem of Himalayan oak-laurel association. Sacred lake for Buddhists and Hindus.

* NB: North Bengal

Agroecosystem

The varied agro-climatic conditions in the KL sustain a huge diversity of crops along various altitudinal gradients (Sharma et al., 1992). The agricultural ecosystem occupies 16.7% in the KL (Figure 2). In KL-Bhutan, agro-ecosystem covers 5.5% of its total area, in KL-India 18.1% and in KL-Nepal 25.9%. Most of the agricultural activities in the KL are subsistence with an integration of crops, forests and livestock.

Urban ecosystem

The urban ecosystem occupies 0.28% of the total KL area (Figure 2). This ecosystem is highest in KL-India with 0.36% of its total area, followed by KL-Nepal (0.27%) and KL-Bhutan (0.07%). Except for a few large towns in the midhill areas of the landscape, most of the urban areas occur in the lowlands of KL-India and KL-Nepal (Table 12).

Farming is generally practiced at subsistence level in the landscape



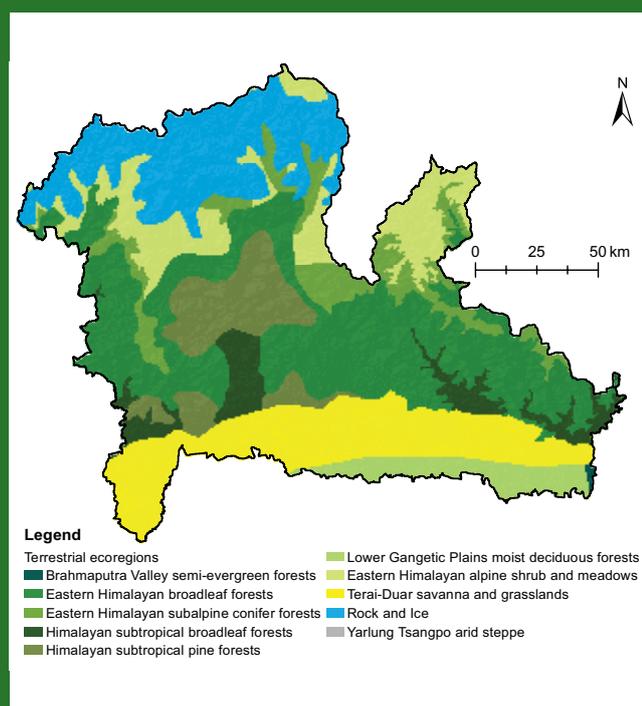
Ecoregions in the Kangchenjunga Landscape

The Eastern Himalayas contains a total of 25 terrestrial ecoregions (Olson et al., 2001). Lying at the intersection of several major floristic regions, the KL hosts nine highly diverse ecoregions. These ecoregions are globally significant because of their high conservation values (Figure 8). Among these, the Eastern Himalayan broadleaf forests is the dominant ecoregion occupying almost 31% of the landscape, followed by Terai-Duar savanna and grasslands (16%) and Eastern Himalayan alpine shrub and meadows (11%). Other less dominant ecoregions in the landscape include Himalayan subtropical pine forests (9%), Eastern Himalayan subalpine conifer forests (8%), Himalayan subtropical broadleaf forests (6%), and Lower Gangetic Plains moist deciduous forests (5%). The Brahmaputra Valley semi-evergreen forests and the Yarlung Tsangpo arid steppe occupy a negligible portion of the landscape at 0.13% and 0.01%, respectively.

Table 12: Major urban areas

Country	District	Major urban areas (cities/towns)
KL-Bhutan	Samtse	Samtse
	Chukha	Phuntsholing
	Paro	Paro
	Dagana	Daga Dzong
	Haa	Haa
KL-India	Sikkim (State)	Gangtok, Namchi, Gezing, Mangan
	Darjeeling	Darjeeling, Siliguri, Kalimpong, Kurseong, Mirik
	Jalpaiguri	Jalpaiguri, Alipurduar, Dhupguri, Malbazar
KL-Nepal	Taplejung	Phungling
	Panchthar	Phidim
	Ilam	Ilam, Fikkal, Pashupatinagar
	Jhapa	Bhadrapur, Birtamod, Kakarbhitta, Damak, Surung

Figure 8: Terrestrial ecoregions



Terrestrial Ecoregion	Area	
	sq.km	%
Eastern Himalayan broadleaf forests	7,662.8	30.55
Terai-Duar savanna and grasslands	3,984.3	15.88
Eastern Himalayan alpine shrub and meadows	2,698.5	10.76
Himalayan subtropical pine forests	2,152.0	8.58
Eastern Himalayan subalpine conifer forests	2,042.6	8.14
Himalayan subtropical broadleaf forests	1,474.1	5.88
Lower Gangetic Plains moist deciduous forests	1,134.8	4.52
Brahmaputra Valley semi-evergreen forests	33.2	0.13
Yarlung Tsangpo arid steppe	1.5	0.01
Rock and Ice	3,902.0	15.55
Total	25,085.8	100

Ecosystem services

The KL not only serves as habitat for globally significant biodiversity, but also provides numerous ecosystem services to communities within and beyond the landscape (Sundriyal et al., 1994; Sundriyal & Sharma, 1996; Chettri et al., 2002, Pant et al., 2012; Parker & Thapa, 2012; Chaudhary et al., 2015). The various types of ecosystem services the KL provides include 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 (Rai & Sundriyal, 1997; Maharana et al., 2000; Chettri & Sharma, 2006; Sandhu & Sandhu, 2014).

An assessment of the economic benefits generated by selective forest ecosystem services in three districts (Ilam, Panchthar and Taplejung) of KL-Nepal amounted to around NPR 8.9 billion per year (Pant et al., 2012). Of this total

amount, almost 80% of the benefits were derived from provisioning services, while the remaining proportion was from regulating and supporting services. Carbon sequestration services (i.e., regulating services) accounted for almost 18% of the total value of the ecosystem services. Most of the reported studies are focused on the provisioning services such as timber and wood, biomass for animal husbandry, NTFPs, wild edibles, and medicinal plants (Sundriyal et al., 1994; Sundriyal & Sharma, 1996; Rai & Sundriyal, 1997; Chettri et al., 2002; Chettri & Sharma, 2006; Parker & Thapa, 2012; Ranjitkar et al., 2014; Sandhu & Sandhu, 2014; Uprety et al., 2016). In one of the studies in Buxa Tiger Reserve of KL-India, around 87 plant species were reported to be NTFPs, among which 60 species were used for commercial purposes and another 27 for subsistence. Of the commercially harvested NTFP species, 35 species sustained the livelihoods of local communities (Sarkar & Das, 2012). The forest ecosystems of the KL are therefore highly important for the subsistence and well-being of local communities.



There are more than forty species of rhododendrons in the landscape

Biological diversity

Floral diversity

The KL is extremely rich in floral diversity (Carpenter et al., 1994; Basnet, 2003; Singh & Sundriyal, 2005) (Table 13). Owing to both its unique location at the intersection of the Palearctic and Indo-Malayan realms, as well as the presence of diverse ecological habitats such as marshes, riverine habitats, gullies, steep slopes with crevices, and dry alpine grasslands, there is a high diversity of plant species in the landscape (Majumdar et al., 1984; Shrestha & Ghimire, 1996; Maiti & Maiti, 2007). Plants in the KL can be categorized into the following vegetation zones based on the altitudinal range in which they occur: tropical (upto 1,000 m) characterized by semi-deciduous and tropical wet forests comprising *Shorea*, *Terminalia*, *Acacia*, and *Macaranga* species; tropical moist broadleaf (1,000-1,800 m) with various broadleaf species such as *Engelhardia* and *Castanopsis*; lower temperate (1,800-2,800 m) dominated by broadleaf forests of *Castanopsis*, *Quercus*, *Schima*, and *Ilex*; upper temperate (2,800-3,800 m) mostly dominated by *Rhododendron* and *Tsuga*, with *Abies densa* and *Thuja* sp. occurring in some areas; subalpine (3,800-4,500 m) dominated mostly by dwarf conifers, dwarf species of rhododendrons, and many spring flowers such as *Potentilla*, *Primula*, *Ligularia*, *Pedicularis*, *Senecio*, and *Aster*; and alpine desert (4,500-5,500 m) with sparse vegetation but mostly dominated by *Meconopsis*, *Sedum*, *Phlomis*, and *Pedicularis* species (Yonzon et al., 2000).

The first botanical expedition in the region was conducted by Joseph D Hooker in the mid-nineteenth century (Hooker, 1854). Subsequently, additional botanical expeditions (Das, 1986; Carpenter et al., 1994; Bhujel, 1996; Singh & Chouhan, 1998), including field surveys conducted during this feasibility assessment process, have resulted in the enumeration of more than 4,500 species of plants in the KL (GBPNIHESD, 2014; RECAST, 2014; WCD, 2014; Chaudhary et al., 2015). This includes 400+ orchid species, 60+ rhododendron species, 350+ wild edible plants, and hundreds of highly valued medicinal plants. Among this vast floral diversity, a substantial number of plants are endemic to the landscape.

Table 13: Floral diversity

	Number of species				
	Bryophytes	Pteridophytes	Lichens	Gymnosperms	Angiosperms
KL					
KL-Bhutan	Na	NA	NA	11	NA
KL-India	904	451	480	12	4,446
KL-Nepal	292	257	56	15	2,448

NA: data not available

Source: GBPNIHESD (2014), RECAST (2014), WCD (2014), Chaudhary et al., (2015)

Of particular significance in the KL is the occurrence of more than 40 species of rhododendron native to the Eastern Himalaya (Pradhan & Lachungpa, 1990; Tiwari & Chauhan, 2006; Singh et al., 2009). The *Rhododendron* genus has a disproportionate impact on the ecosystem in relation to its biomass and its spatial coverage, and is therefore a good example of a keystone species. Rhododendrons support a variety of ecological communities and species, and are often found in riparian habitats, particularly in alpine meadows. These flowering plants are slow growing, hence it is important to ensure survival of the many species of rhododendron by preventing degradation or damage of the plants and their habitat.

The KL-Nepal harbors almost a third of the total angiosperms found in Nepal. Based on preliminary literature survey, there are 56 species of lichens, 292 species of bryophytes, 257 species of pteridophytes, 15 species of gymnosperms, and 2,448 species of angiosperms in KL-Nepal. A rapid survey of vascular plants in the Kangchenjunga-Singhalila ridge of Ilam and Panchthar Districts bordering India alone revealed 598 species of flowering plants, of which 12 species were reported as being new to Nepal, and two species of *Begonia* (*Begonia dolichoptera* S. Rajbhandary & K.K. Shrestha, and *B. panchtharensis* S. Rajbhandary) were reported as being new to science (Shrestha et al., 2008). This further underscores the importance of the KL in terms of biodiversity. On the other hand, studies on non-vascular plants are very limited.

KL-India has very high floral diversity (Biswas, 1967). In Sikkim of KL-India, flowering plants are represented by about 4,500 species belonging to 1,371 genera of 197 families (Bhutia et al., 2002; Subba, 2002). The state also harbors 11 species of oaks, 9 species of conifers, 9 species of tree ferns, 550 species of orchids, 362 species of ferns and its allies, 484 species of medicinal plants, 20 species of bamboos and 175 species of wild edible plants. Similarly, the Darjeeling hills also have high floral diversity, representing an estimated one-seventh of the flora of India with about 4,000 species of flowering plants under 160 families (Bhujel, 1996).

In KL-Bhutan there are more than 736 plant species. In JKSNR alone, there are 427 species of flora under 115 families, including 137 species of trees, 68 shrub species, 182 herb species, 5 weed species, 10 orchid species, 8 grass species, 6 bamboo species and 10 fern species (Rai et al., 2008). Among these, numerous Schedule I plants protected under the Forest and Nature Conservation Act 1995 were recorded during the field survey for preparing the FAR: *Taxus wallichiana*, *Ophiocordyceps sinensis*, *Gentiana crassuloides*, snow down lily, blue poppy, *Panax pseudoginseng* and the recently included *Rhume nobile*. In addition, two CITES Appendix II species (*Sinopodophyllum hexandrum* and *Nardostachys jatamansi*) and four endemic species of the Bhutan Himalaya were also recorded: *Viola bhutanica*, *Bhutanthera himalayana*, *Meconopsis superba* (white poppy) and *Bryocarpum himalaicum*. Other species of high timber value for construction and firewood, along with many medicinal, ornamental and horticulture value were recorded. Many orchid species such as *Bulbophyllum*, *Gastrochilus*, *Cymbidium*, *Liparis* and *Dendrobium* were recorded on a wide range of different host trees and bamboo thickets. Species richness in KL-Bhutan is likely to increase with a more systematic and detailed inventory.

Faunal diversity

Physiographic variations in the KL from tropical to alpine zones and associated altitudinal gradients combined with climatic conditions have resulted in different forest types and habitats which are home to numerous wildlife species, including many flagship species of global importance (Mallick, 2012). Preliminary assessment of the landscape through literature review (Fry, 1923; Ganguli-Lachungpa, 1993; Mukhopadhyay, 1996; Ganguli-Lachungpa, 1998; Sharma & Lachungpa, 2002; Sivakumar & Prakash, 2004; RGoB, 2014,) and field visits indicate that the KL harbors 169 mammal species and 582 bird species (Table 14). However, the biological components of the landscape have not been sufficiently explored. This estimation would significantly increase with a more systematic biodiversity inventory and scientific research on distribution patterns.

Table 14: **Faunal diversity**

	Number of species				
	Mammals	Birds	Herpetofauna	Fish	Butterflies
KL	169	582	NA	NA	NA
KL-Bhutan	57	315	NA	NA	64
KL-India	145	574	NA	246	NA
KL-Nepal	102	354	98	44	186

NA: data not available

Among mammals, the Bengal tiger (*Panthera tigris*) (Anonymous, 1998; Borthakur et al., 2013), one-horned rhinoceros (*Rhinoceros unicornis*) (Bhattacharya & Pal, 1982) and Asian elephant (*Elephas maximus*) (Barua & Bist, 1995) are flagship species of the lowlands; red panda (*Ailurus fulgens*) (Pradhan et al., 2001; Williams, 2004; Dorji et al., 2011), takin (*Budorcas taxicolor*) and clouded leopard (*Neofelis nebulosa*) of the mid-hills (Sathyakumar et al., 2011; Mallick, 2012), and the snow leopard (*Panthera uncia*) (Khatiwada & Chalise, 2006; Karmacharya et al., 2011), musk deer (*Moschus chrysogaster*), Himalayan black bear (*Ursus thibetanus*), Tibetan antelope (*Pantholops hodgsonii*) and blue sheep (*Pseudois nayaur*) (Bhattacharya et al., 2010; Bajimaya & Paudel, 2011) of the high mountains of the KL. Other important mammals in the landscape include the endangered serow (*Capricornis sumatraensis*), the vulnerable Vespertilionidae bat (*Myotis sicarius*), Assamese macaque (*Macaca assamensis*), stump-tailed macaque (*Macaca arctoides*), wild dog (*Cuon alpinus*), back-striped weasel (*Mustela strigidorsa*) and Irrawaddy squirrel (*Callosciurus pygerythrus*) (Mukherjee et al., 1995; Avasthe & Jha, 1999; Bahuguna & Mallick, 2004).



The KL is home to the endangered red panda

Similarly, the landscape is rich in bird diversity. Birds are one of the well-documented taxa within the KL (Ali, 1989; Allen et al., 1996; Chettri, 2000; Chettri et al., 2005; Sivakumar & Prakash, 2005; Sivakumar et al., 2006; Acharya, 2008; Acharya et al., 2011; Basnet & Badola, 2012). The landscape is a nesting and breeding ground for many threatened species of trans-Himalayan birds such as pheasants, tragopans and hornbills (Ludlow & Kinnear, 1944; Khaling, 1998; Acharya & Vijayan, 2007). The presence of globally threatened bird species such as rufous-necked hornbill (*Aceros nipalensis*) and Sclater's monal (*Lophophorus sclateri*), and the threatened white-bellied heron (*Ardea insignis*), Blyth's tragopan (*Tragopan blythii*), and Ward's trogon (*Harpactes wardi*) that are endemic or near endemic to the region also indicates the conservation significance of the KL.

In addition, the landscape offers suitable habitat for numerous insects (Chandra, 2011), butterflies (Maude, 1949; Haribal, 1992; Chettri, 2000; Das et al., 2012; Roy et al., 2012; Singh, 2012; Ghorai & Sengupta, 2014; Sengupta et al., 2014), fishes (Acharjee & Barat, 2013) and herpetofauna (Chettri, 2010; Chettri et al., 2010). However, these groups are not as extensively studied as mammals and birds. Literature review revealed that documentation of these species is sporadic and mostly concentrated in protected areas within the landscape.

Agrobiodiversity

The KL offers diverse physiographic and varied agro-climatic conditions for sustaining a high diversity of crops. A majority of the population in the KL practise subsistence agriculture as a major livelihood strategy, growing different varieties of crops and rearing livestock for household consumption and to meet household expenses. Crops grown in the landscape vary by elevation gradients. Paddy is the predominant crop grown in the lower elevations, whereas in the higher elevations major crops grown are maize, wheat and potato. Besides these, other cereals grown in the landscape include millet and buckwheat. Vegetables including cauliflower, cabbage, radish, mustard green, tomato, chilli, bean, pea, onion, gourd carrot and cress; pulses including lentil, black gram, pigeon pea, chick pea and soybean; oil seeds including mustard and niger; fruits including mango, banana, peaches, plums, pears, coconut, papaya, and apple are also grown in the landscape (Table 15).

Major cash crops in the landscape are large cardamom (*Amomum subulatum*), tea (*Camellia sinensis*), and ginger (*Zingiber officinale*). Other cash crops include chiraito (*Swertia chirayita*), cinchona (*Cinchona officinalis*), turmeric (*Curcuma longa*), areca nuts (*Areca catechu*), tiger grass (*Thysanolaena maxima*), and different varieties of fruits. Minor crops like barley (*Hordeum vulgare*), foxtail millet (*Setaria italica*), horse gram (*Macrotyloma uniflorum*), and traditional vegetables are declining due to the gradual shift to commercialization of agriculture, change in agricultural practices, and changing food habits, over the years.

Livestock are an integral part of the overall farming system in the KL. Milk, dairy products and meat are important food supplements for households. Besides, skin and wool are occasionally marketable products. Draught animals

Table 15: **Crops grown in the landscape**

Crop group	Crops
Cereals and pseudocereals	Paddy, wheat, maize, barley, naked barley, buckwheat
Millets and minor millets	Finger millet, foxtail millet, sorghum
Pulses	Blackgram, kidney beans, mung beans, lentil, pigeon pea, chickpea, horsegram, soybean
Oilseeds	Rape, mustard, sesame, linseed, niger, groundnut, kalai, soybean
Vegetables	Potato, chili, okra, peas, beans, cowpea, tomato, cucumber, squash, radish, pumpkin, gourd, bitter gourd, cabbage, cauliflower, broccoli, tapioca, sweet potato, fenugreek, coriander, spinach, onion, garlic, etc.
Spices and condiments	Large cardamom, ginger, turmeric
Fruits	Orange, pears, plum, peaches, walnut, areca nut, banana, papaya, mandarin, litchi, jackfruit
Jute	<i>Corchorus capsularis</i> and <i>C. olitorius</i>

such as oxen are important for ploughing the field and for providing manure. In lower elevations of the landscape, major types of livestock raised are cows, buffaloes, goats, sheep, pigs, and poultry, whereas in the higher elevations yaks and their crossbreeds are important livestock.

Threatened species

As a part of the Himalaya Biodiversity Hotspot, the KL hosts a number of threatened floral and faunal species (Table 16). These species face threats to their survival due to numerous factors, including but not limited to habitat loss, poaching, excessive harvesting, and climate change. In the KL, there are at least 44 threatened floral species (Annex 1a), some of which are globally threatened, while many are threatened at the national level. The Himalayan yew, *Taxus wallichiana*, is a globally endangered plant species (Thomas & Farjon, 2011) found in the KL. Its leaves and bark are harvested for their medicinal properties, but they are mostly traded rather than locally processed. The trees are also used as fuelwood. To address the problem of unsustainable extraction of the species, the Government of Nepal has placed the species under the 'Vulnerable' category and provided it legal protection under the Forest Act 1993.

Podophyllum hexandrum, a globally threatened plant, is harvested for its medicinal properties



Table 16: Globally threatened floral and faunal species

Critically endangered	Endangered	Vulnerable	Near threatened
Plants			
	1. <i>Taxus wallichiana</i>	1. <i>Podophyllum hexandrum</i>	1. <i>Abies spectabilis</i> 2. <i>Juglans regia</i>
Mammals			
	1. Asian elephant <i>Elephas maximus</i> 2. Bengal tiger <i>Panthera tigris</i> 3. Snow leopard <i>Panthera uncia</i> 4. Red panda <i>Ailurus fulgens</i> 5. Indian pangolin <i>Manis crassicaudata</i> 6. Alpine musk deer <i>Moschus chrysogaster</i> 7. Black musk deer <i>Moschus fuscus</i> 8. Himalayan musk deer <i>Moschus leucogaster</i> 9. Wild dog/dhole <i>Cuon alpinus</i>	1. Greater one-horned rhino <i>Rhinoceros unicornis</i> 2. Takin <i>Budorcas taxicolor</i> 3. Sambar deer <i>Cervus unicolor</i> 4. Clouded leopard <i>Neofelis nebulosa</i> 5. Smooth-coated otter <i>Lutrogale perspicillata</i> 6. Asian small-clawed otter <i>Aonyx cinerea</i> 7. Himalayan black bear <i>Ursus thibetanus</i> 8. Sloth bear <i>Melursus ursinus</i>	1. Himalayan tahr <i>Hemitragus jemlahicus</i> 2. Himalayan serow <i>Capricornis thar</i> 3. Assamese macaque <i>Macaca assamensis</i>
Birds			
1. Baer's pochard <i>Aythya baeri</i> 2. White rumped vulture <i>Gyps bengalensis</i> 3. Slender billed vulture <i>Gyps tenuirostris</i> 4. Red-headed vulture <i>Sarcogyps calvus</i>		1. Chestnut-breasted partridge <i>Arborophila mandellii</i> 2. Great slaty woodpecker <i>Mulleripicus pulverulentus</i> 3. Rufous-headed hornbill <i>Aceros nipalensis</i> 4. Wood snipe <i>Gallinago nemoricola</i> 5. Pallas's fish eagle <i>Haliaeetus leucoryphus</i> 6. Greater spotted eagle <i>Aquila clanga</i> 7. Imperial eagle <i>Aquila heliaca</i> 8. Lesser adjutant stork <i>Leptoptilos javanicus</i> 9. Black-necked crane <i>Grus nigricollis</i> 10. Beautiful nuthatch <i>Sitta formosa</i>	1. Satyr tragopan <i>Tragopan satyra</i> 2. Ferruginous pochard <i>Aythya nyroca</i> 3. Great hornbill <i>Buceros bicornis</i> 4. Lesser fish-eagle <i>Ichthyophaga humilis</i> 5. Himalayan griffon vulture <i>Gyps himalayensis</i> 6. Oriental darter <i>Anhinga melanogaster</i> 7. Black-headed ibis <i>Threskiornis melanocephalus</i> 8. Black-necked stork <i>Ephippiorhynchus asiaticus</i> 9. Rusty bellied shortwing <i>Brachypteryx hyperythra</i>

Source: GBPNIHESD (2014), RECAST (2014), WCD (2014), Chaudhary et al. (2015)

There are 17 globally threatened mammal species in the KL (Table 16 and Annex 1b). Among these, 14 are included in CITES Appendix I or II, while an additional 14 species are included in CITES Appendix I or II. Endangered mammal species occurring in the KL are the Asian elephant, Bengal tiger, snow leopard, red panda, Indian pangolin (*Manis crassicaudata*), and three species of musk deer – *Moschus chrysogaster*, *M. fuscus* and *M. leucogaster*. Most of these species are also protected under national policies in the three countries of the landscape.

Twenty-six globally significant bird species are found in the KL. Among these, 14 are included in the IUCN Red List and 9 in CITES Appendix I, II or III (Table 16 and Annex 1c). Significantly, four critically endangered bird species occur in the landscape – Baer's pochard (*Aythya baeri*), white-rumped vulture (*Gyps bengalensis*), slender-billed vulture (*Gyps tenuirostris*), and red-headed vulture (*Sarcogyps calvus*).

Invasive species

A number of invasive alien species (IAPs) occur in the KL (Table 17). These plants were either intentionally or accidentally introduced to the region: while some were intentionally introduced for aesthetic or economic reasons, others were accidentally introduced as a result of increasing road connectivity and through food imports. Most of these species occur in the tropical and subtropical vegetation zones (Moktan & Das, 2013). Invasive species are very hardy and generally occupy areas that have been disturbed by clearing for agriculture and forest fires. They also have a negative impact on biodiversity as they dominate and alter the landscape and outcompete the native species (Sapkota, 2007). For instance, exotic weeds like *Ageratina adenophora* (locally known as 'ban mara' or 'forest killer' in Nepali) seriously compete with *Artemisia* spp. and spread into both forest as well as urban areas. Species such as *Ageratina adenophora* and *Lantana camara* are toxic to livestock and inhibit the growth of other plants in their vicinity.

Species of economic significance

In addition to agriculture and animal husbandry, NTFPs and MAPs offer local communities an opportunity for cash income. A variety of NTFPs are harvested by local communities for both household consumption (Sundriyal, 1999; Chettri et al., 2005; Sarkar & Das, 2012), as well as for trade. Major NTFPs harvested in the region are: bamboo (*Dendrocalamus* sp., *Phyllostachys* sp.); tiger grass (*Thysanolaena maxima*); and fibre (bark of *Daphne bholua*; *Edgeworthia gardneri*); foods such as mushrooms (*Agaricus* species), bamboo shoots, other vegetables (fern species including *Diplazium esculentum*, *Nasturtium officinale*, and *Pentapanax leschenaultii*), edible fruits (*Castanopsis indica* and *Symplocos ramosissima*), and honey; and medicinal plants (*Aconitum palmatum*, *Asparagus racemosus*, *Bergenia ciliata*, *Dactylorhiza hatagirea*, *Heracleum nepalense*, *Nardostachys grandiflora*, *Neopicrorhiza scrophulariiflora*, *Swertia chirayita*, *Taxus wallichiana*, *Zanthoxylum armatum*), and several other rare species of medicinal plants from alpine rangelands (Pandit et al., 2004; Koirala, 2008; NCDC, 2010; Pant et al., 2012). Medicinal plants are used both locally in traditional medicinal practices (Siwakoti, 1999; Parajuli, 2013), as well as traded - usually across the border.

The fruit *Choerospondias axillaris* (known as lapsi in Nepali), eaten raw or used for making pickles (Rai & Badola, 2009), are marketed widely in KL-India and KL-Nepal. Amongst the less exploited wild edibles, *Pandanus nepalensis* (tarika) offers high commercial potential for making quality fruit jam/jelly/juices (Badola et al., 2009). *Diplazium esculentum* (lingra/ningru) is one of the popular edible ferns that indigenous peoples harvest and sell in local markets as a vegetable. The bark of *Alnus nepalensis*, *Pinus wallichiana*, and *Rubia manjith* are used to produce dye. Many ornamental species along with beverages like *Thea chinensis* and spices such as *Cinnamomum tamala* are also cultivated as NTFPs (NCDC, 2010).

Table 17: Major alien invasive species

Family	Species	Elevation range (m)
Amaranthaceae	<i>Alternanthera philoxeroides</i>	80–1,350
	<i>Amaranthus spinosus</i>	950
Araceae	<i>Pistia stratiotes</i>	75–600
Asteraceae	<i>Ageratum conyzoides</i>	200–2,000
	<i>Ageratina adenophora</i>	850–2,200
	<i>Chromolaena odorata</i>	950
	<i>Bidens pilosa</i>	100–2,100
	<i>Mikania micrantha</i>	75–1,200
	<i>Parthenium hysterophorus</i>	75–1,350
	<i>Xanthium strumarium</i>	75–2,500
Convolvulaceae	<i>Ipomoea carnea</i>	75–1,350
Fabaceae	<i>Cassia tora</i>	75–1,300
	<i>Mimosa pudica</i>	1,100
	<i>Cassia occidentalis</i>	75–1,400
Oxalidaceae	<i>Oxalis latifolia</i>	600–2,200
Papaveraceae	<i>Argemone maxicana</i>	75–1,400
Poaceae	<i>Leersia hexandra</i>	100–300
Pontederiaceae	<i>Eichhornia crassipes</i>	75–1,500
Verbenaceae	<i>Lantana camara</i>	950–2,000

Source: GBPNIHESD (2014), RECAST (2014)2, WCD (2014)



Tea is an important cash crop grown in the landscape

Thus, harvested and traded NTFPs and MAPs in the landscape generate substantial revenue for both local communities and the government. For instance, in KL-Nepal, 17 species of NTFPs and MAPs were legally traded between 2007 and 2012, generating more than NPR 7.6 million during the five-year period (Table 18). Among these, pine resin was traded in the largest amount (more than 1.2 million kg) from the midhill region of the landscape, while the trade of *Acacia catechu* generated the highest revenue (in excess of NPR 3.8 million). The revenue generated per unit of NTFP/MAPs was also highest for *Acacia catechu* (i.e., NPR 39.33 per kg).

Table 18: Major NTFPs and MAPs traded in KL-Nepal between 2007 and 2012

Species	Local name (Nepali)	Plant part traded	Quantity traded (kg)	Revenue (NPR)	Revenue per kg (NPR)
<i>Pinus species</i>	Resin	-	1,256,334	979,940	0.78
<i>Taxus wallichiana</i>	Lauth salla	Leaves	290,500	944,125	3.25
<i>Acacia catechu</i>	Khayar	Wood	97,785	3,845,688	39.33
<i>Edgeworthia gardneri</i>	Argeli	Bark	97,000	410,900	4.24
<i>Swertia chirayita</i>	Chiraito	Whole plant	88,765	744,597	8.39
<i>Rubia manjith</i>	Majitho	Whole plant	78,800	219,924	2.79
<i>Daphne bhoolua</i>	Lokta	Bark	71,076	194,000	2.73
<i>Usnea species, Parmelia species</i>	Lichen (jhyau)	Whole plant	11,000	165,000	15.00
	Budhani phool	Flower	8,000	16,000	2.00
<i>Lycopodium clavatum</i>	Nagbeliko powder	Whole plant	8,000	16,000	2.00
<i>Mahonia napaulensis</i>	Daruhaldi	Fruits, bark	6,500	13,000	2.00
<i>Berberis wallichiana</i>	Chutro	Bark, roots, fruits	5,000	0	0
<i>Aconitum ferox</i>	Bish jara	Rhizome	4,300	30,100	7.00
<i>Juniperus indica</i>	Dhupi paat	Leaves, twigs	3,800	7,600	2.00
<i>Sapindus mukorossi</i>	Ritha	Fruits	1,600	4,800	3.00
<i>Fritillaria cirrhosa</i>	Ban lasun	Bulb	1,500	15,000	10.00

Source: RECAST (2014)

Special places in the KL

Biodiversity Hotspot

The KL falls within the Himalaya Biodiversity Hotspot which includes all of the world's highest (i.e. greater than 8,000 m) mountains and the world's deepest river gorges (Mittermeier et al., 2004). It extends over 3,000 km across northern Pakistan, Nepal, Bhutan, north-western and north-eastern states of India adjoining Myanmar, and the southwest China border in the east. Flagship species in this Biodiversity Hotspot include tiger, Asian elephant, and greater one-horned rhinoceros in the lowlands, golden langur and red panda in the midhills, and snow leopard in the mountains. Some important bird species are vultures and adjutants (Mittermeier et al., 2004).

Ramsar Site

Mai Pokhari in Ilam District, KL-Nepal, is the only Ramsar Site in the landscape. It was declared a Ramsar Site (No. 1850) during the 10th Conference of Parties to the Ramsar Convention (COP10) at Changwon, the Republic of Korea, on 28 October 2008. Located in Mai Pokhari VDC of Ilam District at an altitude of 2,100 m, it has a catchment area of 12 hectares. Mai Pokhari has nine corners where legend has it that the nine goddesses of the Hindu pantheon resided during its formation. It holds cultural and religious significance for both Buddhists and Hindus. Mai Pokhari is a major habitat for some indigenous fauna such as the tree frog, Himalayan newt (locally known as *thakthake*) and more than 300 species of birds.

Important Bird Areas

There are 22 Important Bird Areas (IBAs) in the KL: 5 in KL-Bhutan, 14 in KL-India (Ganguli-Lachungpa et al., 2007) and 3 in KL-Nepal (Baral and Inskipp, 2005) (Figure 9 and Table 19) (Birdlife International, 2014). These IBAs provide shelter to a number of endemic bird species such as chestnut-breasted partridge (*Arborophila mandelli*), rusty-bellied shortwing (*Brachypteryx hyperythra*) and white-naped yuhina (*Yuhina bakeri*); restricted range species



Mai Pokhari in Ilam District is the only Ramsar Site in the landscape

like Ward's trogon (*Harpactes wardii*), red-breasted hill-partridge (*Arborophila mandellii*) and hoary-throated barwing (*Actinodura nipalensis*). These IBAs are also either permanent or temporary habitats for a number of threatened bird species that include the critically endangered white rumped vulture, slender-billed vulture and Baer's pochard, as well as a number of vulnerable and near threatened species such as black-necked crane (*Grus nigricollis*), lesser kestrel (*Falco naumanni*) and red-headed vulture (*Sarcogyps calvus*).

Important Plant Areas

An Important Plant Area (IPA) is a natural or semi-natural site exhibiting exceptional botanical richness and/or supporting an outstanding assemblage of rare, threatened and/or endemic plant species and/or vegetation of high botanic value (Plantlife International, 2004). Eleven IPAs for medicinal plants have been identified in the KL (Hamilton and Radford, 2007; GWB, 2010) – 2 in KL-Bhutan, 7 in KL-India, and 18 in KL-Nepal. In KL-Bhutan, the IPAs are Chele La (2,500 m–4,000 m) and Toorsa (1,600 m–3,000 m). In KL-India, the IPAs are Dzungri-Phedang-Sandakphu (3,600 m–4,000 m); Lachen and Lachung (2,750 m–3,000 m); North Rajabhatkhawa in Buxa Tiger Reserve, Jalpaiguri; Sursuti in Jalpaiguri; and Dhotrey, North Sevoke and Tonglu in Darjeeling. In KL-Nepal, the IPAs are Yamphudin-Hellok, Gyapla-Ghunsa, Ghunsa-Khangbachan, Sarju Pokhari-Olangchung Gola, Dorangdin-Ramje, and Chairam-Yalung in Taplejung District; Timbung Pokhari, Lam Pokhari-Suke Pokhari-Ose, Bhaise Pokhari, Mejartham-Chiwabhanjyang, and Tinsimana-Gorkhepani-Fokte in Panchthar District; Hangetham, Kala Pokhari, Chintapu, Sandakphu, and Dhupi-Guranse in Ilam District; and Ghorwa-Sanischara, Gauriganj-Kathgara, and Jalthal Forest in Jhapa District.

Protected areas

There are 19 protected areas in the KL (Table 20). These protected areas cover 30% of the total landscape area. All protected areas except two (one in KL-Bhutan and the other in KL-Nepal) occur in KL-India. The largest protected area is the Khangchendzonga Biosphere Reserve (2,620 sq.km) in the state of Sikkim in India, followed by

Figure 9: Location of Important Bird Areas (IBA)

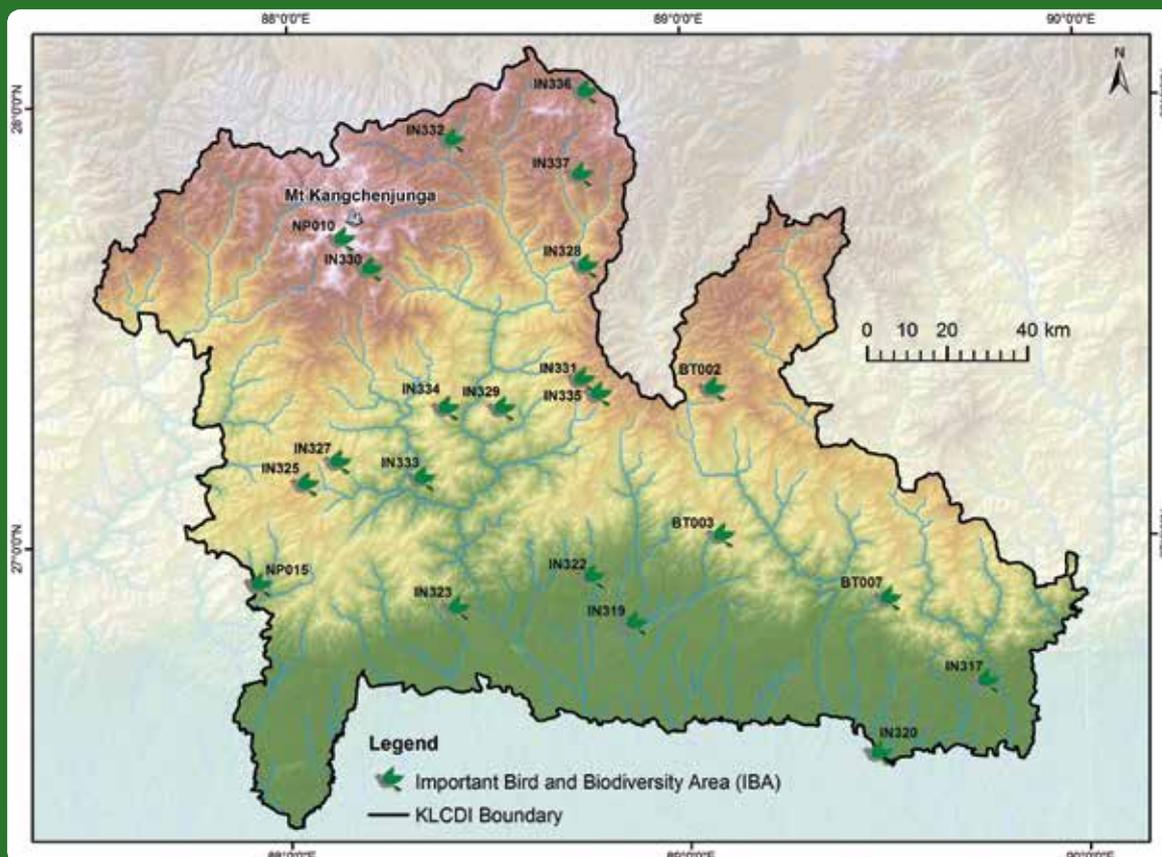


Table 19: Important Bird Areas

IBA*	Country	Protected Area
Jigme Khesar Strict Nature Reserve (BT002) (formerly known as Toorsa Strict Nature Reserve)	Bhutan	√
Samtse (BT003)	Bhutan	-
Chele La (BT004)	Bhutan	-
Paro wetlands (BT005)	Bhutan	-
Kamji (BT007)	Bhutan	-
Lava-Neora Valley National Park (IN322)	India	√
Mahananda Wildlife Sanctuary (IN323)	India	√
Singhalila National Park (IN325)	India	√
Barsey Rhododendron Sanctuary (IN327)	India	√
Dombang Valley-Lachung-Lema-Tsungthang (IN328)	India	-
Fambong Lho Wildlife Sanctuary-Himalayan Zoological Park-Ratey Chu Reserve Forest (IN329)	India	√
Khangchendzonga National Park and Biosphere Reserve (IN330)	India	√
Kyongnosla Alpine Sanctuary-Tsomgo-Tamze-Chola Complex (IN331)	India	√
Lhonak Valley (IN332)	India	-
Lowland forests of South Sikkim (IN333)	India	-
Maenam Wildlife Sanctuary-Tendong Reserve Forest (IN334)	India	√
Pangolakha Wildlife Sanctuary-Zuluk-Bedang Tso-Natula Complex (IN335)	India	√
Tso Lhamo Plateau-Lashar-Sebu La-Yumesandong Complex (IN336)	India	-
Yumthang-Shingba Rhododendron Sanctuary (IN337)	India	√
Kangchenjunga Conservation Area (NP010)	Nepal	√
Mai Valley Forests (NP015)	Nepal	-
Tamur Valley and Watershed (NP026)	Nepal	-

* Numbers indicate IBA code numbers.

Kangchenjunga Conservation Area (2,035 sq km) in Taplejung District, Nepal. All other protected areas are less than 800 sq.km in size. The smallest protected area (0.04 sq.km) is Jore Pokhari Salamander Sanctuary in West Bengal, India.

Conservation corridors

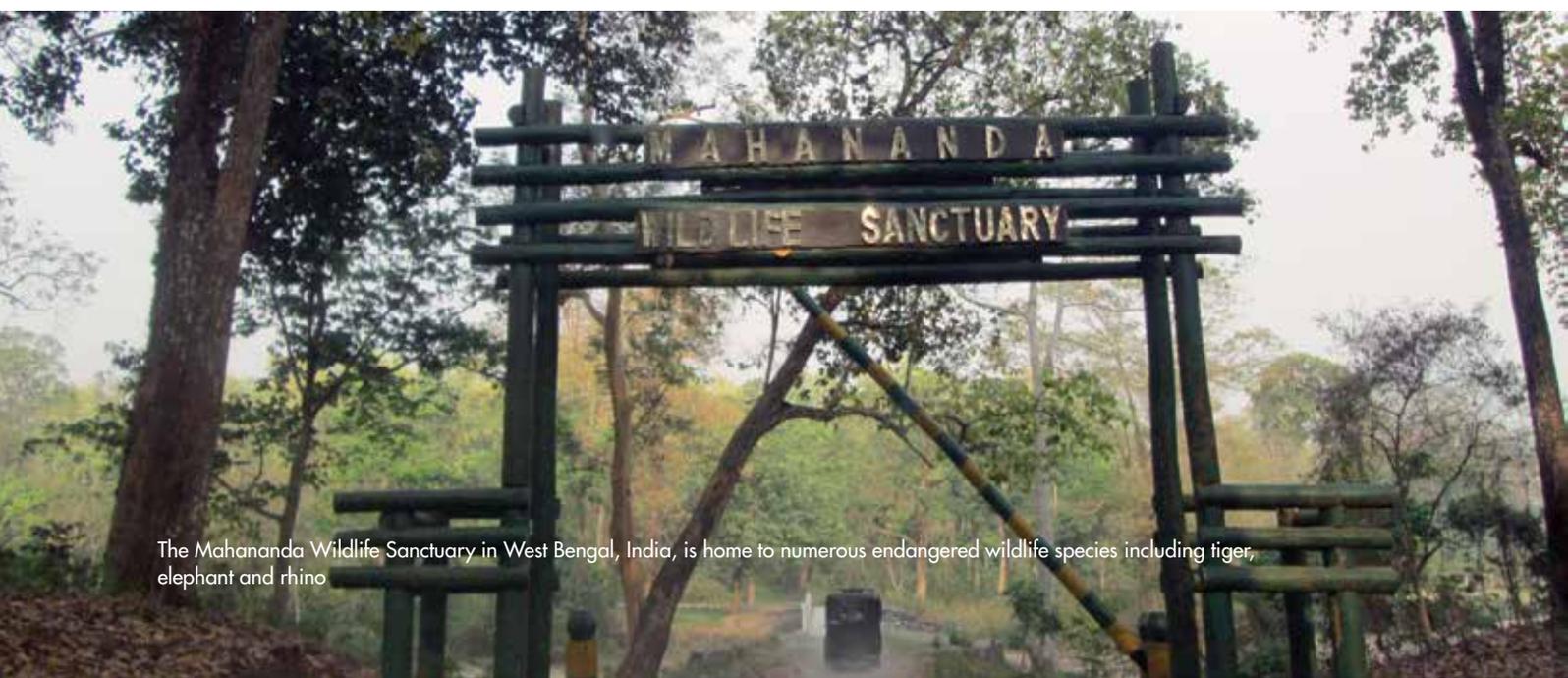
The majority of protected areas in the KL occur as isolated 'conservation islands' that follow a protectionist approach and ignore the human and cultural dimensions embedded in the landscape dynamics (Sharma et al., 2007). They are scattered across various distances in the absence of the natural connectivity needed for species to thrive and sustain themselves. Conservation corridors that can potentially connect these protected areas are ideal for

promoting livelihood activities that do not endanger the rich natural resources contained therein and for providing benefits to both the landscape in general, and local communities in particular.

Out of the existing 19 protected areas in the KL, eight are transboundary in nature: i) Kangchenjunga Conservation Area (Nepal-India); ii) Khangchendzonga Biosphere Reserve (India-Nepal); iii) Barsey Rhododendron Sanctuary (India-Nepal); iv) Singhalila National Park (India-Nepal); v) Pangolakha Wildlife Sanctuary (India-China-Bhutan); vi) Jigme Khesar Strict Nature Reserve (Bhutan-India); vii) Jaldapara National Park (India-Bhutan); and viii) Buxa Tiger Reserve (India-Bhutan). Accordingly, seven potential conservation corridors have been identified in the landscape (Figure 10 and Table 21) to facilitate connectivity of the protected areas. These corridors were identified based on natural wildlife migration routes and area under forest cover while avoiding large settlements and infrastructure. A participatory approach with relevant stakeholders was used to define these corridors. Connecting these areas through conservation corridors would help species to adapt to climate change while also addressing cross-border problems such as poaching, overgrazing, forest fire, and the spread of livestock diseases. Furthermore, it would help local communities to enhance their livelihoods by sustainably utilizing the resources of the corridors (Sherpa et al., 2004; Pant et al., 2012).

Table 20: Protected areas

SN	Protected Area	Area (sq.km)	Country	IUCN Category
1.	Khangchendzonga Biosphere Reserve	2,620	India	-
2.	Kangchenjunga Conservation Area	2,035	Nepal	VI
3.	Buxa Tiger Reserve	760	India	IV
4.	Jigme Khesar Strict Nature Reserve	651	Bhutan	Ia
5.	Jaldapara National Park	216	India	II
6.	Pangolakha Wildlife Sanctuary	128	India	IV
7.	Mahananda Wildlife Sanctuary	127	India	IV
8.	Barsey Rhododendron Sanctuary	104	India	IV
9.	Neora Valley National Park	160	India	II
10.	Gorumara National Park	80	India	II
11.	Singhalila National Park	79	India	II
12.	Fambong Lho Wildlife Sanctuary	52	India	IV
13.	Shingba Rhododendron Sanctuary	43	India	IV
14.	Senchal Wildlife Sanctuary	39	India	IV
15.	Maenam Wildlife Sanctuary	35	India	IV
16.	Kyongnosla Alpine Sanctuary	31	India	IV
17.	Chapramari Wildlife Sanctuary	10	India	IV
18.	Kitam Bird Sanctuary	6	India	-
19.	Jore Pokhari Salamander Sanctuary	0.04	India	-
	Total	7,176		



The Mahananda Wildlife Sanctuary in West Bengal, India, is home to numerous endangered wildlife species including tiger, elephant and rhino

Figure 10: Protected areas and potential conservation corridors

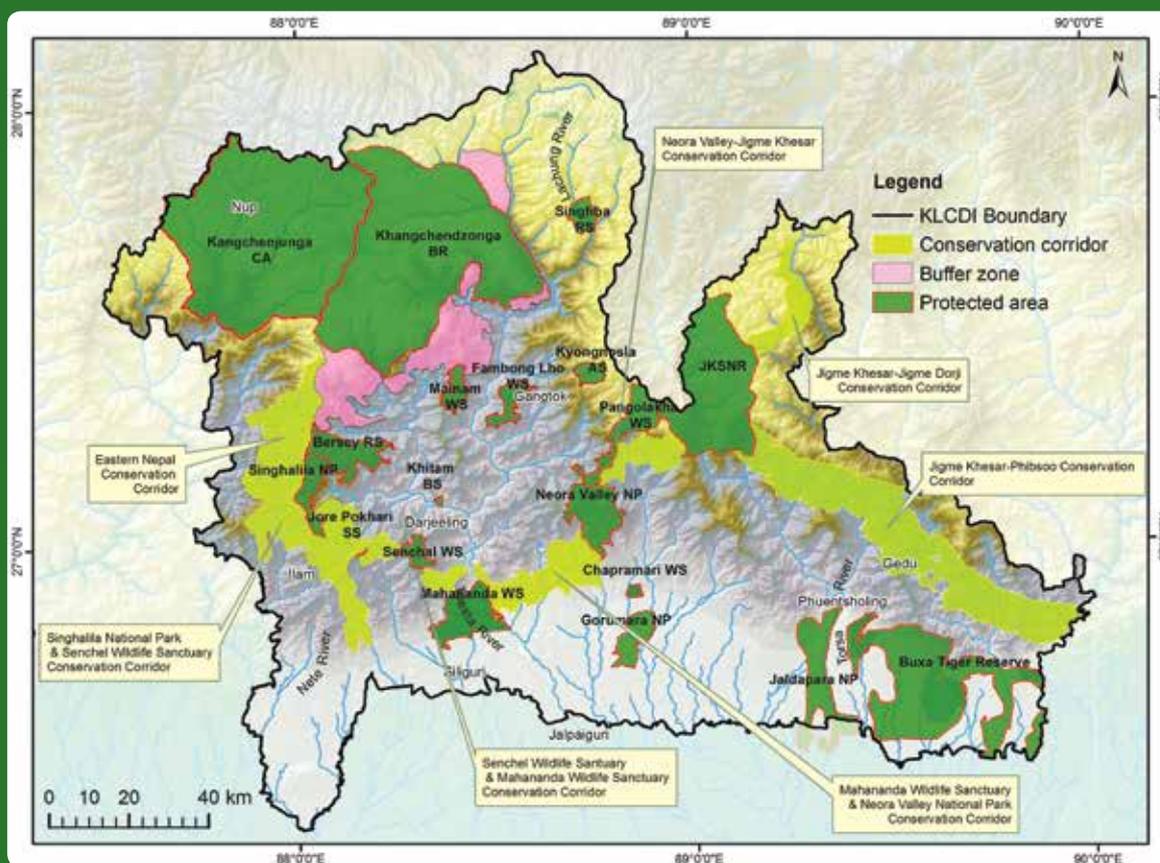


Table 21: Potential corridors connecting protected areas in the landscape

SN	Corridor Name	Adjacent Protected Areas	Area (sq.km)
1	Eastern Nepal Conservation Corridor	Kangchenjunga Conservation Area, Khangchendzonga Biosphere Reserve, Barsey Rhododendron Sanctuary	752
2	Singhalila-Senchal	Singhalila National Park, Senchal Wildlife Sanctuary	158
3	Senchal-Mahananda	Senchal Wildlife Sanctuary, Mahananda Wildlife Sanctuary	46
4	Mahananda-Neora Valley	Mahananda Wildlife Sanctuary, Neora Valley National Park	292
5	Neora Valley-Jigme Khesar	Neora Valley National Park, Jigme Khesar Strict Nature Reserve	169
6	Jigme Khesar-Phibsoo (proposed)	Jigme Khesar Strict Nature Reserve, Phibsoo Wildlife Sanctuary	NA
7	Jigme Khesar-Jigme Dorji (established)	Jigme Khesar Strict Nature Reserve, Jigme Dorji National Park	147

NA: data not available

Development projects present both opportunities, as well as conservation challenges

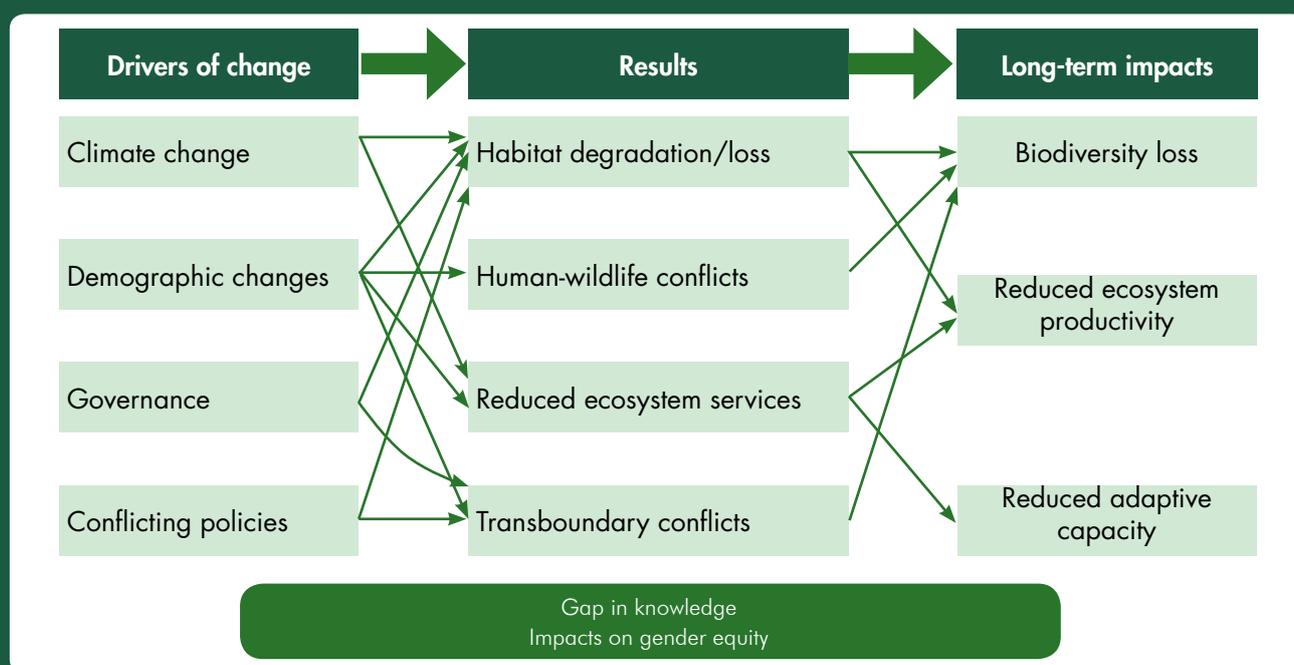


Conservation and Development Challenges

Drivers of Change

The KL faces a number of conservation and development challenges associated with various drivers of change. These drivers of change fall under four major categories: i) climate change, ii) demographic changes, iii) transboundary governance, and iv) conflicting policies (Figure 11). These drivers of change result in loss or degradation of habitat for flora and fauna, while further increasing human-wildlife conflicts and transboundary conflicts, and reducing the value of ecosystem services. The long-term impacts of these changes include biodiversity (and agrobiodiversity) loss, reduced ecosystem productivity, and reduced adaptive capacity for both humans and other organisms.

Figure 11: The complex interconnectedness between drivers of change and long-term impacts on conservation and development in the Kangchenjunga Landscape



Climate change

Annual and seasonal trends in the KL indicate a temperature increase at the rate of 0.01–0.015°C per year with higher warming rates of 0.20–0.30°C per year in the winter months (December to February) (Tse-ring et al., 2010). Moreover, temperature increases are more pronounced at elevations exceeding >4,000 m. Climate change is likely to impact microclimatic habitats in the landscape such as alpine meadows, old growth fir forests, larch forests, cloud forests, and willow scrub, through exposure to impacts from invasive species, insects and diseases (Chettri et al., 2010; Telwala et al., 2013). Endemic species with narrow ranges and restricted distribution in the landscape are also threatened by climate change (Chettri et al., 2010; Kumar, 2012). Phenology is expected to be affected, although there is inadequate information on these changes in the landscape (Shrestha et al., 2012).

Climate change will affect water dynamics as a result of changes in precipitation and temperature. In particular, stream flow is likely to increase significantly during the wet months while potentially being reduced during the dry months. This could have serious impacts on communities who rely on rivers fed by glacial melt-water from the Himalayas (Sharma et al., 2009a). Warming temperatures are also likely to affect water quality of lakes and wetlands by altering the functioning of aquatic organisms, and by creating conditions that promote invasion by alien species such as water hyacinths (Gopal et al., 2010).

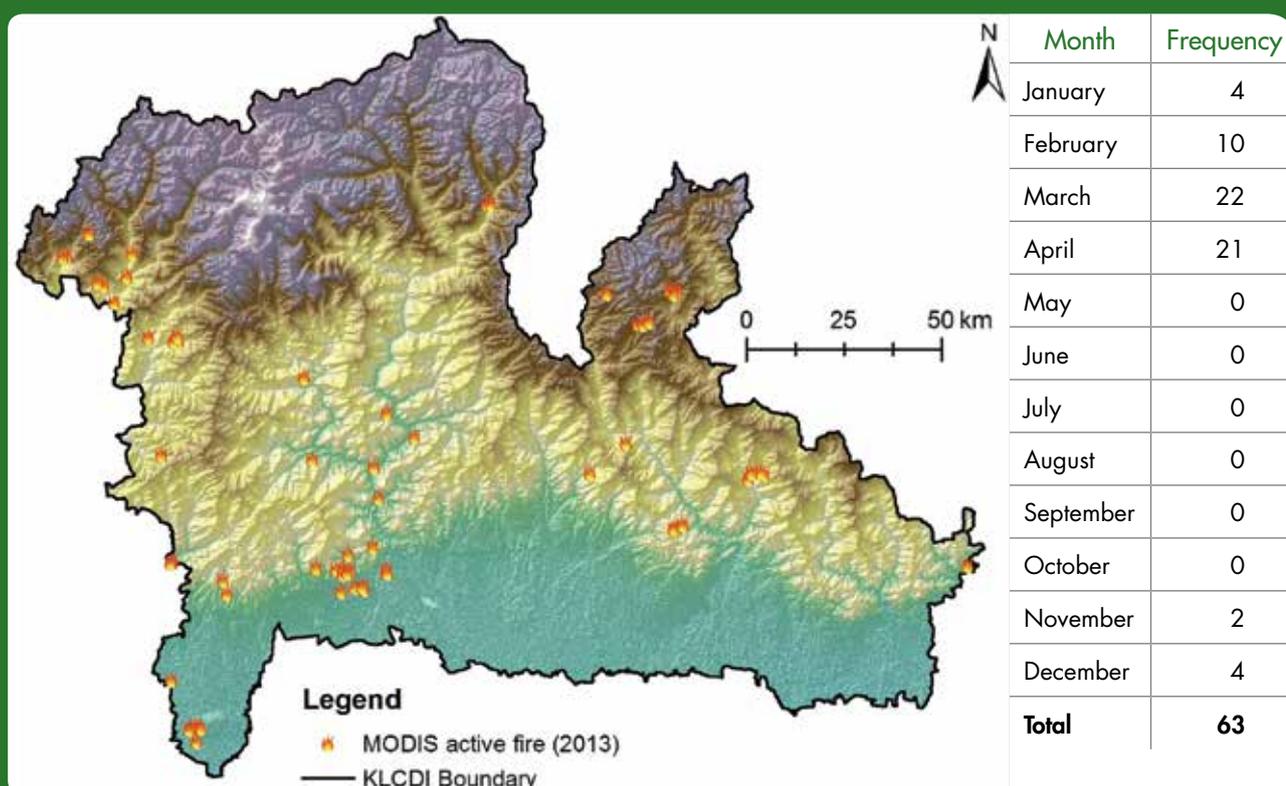
A majority of the population in the KL is dependent on agriculture as their main source of livelihood (Barua et al., 2014). Changes in climatic parameters, such as temperature, precipitation, frost periods, and hailstorms, could have serious consequences for agriculture in the region. Erratic rainfall patterns hamper the growth of crops and can result in soil erosion, landslides and sedimentation downstream. These, in turn, result in increased crop damage, decreased crop yield, and loss of soil fertility, which in turn increase the risk of food insecurity.

The risk of forest fire is likely to increase as a result of higher temperatures and extreme weather events such as long dry spells (Sharma et al., 2009a). In 2013, 63 Modis fires were detected in the KL (Figure 12), with most fires occurring in KL-Nepal (24 events), followed by KL-India (22 events) and KL-Bhutan (17 events). Fires were prevalent during the months of February, March and April, while a few fires occurred during January, November and December.

Demographic changes

The population of the KL is growing. This increase in population is correlated with a number of conservation and development challenges, including growing urbanisation; increased poverty (particularly urban poverty); conversion of forests into agricultural or grazing lands; construction of large development projects such as highways, large dams and extensive railway networks; and unsustainable and/or illegal use and extraction of natural resources (including poaching of animals and plants) (Krishna et al., 2002; Gurung, 2006).

Figure 12: Location of Modis active fires in 2013



Land use change

Geospatial analysis of land cover in the KL indicated that 829 sq.km of forests were converted into rangeland and 289 sq.km into agricultural land from 2000 to 2010 (Figure 13 and Table 22). Built-up area increased from 40 sq.km in 2000 to 66 sq.km in 2010 with most of the conversion occurring from agricultural land (12 sq.km), followed by barren land (11 sq.km) and broadleaf forests (3 sq.km). The conversion of land to other uses, particularly transformation of pristine habitats into extensive monoculture cash crop systems of tea and cardamom, results in the loss of ecosystem productivity through processes such as soil erosion, nutrient over-loading, and soil compaction.

Figure 13: Land use change from 2000 (left) to 2010 (right)

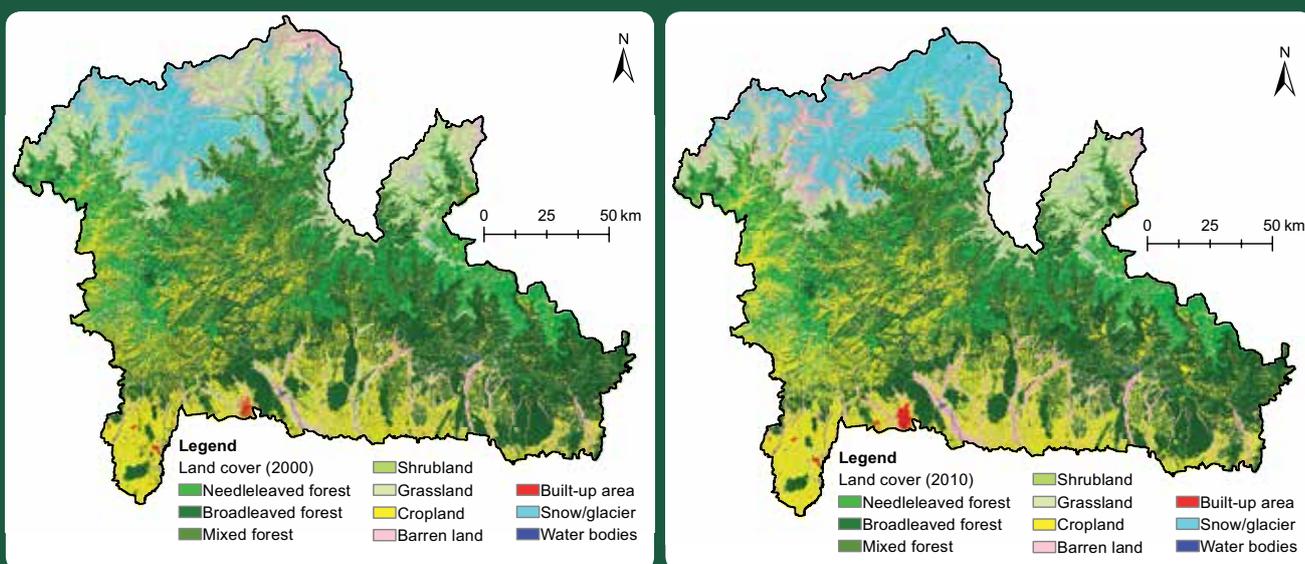


Table 22: Change matrix of land cover (area in sq.km) in 2000 and 2010

Land cover	Conifer forest	Broadleaf forest	Mixed forest	Shrubland	Grassland	Cropland	Barren land	Built-up area	Water bodies	Snow/glacier	LC 2010
Conifer forest	3,003										3,003
Broadleaf forest		6,898									6,898
Mixed forest			1,304								1,304
Shrubland	20	479	62	1,335							1,896
Grassland	22	86	1	159	2,692		95				3,056
Cropland	9	244	35	36	83	3,792					4,199
Barren land					8		1,397			503	1,908
Built-up area		3				12	11	43			69
Water bodies									89		89
Snow/glacier					539		401			1,721	2,661
LC 2000	3,054	7,710	1,403	1,531	3,322	3,804	1,903	43	89	2,224	25,085

Human-wildlife conflict

As a result of population pressures on the land, there are also increasing incidents of human-wildlife conflict (Ghosh, 1996; Bist, 1998). Human-wildlife conflict is of special significance in the KL because of the transboundary nature of this issue. At lower elevations of the landscape, elephant herds migrate annually between Jaldapara National Park in Jalpaiguri District of KL-India and Jhapa District of KL-Nepal (Tiwari, 2005). These migrations result in damages to both humans and elephants. Damages caused by elephants include destruction of houses, crops, and even loss of human life, while on the other hand retaliatory measures such as culling or electric fences around agricultural land result in elephants themselves being killed (Yadav, 2007). Development projects have also resulted in wildlife losses: between 1958 and 2008, 39 elephant deaths have been reported as a result of the 168 km railway line that passes through rich elephant habitat in Jalpaiguri (Roy et al., 2009). Encounters with wild elephants have caused human injury and deaths, along with economic loss as a result of crop damage (Roy & Sah, 2012).

While human-wildlife conflict from large animals is of major concern in the lowlands of KL, small mammals such as herbivores and primates affect the socioeconomic situation of communities living in the mid-hill and mountainous areas of the landscape (Bhattacharjee & Parthasarathy, 2013). Small mammals are also a major cause of crop depredation. A 14-month study (April 2011 to May 2012) in Samanden Forest Village within Singhalila National Park of KL-India indicated that crop damage caused by small mammals amounted to almost INR 38,000 and livestock damage to INR 2,600 (DLR Prerna, 2012). Crop damage was caused mostly by wild boar, porcupine and deer, while livestock damage was caused mostly by yellow-throated marten and eagle.

Weak enforcement of national policies in transboundary areas

Although there is a well-established system of natural resource governance in each of the countries of the KL, the enforcement, particularly patrolling and monitoring in transboundary areas, is weak (Mallick, 2012). As a result, land encroachment, habitat conversion, and poaching of animals and plants are common within the landscape. Some commonly poached species in the landscape include snow leopard, musk deer, red panda, pangolin, and medicinal plants such as *Ophiocordyceps*, *Saussurea*, *Neopicrorhiza*, and *Fritillaria*.

Institutional capacity for biodiversity conservation is fairly weak in the KL. Within the protected areas of the landscape, the concerned institutions lack enough trained personnel and appropriate information on key aspects of conservation. Inadequate housing facilities, field gear and capacity building opportunities remain significant challenges, particularly in KL-Bhutan and KL-Nepal.

The weak governance system is especially conducive for illegal trade through trans-border areas. Large quantities of medicinal plants, cardamom, tea, tiger grass, and NTFPs are traded in unprocessed form across the border from Nepal to India (Chettri & Sharma, 2006; Chettri et al., 2008). Many valuable medicinal plant species are also traded extensively to Tibet from Taplejung District of KL-Nepal with Tibetan traders coming every year to collection sites in Nepal and transporting these herbs without paying any royalty (Paudel, 2010).

Conflicting national policies

National policies can have implications for both national and transboundary issues in conservation and development. Challenges can arise at the national level when there is conflict between the mandates of various government agencies. For example, within KL-Nepal, the Local Self Governance Act 1999 empowers Village Development Committees (VDCs) to sell specific natural resources with the proceeds from these sales to be deposited in the VDC fund, while the Forest Act 1993 empowers Community Forestry User Groups to sell these same products. However, religious forest user groups established under the Forest Act 1993 and user committees established under the National Parks and Wildlife Conservation Act 1973 do not have the right to sell these forest products. Within a VDC, there may be overlaps in the membership of a VDC, a user group, or a user committee, and the contradictory provisions concerning members' rights to use natural resources create the potential for conflict between the local government and the user groups (Joshi, 1997; Belbase & Thapa, 2007).

Conflicting national policies along transboundary areas can also have significant implications for conservation and development in the KL. For example, the ban on livestock grazing in the Singhalila National Park of Darjeeling, KL-India, since 2000 resulted in the sale and transfer of large numbers of livestock to KL-Nepal, thereby placing

considerable pressure on the rangelands of KL-Nepal. Similarly, despite the ban on livestock grazing in the Khangchendzonga National Park in Sikkim, KL-India, free-ranging livestock from KL-Nepal are found grazing in the park.

Community Perceptions on Environmental Issues and Climate Change

Resource use by local people is based on their deep knowledge of ecological systems and the services they provide (Gadgil et al., 1993). More and more, scientists are finding value in collaborating with local communities, and growing political awareness and activism by indigenous peoples have led to increased recognition of their knowledge and ideas (Huntington, 2011). Therefore, understanding the perception of local communities on environmental and climate change issues is vital in order to address conservation and development challenges.

Community perceptions on environmental issues in the KL are summarized in Table 23. Increase in temperature was experienced by communities throughout the KL (Chaudhary et al., 2011). Irregular rainfall patterns, prolonged dry season, and change in the snowing season with less snowfall were also perceived in the landscape. Many ecological changes have occurred in the landscape, significant among which are the occurrence of new plant species (particularly weed) and bird species, and increase in emergence of new pests and crop diseases. Decreasing availability of water in water sources and wetlands have also been perceived by local communities. As a result of these changes, communities are increasingly being exposed to more risks and hazards including crop failures, landslides and soil erosion.

Climate change has had an impact on local livelihoods in the KL. Farmlands are less productive due to unpredictable rainfall and prolonged dry season. Desiccation of cash crops, especially large cardamom, due to the prolonged dry season has resulted in economic loss among local farmers. Invasion by new weeds and loss of

Table 23: Community perceptions on environmental issues

Environmental issue	KL-Bhutan	KL-India	KL-Nepal
Climate:			
Increase in temperature	√	√	√
Change in snowing season; less snowfall and snow cover	–	√	√
Irregular rainfall patterns	√	–	√
Less rainfall during monsoons			√
Prolonged dry season	√	–	√
Unpredictable weather	–	√	–
Less fog coverage; fewer (or no) fog-covered days	–	–	√
Ecological changes:	–	–	–
Shifting of species range, including evidence of new plant (also weeds) and bird species in some areas	√		√
Change in forest composition	√	–	–
Change in flowering time	√	–	–
Shift in harvest time of crops such as barley, maize and wheat		–	√
Increase in emergence of new pests and crop diseases	√	–	√
Longer period of time spent by livestock in higher rangelands	–	–	√
Increased number of mosquitoes in residential areas	–	–	√
Higher occurrence of wildlife in human habitat, thereby increased human-wildlife conflict	√	–	–
Less water in water sources, including wetlands	√	–	√
Waste and pollution:	–	–	–
Increased pollution	–	√	–
Increased garbage load	–	√	–
Risks and disasters:	–	–	–
Increased risk of crop failure	–	√	–
Increased risk of forest fires	–	√	–
More incidents of natural calamities including landslides and soil erosion	√		√

Source: GBPNIHESD (2014), RECAST (2014), WCD (2014)

indigenous grasses has meant that communities must now invest more in animal husbandry. Increasing new pests and crop diseases have also resulted in the need to invest more in crop production, but with decreasing quality and quantity of production, food insecurity is now an emerging issue. Health of local communities is also more vulnerable with the emergence of new epidemics, and conflicts are rising at the local level, especially over the use of water resources.

Status of Knowledge on Biological Diversity

The Kangchenjunga region is an extensively researched area. The first recorded study of the area was conducted more than 170 years ago on the Lepchas of Sikkim by Archibald Campbell (1840), the British political agent to Sikkim and Darjeeling in the East India Company. This was followed by the work of the notable British naturalist Joseph Dalton Hooker, who published an account of his botanical expedition in the Kangchenjunga region in two volumes of *The Himalayan Journals* in 1854. Exploring, analysing and synthesizing literature related to the KL is thus a challenging task. However, accessible and available research can serve as a starting point for such an endeavour. Thus, 777 publications related to biodiversity in the KL were accessed through online media, compiled and analysed. These publications included journal articles, books and/or book chapters, published and unpublished reports, conference proceedings, management and/or development plans, and student theses.

Geographical distribution of study sites

The majority of research on biodiversity in the KL has been conducted in KL-India (79%), while 12% were in KL-Nepal and 5% in KL-Bhutan. Approximately 4% of the 777 studies were of a transboundary nature and were collectively conducted in KL-Bhutan, KL-India and KL-Nepal. In KL-India, research focused more on Sikkim than on Darjeeling and Jalpaiguri Districts. In KL-Nepal, 62% of the documentation was from the Kangchenjunga Conservation Area in Taplejung District. Transboundary coverage of biodiversity research has been increasing in recent years and is thus a clear indication of the evolving concept of transboundary landscapes and regional cooperation for biodiversity conservation.

Publication trends

The first recorded study in the KL was most probably a manuscript by Campbell in 1840 on the *Lepchas* – the indigenous inhabitants – of Sikkim. Along these lines, much of the earlier studies from the KL are on ethnology and anthropology of the Lepchas with a focus on their language and culture. The first recorded study on biodiversity in the KL was by Tickell (1843) on the ‘tiger’ of Darjeeling. For more than 130 years after Tickell’s manuscript, research on biodiversity and natural resources was limited (Figure 14). Between 1840 and 1980, only 65 documents on biodiversity were recorded from the KL. However, research and documentation increased significantly after 1980, and between 1980 and the present, 92% of the 777 studies we accessed was documented. The decade of 2000 to 2010 was particularly significant with a total of 505 studies, averaging 50.5 studies per year.

Most of the preliminary studies from the KL are from Sikkim, e.g., *Rhododendrons of Sikkim Himalaya* (Hooker, 1849), *Birds of Sikkim* (Blandford, 1872a), *Eastern and Northern Frontiers of Independent Sikkim*, with notes on zoology (Blandford, 1872b), and *Butterflies of Sikkim* (De Niceville, 1881). At the end of the millennium the concept of transboundary biodiversity conservation was initiated by both national, and international organizations such as ICIMOD, The Mountain Institute (TMI) and World Wildlife Fund (WWF), as well as the governments of countries in the region, such as Bhutan, China, India and Nepal. Several initiatives were carried out since then to bring together governments, protected area managers, scientists, academics and local stakeholders for transboundary conservation, all of which played a significant role in communicating the importance of the KL to a global audience.

Publication by subject

Among the 777 publications on biodiversity in the KL, a majority (71%) were on species, 28% were on ecosystems, while only 1% were on the genetic level studies. Meanwhile, studies on fauna accounted for 39% of the total, while flora related research accounted for 31% (Figure 15). Among fauna, mammals were the most studied taxa (50% of total faunal studies) with the red panda being the most studied mammal (14% of mammal studies) (e.g., Pradhan,

Figure 14: Publication trend of studies related to biodiversity (1840s to 2014)

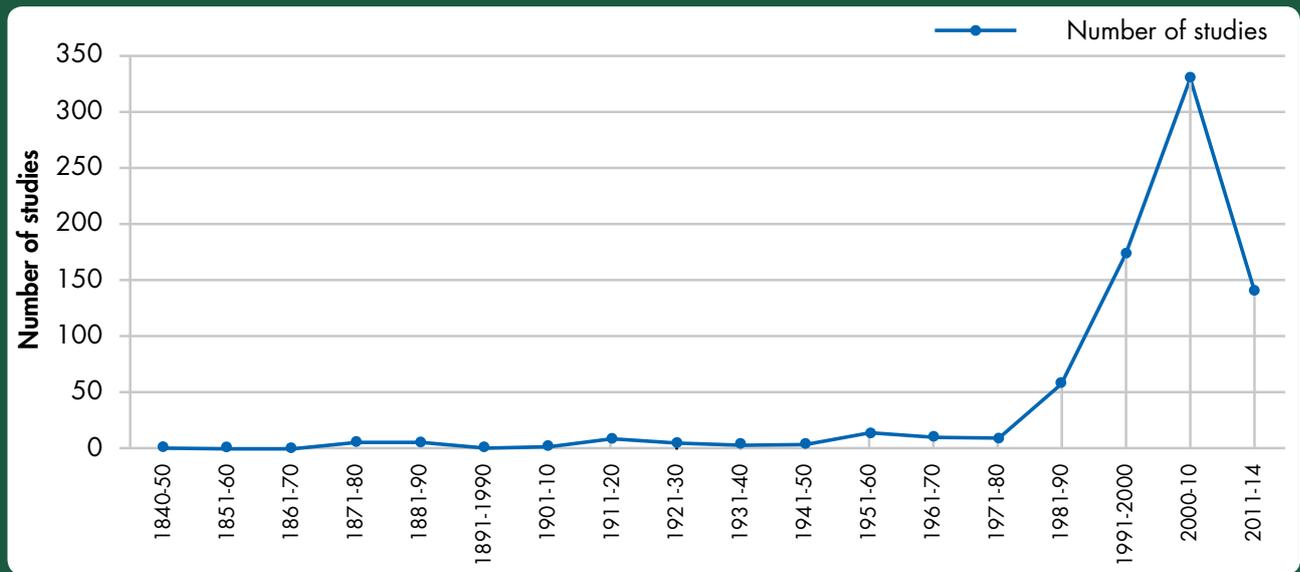
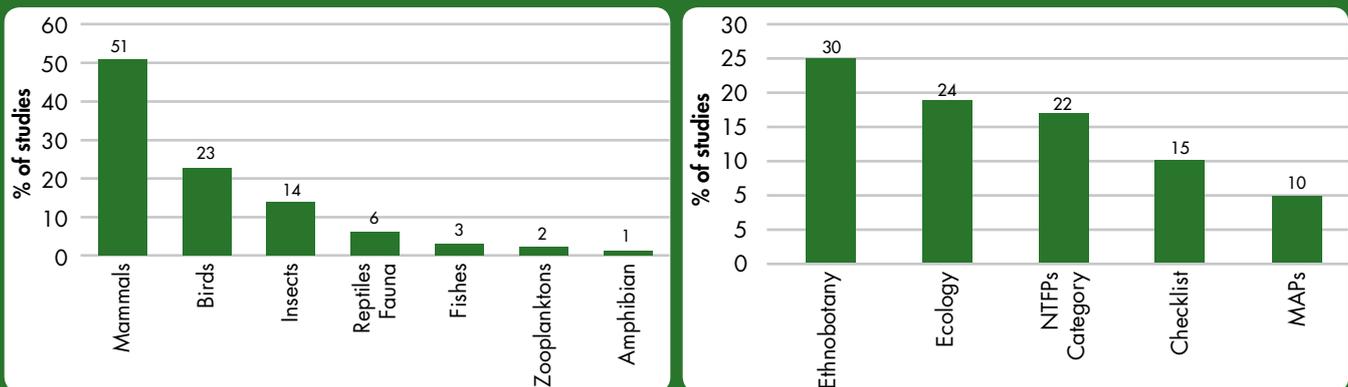


Figure 15: Categories of faunal (left) and floral (right) studies



1998; Williams, 2004; Mallick, 2010). Research topics on the red panda include population status, ecological distribution and feeding habits. Other mammals that have received research attention are tiger, clouded leopard, wild dog, Asian elephant, Assamese monkey (*Macaca assamensis*), Tibetan wild ass (*Equus kiang*), Sikkim vole (*Neodon sikimensis*), gaur (*Bos gaurus*), Himalayan goral (*Naemorhedus goral*), Himalayan serow (*Capricornis thar*), blue sheep (*Pseudois nayaur*), several ungulates, primates and rodents. Faunal research is largely confined to a few protected areas, but a systematic research methodology is lacking in the majority of protected areas and across the transboundary landscape.

Birds accounted for 23% of the total faunal studies in the KL. Black winged kite (*Elanus caeruleus*), osprey (*Pandion haliaetus*), Brahminy duck (*Tadorna ferruginea*), black-necked grebe (*Podiceps nigricollis*), Hodgson’s frogmouth (*Batrachostomus hodgsoni*), black-necked crane, Satyr tragopan (*Tragopan satrya*), and rusty-bellied shortwing (*Brachypteryx hyperythra*) were some of the bird species studied. Compared to mammals and birds, other faunal categories – insects, herpetofauna, fishes, zooplanktons and amphibians – have received less priority in the KL with 14%, 6%, 3%, 2% and 1% of research on these categories, respectively.

Studies on flora accounted for 31% of the total number of studies in the KL. Among these, almost a third (30%) were focused on ethnobotany, indicating the relevance of indigenous knowledge and the sustainable use of plants and plant products by local communities in the KL. Moreover, 22% of the floral studies were on NTFPs and 10% on MAPs. Plant ecology constituted 24% of the studies while plant checklists were 15%. Among floral species, the *Rhododendron* was the most highly studied genus in the landscape.

This research on the status of knowledge on biodiversity in the KL indicates that there are significant gaps in research on ecology and population dynamics of several biodiversity elements. Many of the protected areas in the KL lack a basic checklist of species. Studies on biodiversity outside protected areas are severely inadequate. There is also a need to better understand the ecology of lower floral and faunal taxa, particularly in the context of climate change and population pressures.

Gaps in Knowledge

The previous section highlights the gaps in knowledge in the KL with a special focus on biodiversity. Our understanding of the various drivers of changes in the KL is also limited by gaps in our knowledge on several issues of conservation and development in the landscape. Much of our current knowledge is limited to the 19 protected areas within the landscape. The knowledge gaps in the KL can be categorized under the following themes:

Climate change and its impacts: There is inadequate knowledge on the nature and degree of climate change in the landscape, as well as the impacts of climate change on biodiversity and livelihoods.

Biodiversity status: The status of many key species in the landscape, and particularly of lower level taxa, is unknown. Moreover, the response of these species to various forms of disturbance – including human pressures and climate change – and their adaptive capacity is not adequately known.

Gender inclusion: There is inadequate information on the gender roles and relations that shape conservation and development outcomes, and vice versa. Emphasis must be placed on topics that cover the impacts of non-agriculture based livelihoods on gender roles and relations; gender analysis of selected value chains – large cardamom, tea, chiraito – especially given the scenario of climate change; gender differential effects of climate induced hazards; and strategies and needs among men and women to adapt to climate change.

Policies: Conflicting policies that affect conservation and development both at national and transboundary levels need to be reviewed and analysed.

Livelihoods: Knowledge on the scope of key livelihood strategies in the landscape is necessary. These include tea, large cardamom, floriculture, dairy, and tourism. There is also inadequate information on value chain analysis of important products in the landscape. Except for a few discrete cases, there is no factual data on the volume and extent of illegal transborder trade in the landscape.

Little is known about the biodiversity status of lower taxa in the landscape



Natural Resources Management and Governance

Policies and Enabling Environment

The countries in the KL are equipped with policies and other mechanisms that create an enabling environment for implementing conservation and sustainable development programmes. These can be categorized into international (Table 24), regional and national legal frameworks, with particular emphasis on biodiversity, forests, environment and livelihoods.

Table 24: **International conventions ratified by KL member countries**

Convention	Year ratified		
	Bhutan	India	Nepal
Convention on Biological Diversity	1995	1994	1993
Ramsar Convention	2012	1982	1988
World Heritage Convention	2001	1977	1978
CITES	2002*	1976*	1975*
Convention on Migratory Species	-	1983	-
Convention for the Safeguarding of Intangible Cultural Heritage	2005	2005	2010
ILO Convention No. 169	-	-	2007

* Date indicates year of entry into force.

International obligations

Convention on Biological Diversity (1992)

The Convention on Biological Diversity (CBD) is a major global agreement on the sustainable use and conservation of biological diversity. The Convention was adopted at the Earth Summit in Rio de Janeiro in June 1992 and entered into force on 29 December 1993. The CBD has three main goals: 1) conservation of biological diversity, 2) sustainable use of its components, and 3) fair and equitable sharing of benefits arising from genetic resources. Transboundary landscape management approach falls under the overall framework of the CBD. This approach received global attention after the seventh COP meeting in 2004, which endorsed the 'ecosystem approach' to conservation and highlighted the significance of regional cooperation among the signatories to the Convention. The seventh COP meeting also adopted 'Mountain Biodiversity' as a programme of work for mountain-specific activities.

Ramsar Convention on Wetlands (1971)

The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Under the 'three pillars' of the Convention, the Contracting Parties commit to: 1) work towards the wise use of all their wetlands, 2) designate suitable wetlands for the list of Wetlands of International Importance (the Ramsar List) and ensure their effective management, and 3) cooperate internationally on transboundary wetlands, shared wetland systems and shared species.

Convention for the Protection of World Cultural and Natural Heritage (World Heritage Convention) (1972)

The World Heritage Convention links together the concepts of nature conservation and the preservation of cultural properties. The Convention recognizes the way in which people interact with nature, and the fundamental need to preserve the balance between the two. The Convention defines natural or cultural sites that can be considered for inscription on the World Heritage List.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)

The aim of CITES is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Levels of exploitation of some animal and plant species are high, and the trade in them, together with other factors, such as habitat loss, may lead to heavy depletion of their populations, even bringing some species close to extinction. Many wildlife species in trade are not endangered, but the existence of an agreement to ensure the sustainability of the trade is important to safeguard these resources for the future. CITES recognizes that trade in wild animals and plants is transboundary in nature and builds on the cooperation among different countries to protect more than 35,000 species of animals and plants.

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (1979)

The Bonn Convention provides a global platform for the conservation and sustainable use of migratory animals and their habitats. The Convention brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range. All three countries in the KL are Range States, but India is the only contracting party to the Convention.

Convention for the Safeguarding of Intangible Cultural Heritage (2003)

The aim of this Convention is to safeguard the uses, representations, expressions, knowledge and techniques that communities, groups and, in some cases, individuals, recognize as an integral part of their cultural heritage. This intangible heritage is found in forms such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe, and knowledge and techniques of traditional craftsmanship.

The Indigenous and Tribal Peoples Convention (No. 169) (1989)

Convention No. 169 of the International Labour Organization deals specifically with the rights of indigenous and tribal peoples. The Convention covers a wide range of issues, including land rights, access to natural resources, health, education, vocational training, conditions of employment and contacts across borders. The fundamental principles of the Convention are that indigenous and tribal peoples should be consulted and fully participate at all levels of decision-making processes that concern them. Among the three countries in the landscape, only Nepal has ratified ILO Convention No. 169 in 2007.

Regional agreements

There are two regional agreements in the field of biodiversity conservation in the countries within the KL: one between Nepal and China and the other between Nepal and India (DNPWC, 2010). These bilateral agreements provide a basis for transboundary cooperation in the future.

The *Memorandum of Understanding on Cooperation in the Field of Forestry and Biodiversity Conservation* between the Ministry of Forests and Soil Conservation, Government of Nepal, and the State Forestry Administration, People's Republic of China, was signed on 3 June 2010. The MoU mentions each state's commitment to implement the obligations of multilateral agreements and conventions to protect the environment and conserve biodiversity. Major areas of cooperation include formulating forestry policies and strategies, forest management and addressing adverse effects on forests, wildlife conservation including illegal hunting of animals and illegal trade of their body parts, scientific research, and public awareness.

A resolution was signed between the Department of National Parks and Wildlife Conservation, Ministry of Forests and Soil Conservation, Government of Nepal, and the National Tiger Conservation Authority, Ministry of Environment, Forest & Climate Change, Government of India, on 29 July 2010, on transboundary conservation as an outcome of the Fourth Nepal-India Consultative Meeting. The resolution focused on areas of, *inter alia*, conservation of endangered species including tiger, rhino and elephant; capacity building; joint monitoring arrangements; and cooperation on recognized priority landscapes.

National policies and practices

KL-Bhutan

Bhutan's forest cover remains at an impressive 72.5% of the country's total land area. The Royal Government of Bhutan has adopted a landmark policy decision to maintain at least 60% of its land area under forest cover at any given time. The Royal Government also adopted a revised national protected area system in 1993, which currently covers 51.4% of the total area. Protected areas include five national parks, four wildlife sanctuaries and one strict nature reserve. Furthermore, the Royal Government adopted the concept of biological corridors to connect the country's protected areas for the dispersal of both plant and animal species (Wangchuk, 2007). To this effect, in 1999 the Government declared a total area of approximately 9% as biological corridors.

The legislation governing the establishment and management of protected areas in Bhutan is the Forests and Nature Conservation Act of Bhutan, 1995. The legislation is supplemented by other interventions such as scientific management initiatives through Forest Management Units and National Park Management plans, as well as stakeholder programmes through Integrated Conservation and Development Programme, Social Forestry, Community Forestry and Private Forestry Programmes. Government policies are designed to ensure sustainability of all forestry operations, while at the same time continuing to meet the basic forest product needs of the rural population. Other legislation and policies supporting conservation and sustainable development in KL-Bhutan are listed in Annex 2a.

KL-India

Approximately 5% of the total area of India is under the protected area network, which consists of 85 national parks, 448 wildlife sanctuaries, and 12 biosphere reserves. A number of national conservation projects, notably Project Tiger initiated in April 1973 and the Crocodile Breeding and Management Project launched on 1 April 1975, further strengthened the protected area network. In recent years, an eco-development programme for *in situ*

There are several policies in place to conserve biodiversity, such as *Amolops formosus*, in the landscape



conservation of biological diversity involving local communities has been initiated. Under the Ramsar Convention, eight wetlands and one mangrove have been declared Ramsar Sites, while under the World Heritage Convention, six natural sites have been declared World Heritage Sites.

KL-India has both central-level (Annex 2b) and state-level policies (Annex 2c) that govern the conservation and sustainable use of natural resources. Among the state-level policies, the State Green Mission 2006, Ten Minutes to Earth 2009, and Glacial Commission 2007 are exclusive only to the state of Sikkim.

KL-Nepal

Forests in Nepal occupy 6.61 million ha, equivalent to 44.7% of the total area of the country (DFRS, 2015). Of the total forest area, 82.7% lie outside protected areas and 17.3% occur inside protected areas. There are 20 protected areas in the country comprising 23.2% of the total land area and include eleven national parks, six conservation areas, two wildlife reserves, and one hunting reserve, with buffer zones declared in twelve protected areas. The Master Plan for Forestry Sector 1989 provided a 25-year policy and planning framework for the forestry sector with the objectives of meeting people's basic needs for forest products on a sustainable basis, conserving ecosystems and genetic resources, protecting land against degradation and other effects of ecological imbalance, and contributing to local and national economic growth. The more recent Forestry Sector Strategy 2015 and Forest Policy 2015 further support the vision of contributing to local and national prosperity through sustainable management of forests, biodiversity and watersheds. Important policies in relation to natural resource management and sustainable development are included in Annex 2d.

Conservation and community development practices

Since the 1980s governments across the world have made efforts towards decentralization and devolution of authority for management of forests and biodiversity. The United Nations Conference on Environment and Development (UNCED) in 1992 placed a premium in people's participation and promotion of conceptual shift in both forest management and biodiversity conservation. As a result, participatory forest management approaches are becoming more popular. Experiments on such approaches were started as early as the 1970s. Joint forest management in India (JFM) and community forests (CF) and leasehold forests (LF) in Nepal are often hailed as successful approaches for the regeneration of degraded forests. In all of these approaches, forest management is the instrument that enhances the management of biodiversity, leading to conservation. Therefore biodiversity conservation is a by-product of such forestry initiatives.

JFM in north Bengal and Sikkim represents an important breakthrough in relations between forest departments and local communities and has been widely accepted as a promising approach to forest management. In essence, JFM involves formal partnerships between forest villagers and government forest departments. These partnerships are built through the formation of forest protection committees, which are responsible for protecting and managing the state forests. Although there are many variations of JFM, the core idea is that, in exchange of their cooperation and assistance, villagers are given free access to NTFPs and entitled to a share of profits from the sale of the regenerated trees when they are finally harvested. JFM represents a significant policy shift and the changes are: (a) from production for commercial market and generation of government revenue to production to fulfil the needs of forest communities; (b) from an exclusive focus on timber to attention to the NTFPs (firewood, fodder, grasses, leaves, medicinal plants, wild edibles, etc.) that are important to the livelihoods of forest communities; (c) from monoculture single-layered (of commercially valuable species) to multi-layered mixed forests that include a diversity of trees species; (d) from plantations of a similar age (to make harvesting easy) to plantations of diverse ages (for sustained supply of timber and other products to meet community needs); and (f) from custodial management through policing, to participatory management. Data from West Bengal in India indicate that these changes have produced positive results. Forest cover has increased, timber production has increased, conflict between foresters and communities has decreased and the yield of NTFPs has increased. In addition, a number of initiatives by West Bengal and Sikkim governments focus on conservation. The *Smriti Ban* concept, solid waste management and organic farming in Sikkim, and JFM, ecotourism and human-wildlife conflict mitigation in north Bengal are some initiatives that have shown positive results.

Community forestry in Nepal is one of the commonly cited success stories. Community forestry regime essentially involves handing over use rights of government-owned forests to local communities who customarily hold the de

facto use rights of such forests (Gilmour & Fisher, 1991). Over 63% of the total forest of Jhapa district has already been handed over to the communities (Chaudhary et al., 2015). The leasehold forestry programme was initiated in Panchthar district in 2002/03 with the aim of providing forests to households living below poverty line and reducing their poverty mainly through increased utilization of forest products and animal husbandry. A limited proportion of the forest in KL Nepal is also managed as private forests and religious forests. With the initiation of DNPWC and KCAP, 73,327 ha of forest and rangeland within KCA has been handed over to the communities as 26 Conservation Community Forests (CCFs). In Ghunsa, 676 ha of forest is managed as sacred forest (KCAMC, 2013). The CFUG's management of the forests has resulted in recovery of enough vegetation to form reasonably dense forests in the hills. This is a significant achievement, because majority of Nepal's rich biodiversity would have been lost without forests. Local extinction of species has been prevented, habitat corridors created and successive stages of forests developed. Wildlife sightings have increased, but so have damages caused by livestock and wildlife on the fields. All three approaches – JFM, CF and LF – of participatory forest management in India and Nepal are regarded as successes in many respects, especially shared responsibility for management and sharing of profits with the local communities.

Biodiversity management by the local people becomes more evident when it has utility value and communities benefit from it. In the KL, there are instances of communities developing successful enterprises that make use of biodiversity, but these isolated efforts have not yet been scaled up (Chaudhury, 2015; Uprety et al., 2016). There is great potential for enterprise development of NTFPs and MAPs. However forward linkages have not been properly studied. In general, problems faced by most of these NTFPs and medicinal plants are unsustainable harvesting and lack of management of these resources in both government and community-managed forests and pastures. Only a few species are being cultivated on a small scale in private areas.

Other examples are ecotourism enterprises linked with nature and biodiversity conservation. Sikkim Biodiversity and Ecotourism made high impact leading to increased income of the communities and enhanced biodiversity conservation (Rai & Sundriyal, 1997; Maharana et al., 2000).

NTFP-based enterprises have great potential in the landscape



Conservation Institutions and Organizations

There are various organizations responsible for biodiversity conservation in the KL. They can be broadly categorized into government institutions, formal community institutions, and other community organizations that include non-governmental organizations and traditional institutions. Conservation institutions and organizations are described below for the three countries that share the KL.

Institutional arrangements in KL-Bhutan

The Ministry of Agriculture and Forests (MoAF) is the central organization responsible for the formulation and implementation of policies and legal frameworks related to biodiversity, forests, livestock and agriculture. MoAF is also the focal ministry for CBD implementation in Bhutan. Under MoAF, there are five departments and central agencies that implement various biodiversity programmes:

- The National Biodiversity Centre coordinates implementation of biodiversity conservation and sustainable utilization programmes in the country, specifically the objectives of the CBD.
- The Department of Forests and Park Services is the overall authority for the management of forest resources and wild biodiversity. It is responsible for *in situ* conservation of wild biodiversity through the creation and management of a protected area system, protection and management of forest and wildlife resources, and education and public awareness.
- The Department of Agriculture is mandated to enhance food security and income through improved management of field crops, horticulture crops, and medicinal plants.
- The Department of Livestock is responsible for coordination, administration and management of services related to livestock production, livestock input supply and livestock health.
- Bhutan Agriculture and Food Regulatory Authority regulates the trade of restricted biological resources and prevents the introduction of pests, diseases and invasive alien species, including genetically modified organisms.

Other key stakeholders in KL-Bhutan are:

- National Environment Commission is an independent authority and the highest decision-making body for all matters related to the environment and its management in the country. It is chaired by the Prime Minister and is composed of high-level multi-sectoral representatives.
- The Department of Local Governance is responsible for overseeing local development and governance affairs for effective management and delivery of public services. It provides overall coordination and guidance for the social, economic and political progress of local government affairs in accordance with the national framework for development.
- The local administration (Dzongkhag or Gewog) is cross-sectoral and consists of government staff and locally elected representatives responsible for planning and implementing programmes at the local level. They play an instrumental role in programmes on biodiversity conservation and sustainable use and in disseminating related information to local communities.
- The Royal Society for Protection of Nature (RSPN) was registered as a Public Benefit Organization under the Civil Society Organization Authority of Bhutan in 2010. Since 1987, RSPN has been engaged in environmental conservation through education and advocacy, conservation of natural resources and sustainable livelihood programmes. It also focuses on research and emerging issues such as climate change, solid waste and water management.
- Bhutan Trust Fund for Environmental Conservation is an independent grant making organization. It uses its annual investment income of USD 1.5–1.8 million to finance field programmes for biodiversity/environmental conservation and the promotion of social welfare in the country.

Institutional arrangements in KL-India

The Ministry of Environment, Forest & Climate Change (MoEFCC) is responsible for planning, promoting, coordinating and overseeing the implementation of environmental and forestry programmes in India. The main activities undertaken by the ministry include conservation and survey of the flora and fauna of India, forests and other wilderness areas; prevention and control of pollution; afforestation and land degradation mitigation. It is responsible for the administration of the national parks of India.

Sikkim and West Bengal have different modes of implementing the acts and policies of the Government of India. As a result, the two states have different institutional arrangements for biodiversity conservation.

Sikkim

- With the implementation of JFM in Sikkim, there are 159 JFM Committees and 49 Eco-Development Committees (EDCs) that implement plantation and other forestry related programmes in the state.
- The Sikkim Biodiversity and State Wildlife Board advises the State Government on matters relating to the conservation of biodiversity, sustainable use of its components, and equitable sharing of the benefits arising out of the use of biological resources.
- Biodiversity Management Committees (BMCs) are responsible for promoting conservation, sustainable use and documentation of biological diversity at the state level. One of the key mandates of the BMCs is to prepare the Biodiversity Register, which documents the elements of biodiversity in the area and issues related to sustainable use, suitability for sharing and traditional knowledge. There are seven BMCs in Sikkim.
- The Sikkim Ecotourism Council is an autonomous body whose purpose is to establish Sikkim as an ultimate and unique ecotourism destination.

West Bengal

- The State Biodiversity Board of West Bengal ensures proper implementation of the Biological Diversity Act, 2002, and the West Bengal Biological Diversity Rules, 2005.
- There are 81 BMCs in West Bengal.
- West Bengal is the pioneer state in India in initiating JFM. At present, there are 491 JFM Committees (389 Forest Protection Committees and 102 EDCs) involving 64,000 households in the protection of about 2,250 sq.km of forest area in North Bengal of KL-India.

Institutional arrangements in KL-Nepal

Government institutions

The Ministry of Forests and Soil Conservation (MoFSC) is the lead agency with the overall responsibility for biodiversity conservation and for improving livelihoods in the KL. MoFSC is also the national focal point for implementing the CBD. MoFSC approves and implements plans and programmes through five Regional Directorates and five departments – Department of Forests, Department of National Parks and Wildlife Conservation, Department of Soil Conservation and Watershed Management, Department of Forest Research and Survey, and Department of Plant Resources. In MoFSC, a high-level national committee comprising relevant stakeholders is functioning at the central level to steer the implementation of landscape-level programmes in Nepal. In KL-Nepal, the regional multi-stakeholder committee, chaired by the Regional Director of the Eastern Directorate Office, is responsible for monitoring the KLCDI programme.

In each district of KL-Nepal, programme implementation is facilitated and coordinated by the District Forestry Sector Coordination Committee. This committee is chaired by the DDC Chairperson or Local Development Officer, while the District Forest Officer serves as the Member Secretary. Other district level government line agencies play a major role in implementing the programmes of the landscape. These line agencies also mobilize various partners including CBOs, communities, and private sector for programme implementation.

Formal community institutions

Formal community organizations in KL-Nepal include Community Forestry User Groups (CFUGs), Leasehold Forestry User Groups (LFUGs), Water User Groups, among others. These organizations operate at the district level and are involved in preparing programme plans and implementing them as mandated by existing legislation. The institutionalization of CFUGs and LFUGs has significantly contributed to sustainable community development and biodiversity conservation. There are currently 486 CFUGs and 196 LFUGs in KL-Nepal.

The KCA is the only protected area within KL-Nepal. Since 22 September 2006, when the Government of Nepal handed over its management to the Kangchenjunga Conservation Area Management Council (KCAMC), the KCA has been managed through a participatory conservation approach with local people participating in its management. In addition, the DNPWC provides legal, technical and financial support to the KCAMC. Under the

KCAMC, there are other formal community institutions including 7 KCA Management Committees, 46 User Groups, 35 Mother Groups, 26 Community Forest User Groups, 4 Snow Leopard Conservation Sub-Committees, 8 Anti-Poaching Units, 6 Fire Control Sub-Committees, and 5 agricultural cooperatives (KCAMC, 2013).

Other community organizations

Civil society organizations, NGOs, private sector, and community-based organizations (e.g., mother groups, eco clubs, youth clubs and cooperatives) are other community-based organizations engaged in biodiversity conservation and sustainable community development in KL-Nepal. At present there are 588 NGOs in KL-Nepal, of which 66 (11% of total) are working on women and gender related issues and 31 (5%) are working on environmental issues. Not all NGOs are similar in terms of their capacity, financial resources, networking, and development, but some of them have potential to establish partnership for KLCDI programme implementation.

Traditional institutions play an important role in local level resource governance and management. The culturally diverse communities within KL-Nepal have been managing their natural resources through their own traditional systems and institutions, notable among which are the *kiduk* (also spelled as *kyiduk*) of the Sherpas and *kipat* of the Limbus. *Kiduk* is a Tibetan term for 'welfare' and is a formalized system of mutual aid that is especially important during life events such as death, marriage and birth, as well as during illnesses. *Kipat* is a form of communal land ownership that dates back to the period before the Gorkha conquest of eastern Nepal in 1774 (Regmi, 1976).

Guru Dongmar Lake (5,210 m) in Sikkim, India, is a sacred lake for Buddhists and Sikhs



Major Issues and Conservation and Development Priorities

Major Issues in the Landscape

Despite the biological significance of the KL, the region faces several challenges for biodiversity conservation and sustainable development. While some of these issues are manifested at the local and national levels, others occur at the transboundary level.

Local and national issues in the landscape

Wildlife poaching

Conservation and development issues at the local and national levels are generally common throughout the landscape (Table 25). Wildlife poaching is a common issue in the KL. Commonly poached species include snow leopard, musk deer and pangolin. Although birds are not known to be poached, large birds such as Himalayan monal and Tibetan snow cock sometimes get trapped in snares laid for musk deer. Factors promoting wildlife poaching include the lucrative market for wildlife parts and products, porous international borders, inadequate surveillance and monitoring, and human-wildlife conflict, among others.

Declining agriculture and crops

Agricultural practices in the KL are showing a declining trend. Local people are either changing their agricultural practices or leaving the land fallow. Some of the traditional crops such as finger millet and buckwheat are no more grown in the field. Even promising cash crops like large cardamom are facing challenges due to low productivity and market fluctuations (Sharma et al., 2016).

Table 25: **Local and national conservation and development issues**

Conservation and development issues	KL-Bhutan	KL-India	KL-Nepal
Ecosystems and biodiversity			
Wildlife poaching	√	√	√
Human-wildlife conflict	√	√	√
Unsustainable/illegal collection of NTFPs and MAPs	√	√	√
Lack of pastureland management (free grazing, over grazing, under grazing)	√	√	√
Deforestation and forest degradation	√		√
Forest fire	√	√	√
Rapid urbanization		√	
Development projects	√	√	√
Inadequate institutions and service delivery	√		√
Knowledge gap on species, ecosystems and landscapes	√	√	√
Livelihoods			
Declining soil fertility		√	
Declining (cash) crop productivity		√	√
Crop pests and diseases	√		
Tea gardens and associated impacts		√	
Drying of water sources and lack of potable water	√	√	
Migration to urban areas and/or other countries		√	√
Unmanaged tourism		√	√
Improper management of solid waste	√	√	√
National issues			
International boundary demarcation	√		
Porous border	√		√

Source: GBPNIHESD (2014), RECAST (2014), WCD (2014)



Sand is often extracted from river beds in the landscape

Human-wildlife conflict

Degradation or loss of wildlife habitat, decreasing prey base, and human incursion into wildlife habitat has meant that there are increasing numbers of human-wildlife conflicts in the KL. Some of the consequences of human-wildlife conflict are livestock depredation, especially by snow leopards, common leopards, wild dogs and occasionally by tigers; crop raiding by deer, elephants, macaques, porcupines and wild boar; and occasional loss of human life. For this reason, some local people resort to retaliatory killing of these wildlife species.

Unsustainable extraction of natural resources

Unsustainable, and often illegal, collection of NTFPs and MAPs is another major issue of concern in the KL. Plants that are unsustainably harvested include high-value plants such as *Fritillaria*, *Saussurea*, *Neopicrorhiza*, and *Ophiocordyceps* in KL-Bhutan and *Dactylorhiza hatagirea* and *Neopicrorhiza scrophulariiflora* in KL-Nepal. A number of medicinal plants are protected by the Government of Nepal with the following restrictions: i) species banned for collection, use, sale, distribution, transportation and export: *Dactylorhiza hatagirea*, bark of *Juglans regia*, and *Neopicrorhiza scrophulariiflora*; ii) species banned for export unless processed with permission from the Department of Forests: *Cinnamomum glaucescens*, *Ophiocordyceps sinensis*, *Rauvolfia serpentina*, *Nardostachys grandiflora*, *Valeriana jatamansii*, *Abies spectabilis*, *Taxus wallichiana*, *Taxus contorta* and *Parmelia* species (GoN, 2014). However, despite government restrictions, illegal harvesting and trade of many of these medicinal plants take place in KL-Nepal (Koirala, 2008).

Pastureland management

Pastureland management is another major issue of concern throughout the KL. Yaks are an integral part of the pastoral system and domestic biodiversity in high-altitude pasturelands, and yak husbandry plays a significant role in the livelihoods of high-altitude communities in the KL. Winter pastures face intense grazing pressure due to the high density of livestock, though summer grazing also puts pressure on highland pastures. In KL-Bhutan, free range grazing, where large numbers of livestock are left in the forests and pastures to graze freely, is practised in some places. This leads to numerous problems, including over-grazing and increased potential for livestock depredation by predators, thus resulting in human-wildlife conflicts. In Bhutan, under-grazing is also a problem in some areas where local herders have sold their yaks and quit the pastoral lifestyle. This skews the ecological balance previously achieved through generations of livestock grazing, leading to increase in natural wild prey and subsequent crop raiding and thus increasing human-wildlife conflicts.

Habitat degradation in pasturelands is common throughout the KL. Removal of trees to facilitate grazing areas, harvesting of trees and scrub vegetation for fuelwood, depredation of ground-dwelling birds and their nests by herders' dogs and humans, and poaching of rangeland wildlife are some problems associated with pastoral activities in the landscape.

Inadequacy of formal institutions

It was found that formal institutions are limited for addressing transboundary for delivering services at regional level for conservation and sustainable development. There is inadequate infrastructure in some of the protected areas within the landscape. Lack of adequate personnel, staff gear, and insufficient capacity hampers service delivery in the landscape. Moreover, many of the areas where wildlife poaching and illegal trade occur are in remote areas, where there is insufficient patrolling and surveillance by the park staff or communities.

Knowledge gaps

The lack of knowledge on several topics in the KL was a recurrent theme throughout the three countries in the landscape. While a few topics such as biodiversity, particularly rhododendrons, mammals and birds, receive high preference for scientific inquiry, others receive little or no attention. There is also a dearth of long-term data that would allow interpretation of the changes occurring in the landscape, particularly in the light of global climate change that may be affecting phenology, the distribution of vegetation, and the emergence of new pests and diseases.

Solid waste

Another issue of major concern at local and national levels in the KL is the increasing quantity of solid waste and the ineffective management of waste. Although policies and rules are in place for waste management, large quantities of waste find their way into streams and water bodies. This has negative impact on water quality and subsequently on aquatic, wildlife, livestock, and human health.

Transboundary issues and challenges

Illegal trade

One of the major transboundary issues in the KL is illegal trade of wildlife and plants. A lucrative market, porous borders, and insufficient patrolling are factors that promote illegal trade in the transborder areas of the landscape. The porous borders of KL-Bhutan and KL-Nepal serve as transit routes for illegal trade of timber and other forest products. Collection of butterflies and Rhino beetles from border VDCs of Ilam District, collection of pangolin scale from border VDCs of Taplejung and Panchthar districts, trade of tiger skin, and arrest of Tibetan poachers from Taplejung District have been reported from KL-Nepal (NCDC, 2010). While all three countries in the KL have ratified CITES, there is an urgent need for transboundary cooperation to address the issue of illegal trade in the landscape.

Transboundary movement of people and livestock

Transboundary movement between KL-Nepal and KL-India is an age-old practice of great socioeconomic importance. KL-Nepal (Ilam, Panchthar and Taplejung districts) is separated from KL-India (Darjeeling and Sikkim) by a long stretch of the Kangchenjunga-Singhalila complex. This is an open border and is crossed by both people and livestock. Most people living on either side of this Nepal-India border are from the same families. Some even possess dual citizenship and own land on both sides of the border while also enjoying rights over the use of natural resources, including pasturelands. Thus, if the use of natural resources is regulated on one side of the border, then they are able to extract resources from the other side. Law enforcement is stringent in Singhalila National Park of KL-India but weak in the KL-Nepal side of the border. As a result, natural resources in KL-Nepal side of the border are more prone to illegal and unsustainable extraction and poaching in comparison to KL-India. The open border also facilitates movement of livestock from KL-Nepal to KL-India.

Dolomite mining

Illegal dolomite mining along the Indo-Bhutan border is a transboundary issue of concern in the KL. While some of the excavated dolomite is used by Bhutanese industries, most of it is purchased by companies in India, especially to produce cement. Dolomite mining causes dolomite aerosols and mining chemicals to be leached into groundwater and nearby streams, polluting them. It tends to alter the natural pH value of the soil and causes increased salinity. This adversely affects the productivity of tea estates that use these waters. Dolomite mining in Bhutan was conducted since the 1960s, but the official trade lost its significance in the 1980s. However, illegal dolomite mining in the transborder area remains a concern although several Indo-Bhutan meetings have been held to address the issue.

Tea industry and its associated issues

The tea industry in KL-India began in around 1875 in the districts of Alipurduar, Darjeeling and Jalpaiguri. There are at present more than 240 tea gardens in the plains of Dooars alone, covering an area of over 33,000 hectares and employing approximately 600,000 people. In KL-Nepal, tea gardens are found in Jhapa, Ilam, and Panchthar districts; Jhapa is the major tea-producing district, contributing 87% of the total tea production of the country. Tea gardens in the landscape regularly use many types of pesticides, fungicides, herbicides, rodenticides, insecticides and nematocides, much of which leaches into surface- and groundwater. This has severe repercussions on the health of the local people, children in particular. Moreover, some of these pesticides are used by local people to poison leopards or other prey during incidents of human-wildlife conflict.

Conservation and Development Priorities

Conservation and development priorities have been identified to address the aforementioned issues in the KL. These priorities have been grouped into a number of thematic areas. 'Development' in this context should be understood as initiatives and interventions that can be carried out at the local level; are based on the management of ecosystem goods and services; and contribute to healthy ecosystems, livelihoods, and human well-being in a sustained manner. Ecosystem integrity and eco-friendly development are the pillars of conservation and development in the KL.

Land use and climate

Comprehensive information on land use and land cover contributes to sustainable planning of the landscape. This information is also essential for long-term monitoring of environmental and social changes, as well as identification of hazard zones.

- Detailed land use and land cover assessment and planning including the socio-political dimension
- Establishment of automatic weather stations along eco-climatic zones for acquiring climatic variables and to extract climate models
- Comprehensive environmental monitoring plans
- Assessment of vulnerability and/or resilience to natural hazards and climate change
- Assessment of the impact of climate on the distribution of flagship species, glacial recession, and agro biomes.

Socioeconomic situation and livelihoods

Several factors influence the socioeconomic situation in the KL. Therefore, micro-level analysis of agriculture, food sufficiency, wage and income, livestock development, trade, and tourism development is essential. Cultural/religious issues are also important and must be taken into consideration.

- Dissemination of information and technological advances to farmers for enhancing agricultural productivity
- A comprehensive tourism plan that includes tourist carrying capacity and promotes ecotourism at the regional level, considering Nepal, India and Bhutan as regional destinations
- Green economy and employment (value addition and market promotion of local and high-value agrobiodiversity products such as large cardamom, tiger grass, dairy products including fodder, ginger, *argeli* and *chiraito*; village tourism; local crafts; yak products)
- Assessment of traditional knowledge systems, cultural diversity and social fabric
- Research and development on diseases (crops and livestock)
- Promotion of alternative/renewable energy technologies
- Promotion of tourism/ecotourism as an alternative livelihood source
- Assessment of ecological and social vulnerability of tea gardens
- Assessment of organic farming
- Gender equity and social inclusion

Biodiversity

Sustainable management and conservation efforts need reliable information on biodiversity at all levels. Specific priorities are:

- Comprehensive biodiversity assessment along representative biomes and conservation plan at all levels
- Updating gaps in basic biodiversity inventories for all protected areas in the landscape
- Conservation action plan of endangered and/or priority species

- Environmental awareness programmes for local communities to highlight the importance of biological corridors and biodiversity conservation
- Comprehensive documentation and action plan for agrobiodiversity

Ecosystem services

Ecosystem services are vital for human well-being. Lack of assessment of ecosystem goods and services hinders sustainable planning. Therefore, the following priorities are identified:

- Comprehensive inventory and management of wetlands and sacred forests
- Assessment of ecosystem functioning in protected areas and corridors
- Valuation and prioritization of ecosystem services

Resource management

Institutional strengthening and capacity building of management institutions are essential for conservation and development. The common goals of transboundary landscape programmes can be achieved with coordination and cooperation of all stakeholders.

- Strengthening transboundary coordination and cooperation among KL countries for resource management
- Monitoring along transborder areas with improved monitoring protocols
- Documentation of transboundary illegal trade and poaching
- Assessment of traditional/local resource governance systems
- Sustainable management plan for NTFPs/MAPs
- Strengthening institutional capacity
- Assessment of carrying capacity, productivity and stock analysis of rangelands
- Effective planning and implementation of programmes in Chure
- Monitoring and regulation of environmental pollution
- Strengthening forest management and community participation approaches

Long-term conservation and monitoring

Systematic long-term environmental and socio-ecological monitoring is necessary for achieving the goal of biodiversity conservation and sustainable development in the KL. Monitoring mechanisms must be developed for:

- Biodiversity assessment at spatial and temporal scales through permanent plots along different climatic biomes
- Human-wildlife conflicts
- Scientific and indigenous knowledge on climate change
- Socioeconomic situation
- Tourism, including carrying capacity, impacts on natural resources and socioeconomic situation
- Climate change including cryosphere, rainfall and temperature
- Transboundary environmental issues

Policy and enabling environment

Policy and institutional development issues must be addressed to create an enabling environment for landscape level conservation and development.

- Harmonization of landscape conservation and development policies among KL countries
- Comprehensive policy and legislation for landscape level conservation and development
- Harmonization of national policies and laws
- Development of effective mechanism for multi-stakeholder participation
- Environment-friendly local governance
- Enable transboundary eco-tourism in KL
- Development of a knowledge management centre for effective knowledge dissemination



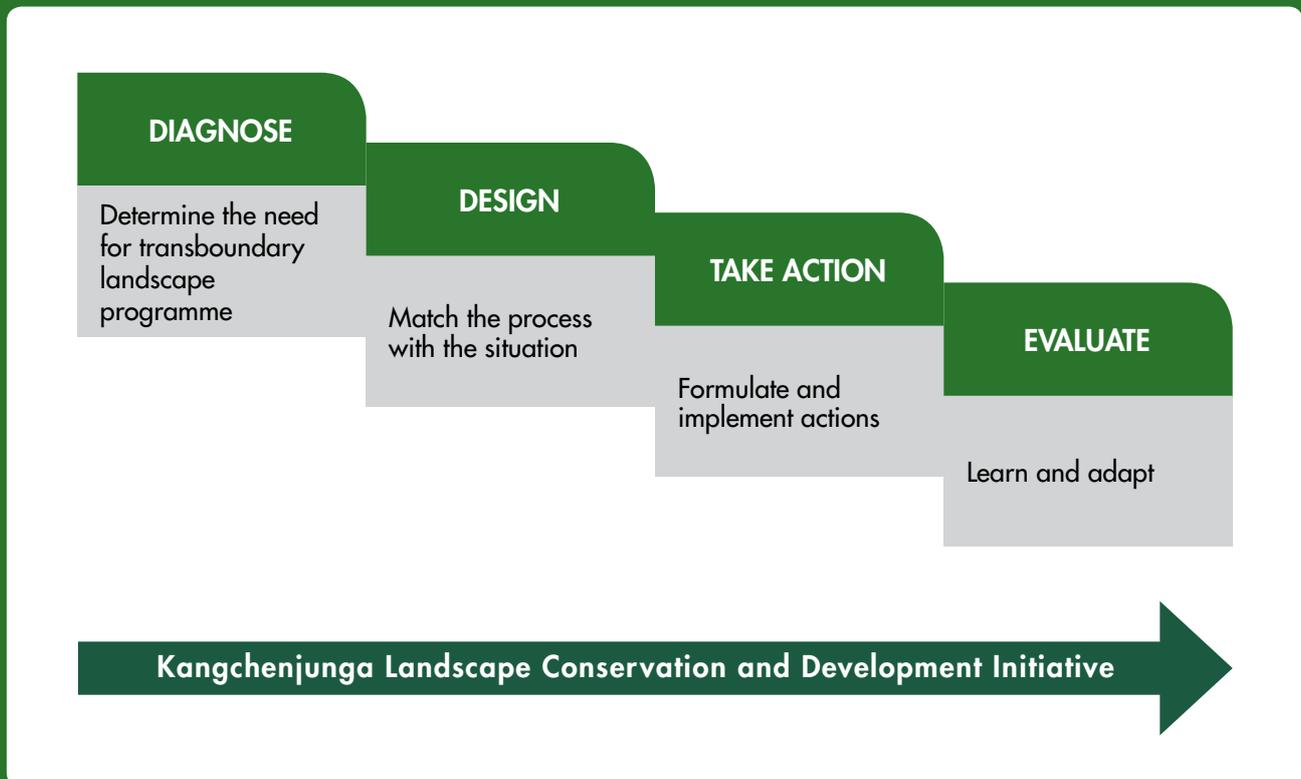
Recommendations and Ways Forward

The KL is among the richest landscapes within the Himalaya Biodiversity Hotspots and an important transboundary area for biodiversity conservation. It is home to flagship wildlife species such as the snow leopard and takin that reside in highland areas, as well as the Bengal tiger, Asian elephant and one-horned rhino that are found in the lowlands of the landscape. It is also home to many threatened and endemic species of plants and animals. The biodiversity of the landscape is further enriched by diverse ethnic groups and their traditional livelihoods and ways of managing natural resources.

The three countries in the landscape share many of the local and national issues and challenges in conservation and development. Additionally, there are transboundary issues that must be addressed in order to ensure that the rich biodiversity of the KL is conserved and can continue to provide ecosystem services to future generations while enhancing local livelihoods.

The World Conservation Union (IUCN) has identified the four common stages of transboundary conservation programmes: diagnosing the situation to understand the problems or opportunities in the landscape; designing the process for the programme including agreeing on a common transboundary vision; taking action through the formulation and implementation of actions; and conducting an ongoing process of monitoring, evaluation and adapting as necessary (Figure 16) (Erg et al., 2012). This feasibility assessment report contributes to the diagnostic framework of this process.

Figure 16: Four common stages of transboundary landscape programme



Source: Erg et al. 2012

Guiding Principles for KLCDI

The KLCDI is an opportunity to achieve biodiversity conservation and sustainable development in a transboundary landscape using the ecosystem approach to achieve socioeconomic, cultural and environmental security (Sharma et al., 2007; Phuntsho et al., 2012). The transboundary approach is based on the following guiding principles:

- **Participatory management** – ensuring the participation of indigenous and local communities, as well as disadvantaged and socially marginalized groups, for biodiversity conservation and management and sustainable livelihoods
- **Equitability** – ensuring fair and equitable sharing of benefits arising from genetic and biodiversity resources
- **Sustainability** – aiming for economic, social and environmental sustainability
- **Ecosystem approach** – adopting an integrated approach for socioeconomic, cultural and environmental security
- **Partnerships** – building partnerships among local communities, government and non-government institutions, the private sector, and financial institutions
- **Lessons-learned approach** – applying lessons learned from other transboundary mountain programmes including the Alpine Convention, the Carpathian Convention, Mount Everest transboundary programme, Sacred Himalayan Landscape programme, and Kailash Sacred Landscape Conservation and Development Initiative
- **Transboundary cooperation** – promoting and strengthening transboundary cooperation for conservation and sustainable development in the KL.

Recommendations

Based on the conservation and development priorities identified earlier, the following priorities are recommended for KLCDI.

Ensure human well-being through the maintenance of ecosystem functions and services in the landscape:

- Sustainable management of key ecosystems, particularly those that are transboundary in nature
- Ensuring equitable governance of natural resources with special emphasis on increasing participation and leadership of women and disadvantaged social groups
- Promote wise and sustainable use of natural resources and support renewable energy while controlling wildlife poaching and illegal trade of wildlife and plants
- Use tools such as value addition, product diversification, REDD+, and ecotourism to enhance local livelihoods while ensuring ecosystem services.

Increase the resilience of communities and ecosystems so that they can better adapt to environmental changes:

- Use integrated landscape approaches and conservation corridors to restore and improve ecosystems and genetic resources
- Reduce human-wildlife conflict through integrated approaches
- Promote community-based resilience and mitigation measures while increasing the adaptive capacity of local communities and ecosystems.

Monitor the changes in key aspects of biodiversity and ecosystem services and predict future changes in light of national, regional and global vulnerabilities:

- Develop and implement monitoring frameworks for assessing changes at national and regional levels
- Promote a regional forum for knowledge sharing and exchange.

Improve cooperation among KL member countries for sustainable ecosystem management that contributes to both livelihood benefits, as well as to global conservation agendas:

- Support and strengthen bilateral agreements that deal with issues of natural resources.

This Regional Synthesis FAR will be supported by the following major documents for KLCDI:

KLCDI Conservation and Development Strategy: The regional CDS for the KL is the core document that will define the goal and objectives of the KLCDI. It will provide strategic guidance for achieving the goal and objectives through specific approaches and targets. The regional CDS for the landscape will be prepared by compiling and analysing country level CDS documents.

KLCDI Programme Implementation Plan: The KLCDI Implementation Plan will synthesize the activities of country level implementation plans for achieving the goal and objectives defined in the CDS document. The Implementation Plan will also include a theory of change and a comprehensive monitoring and evaluation plan.



The Kangchenjunga range – view from Pathibhara Temple, Taplejung, Nepal



Gorkhay Village, West Bengal, India

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Glossary of Terms

Adaptation	¹ 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.
Agrobiodiversity	¹ The diversity of plants, insects and soil biota associated with cultivated systems.
Biodiversity	¹ 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	¹ A process of strengthening or developing well-equipped and able human resources, institutions, organizations, or networks in order to enhance their performance.
Climate change	¹ 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	¹ Instituted or run by communities and formalized through participatory approaches.
Corridor	¹ '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 <i>biodiversity corridors</i> , which are large scale landscape linkages synonymous with landscape corridors; <i>dispersal corridors</i> , which promote movement or migration of specific species or groups of species, often simply called 'corridors'; <i>ecological corridors</i> , which maintain and restore ecological services; and <i>habitat corridors</i> , 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 origin (Bennett, 2003), corridors can be natural habitat corridors (e.g., streams and riparian zones following topographic or environmental contours); or planted habitat corridors.
Deforestation	¹ Conversion of forest into non-forest land use.
Development	² Development in the context of KLCDI can be understood as initiatives and interventions based on the management of ecosystem goods and services which contribute to a healthy ecosystem, livelihoods, and human well-being in a sustainable and equitable manner.
Driver of change	¹ Any natural or human-induced factor that directly or indirectly causes a change in a system.
Ecosystem	¹ 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	¹ 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 function	¹ 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	¹ 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	¹ Species that elicit a strong and positive emotional response.
Indicator species	¹ 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	¹ 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	¹ The physical coverage of land, usually expressed in terms of vegetation cover or lack of it.
Land use	¹ Use of land for a certain purpose such as settlement, agriculture, or irrigation.
Landscape	¹ 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 management	¹ 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.
Mitigation	¹ A human intervention to reduce the human impact on the climate system; it includes strategies to reduce greenhouse gas sources and emission and enhance greenhouse gas sinks.
Planned adaptation	¹ Adaptation that is the result of a deliberate policy decision based on awareness that conditions have changed or are about to change.
Protected area	¹ 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	¹ 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.
Valuation	¹ The process of expressing value for particular goods or service, usually in terms of monetary measures, but also accentuated through non-tangible, existence, or option value-based measures.
Vulnerability	¹ 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.

References

- ¹ Shakya, B., Chettri, N., & Rawat, G.S. (2012). *Transboundary Landscape Management Framework for Ecological and Socioeconomic Resilience*. ICIMOD Working Paper 2012/7. Kathmandu: ICIMOD.
- ² ICIMOD. (2014). *Workshop Proceedings KL Conservation and Development Initiative (KLCDI) – Regional Workshop on the Preparation of Conservation and Development Strategies, Pokhara, Nepal, 26 to 29 August 2014*. Kathmandu: ICIMOD.

Annex 1a: Threatened plant species in the Kangchenjunga Landscape

Family	Species	IUCN*	CITES	Threatened status**		
				KL-Bhutan	KL-India	KL-Nepal
Aceraceae	<i>Acer osmastoni</i>				√ (E)	
	<i>Calamus inermis</i>				√ (E)	
Anacardiaceae	<i>Choerospondias axillaris</i>			√		√ (V)
Apiaceae	<i>Pimpinella tongloensis</i>				√ (E)	
	<i>Pimpinella wallichii</i>				√ (E)	
Araliaceae	<i>Panax pseudoginseng</i>			√	√ (E)	
Asclepiadaceae	<i>Ceropegia hookerii</i>		II		√ (T)	√ (T)
	<i>Ceropegia lucida</i>				√ (E)	
Asteraceae	<i>Lactuca cooperi</i>				√ (E)	
Berberidaceae	<i>Sinopodophyllum hexandrum</i>	V		√		√ (V)
Boraginaceae	<i>Maharanga emodi</i>					√ (T)
Cycadaceae	<i>Cycas pectinata</i>				√ (V)	
Dioscoreaceae	<i>Dioscorea deltoidea</i>		II			√ (T)
	<i>Dioscorea prazeri</i>		II			√ (T)
Ericaceae	<i>Rhododendron barbatum</i>			√	√ (V)	
	<i>Rhododendron niveum</i>				√ (V)	
Fagaceae	<i>Lithocarpus fenestratus</i>					√ (T)
Gentianaceae	<i>Swertia chirayita</i>			√		√ (V)
Juglandaceae	<i>Juglans regia</i>	NT		√		√ (GoN-I, III)
Lauraceae	<i>Cinnammum glauscescens</i>					√ (T; GoN-II)
Magnoliaceae	<i>Magnolia campbelli</i>		II	√		√ (T)
	<i>Magnolia globosa</i>	LC	II			√ (T)
	<i>Michelia champaca</i>		II	√		√ (E)
	<i>Michelia kisopa</i>					
	<i>Michelia velutina</i>		II			√ (T)
Orchidaceae	<i>Cymbidium eburneum</i>				√ (V)	
	<i>Cymbidium hookerianum</i>				√ (V)	
	<i>Cymbidium whiteae</i>				√ (E)	
	<i>Didickea cunninghamii</i>				√ (E)	
	<i>Paphiopedilum venustum</i>				√ (V)	
	<i>Zeuxine pulchra</i>				√ (E)	
Pinaceae	<i>Abies spectabilis</i>	NT				√ (GoN-II)
	<i>Larix griffithiana</i>	LC		√		√ (R, T)
	<i>Pinus roxburghii</i>	LC				√ (T)
Polygonaceae	<i>Rheumobile</i>			√		√ (T)
Ranunculaceae	<i>Aconitum ferox</i>			√	√ (E)	
	<i>Aconitum spicatum</i>			√		√ (T)
Saxifragaceae	<i>Bergenia ciliata</i>					√ (T)
Scrophulariaceae	<i>Picrorhiza kurrooa</i>			√	√ (V)	
	<i>Neopicrorhiza scrophulariiflora</i>		II			√ (V, GoN-I)
Taxaceae	<i>Taxus wallichiana</i>	E	II			√ (V, GoN-II)
Tetracentraceae	<i>Tetracentron sinense</i>		III			√ (T)
Trilliaceae	<i>Paris polyphylla</i>					√ (V)
Valerianaceae	<i>Nardostachys grandiflora</i>		II	√	√ (V)	√ (V)

* IUCN Categories: E=Endangered; V=Vulnerable; NT=Near Threatened; LC=Least Concern

** National categories: E=Endangered; V=Vulnerable; T=Threatened; R=Rare

Source: GBPNIHESD (2014), RECAST (2014), WCD (2014)

Annex 1b: Threatened mammal species in the Kangchenjunga Landscape

Family	Species	Common name	IUCN*	CITES	Presence		
					KL-Bhutan	KL-India	KL-Nepal
Ailuridae	<i>Ailurus fulgens</i>	Red panda	EN	I	√	√	√ (E,P)
Bovidae	<i>Nemorhaedus goral</i>	Goral		I	√	√	√ (S)
	<i>Hemitragus jemlahicus</i>	Himalayan tahr	NT			√	√ (S)
	<i>Capricornis thar</i>	Himalayan serow	NT	I	√	√	√
	<i>Budorcas taxicolor</i>	Takin	VU	II	√	√	
Canidae	<i>Canis lupus</i>	Grey wolf		I			√ (S,P)
Cercopithecidae	<i>Macaca assamensis</i>	Assamese macaque	NT	I	√	√	√ (V,P)
	<i>Macaca mulatta</i>	Rhesus macaque		II	√	√	√
	<i>Presbytus entellus</i>	Langur		I	√	√	√ (S)
Cervidae	<i>Cervus unicolor</i>	Sambar deer	VU		√		
Elephantidae	<i>Elephas maximus</i>	Asian elephant	EN	I	√	√	√ (E,P)
Felidae	<i>Felis chaus</i>	Jungle cat		II			√ (S)
	<i>Felis temminckii</i>	Golden cat		I	√	√	√ (V,P)
	<i>Panthera pardus</i>	Common leopard		I			√ (S)
	<i>Panthera tigris</i>	Bengal tiger	EN	I		√	√
	<i>Neofelis nebulosa</i>	Clouded leopard	VU	I	√		√ (V,P)
	<i>Prionailurus bengalensis</i>	Leopard cat		II			√ (V,P)
	<i>Cuon alpinus</i>	Wild dog/dhole	EN	II	√	√	√ (V)
	<i>Panthera uncia</i>	Snow leopard	EN	I	√	√	√ (E,P)
Manidae	<i>Manis pentadactyla</i>	Chinese pangolin		II			√ (S,P)
	<i>Manis crassicaudata</i>	Indian pangolin	EN			√	√
Moschidae	<i>Moschus chrysogaster</i>	Alpine musk deer	EN	I	√	√	√ (E,P)
	<i>Moschus fuscus</i>	Black musk deer	EN	I			√ (E,P)
	<i>Moschus leucogaster</i>	Himalayan musk deer	EN	I			√ (E,P)
Mustelidae	<i>Lutra lutra</i>	Common otter		I		√	√ (S)
	<i>Lutrogale perspicillata</i>	Smooth-coated otter	VU	II			√ (S)
	<i>Aonyx cinerea</i>	Asian small-clawed otter	VU			√	√
Rhinocerotidae	<i>Rhinoceros unicornis</i>	Indian rhinoceros	VU	I		√	
Sciuridae	<i>Ratufa bicolor</i>	Black giant squirrel		II			√ (E)
Ursidae	<i>Ursus thibetanus</i>	Himalayan black bear	VU	I	√	√	√ (V,P)
	<i>Melursus ursinus</i>	Sloth bear	VU	I	√		
Viverridae	<i>Prionodon pardicolor</i>	Spotted linsang		I			√ (E,P)

* CR= Critically endangered, NT= Near threatened, VU= Vulnerable

Source: GBPNIHESD (2014), RECAST (2014), WCD (2014)

Annex 1c: Threatened bird species in the Kangchenjunga Landscape

Family	Species	Common name	IUCN*	CITES	Presence		
					KL-Bhutan	KL-India	KL-Nepal
Phasianidae	<i>Arborophila mandellii</i>	Chestnut-breasted partridge	VU			√	
	<i>Tragopan satyra</i>	Satyr tragopan	NT	III	√	√	√
Gruidae	<i>Grus nigricollis</i>	Black-necked crane	VU	I	√	√	
Anatidae	<i>Aythya nyroca</i>	Ferruginous pochard	NT			√	
	<i>Aythya baeri</i>	Baer's pochard	CR			√	
Picidae	<i>Mulleripicus pulverulentus</i>	Great slaty woodpecker	VU			√	
Bucerotidae	<i>Buceros bicornis</i>	Great hornbill	NT		√	√	
	<i>Aceros nipalensis</i>	Rufous-headed hornbill	VU		√	√	
Scolopacidae	<i>Gallinago nemoricola</i>	Wood snipe	VU		√	√	√
Accipitridae	<i>Haliaeetus leucoryphus</i>	Pallas's fish-eagle	VU			√	
	<i>Ichthyophaga humilis</i>	Lesser fish-eagle	NT	II		√	
	<i>Gyps bengalensis</i>	White-rumped vulture	CR	II		√	√
	<i>Gyps himalayensis</i>	Himalayan griffon vulture	NT		√		
	<i>Gyps tenuirostris</i>	Slender-billed vulture	CR	II		√	√
	<i>Sarcogyps calvus</i>	Red-headed vulture	CR	II		√	√
	<i>Aquila clanga</i>	Greater spotted eagle	VU	II		√	√
	<i>Aquila heliaca</i>	Imperial eagle	VU	I		√	
Falconidae	<i>Falco naumanni</i>	Lesser kestrel		II		√	
Anhingidae	<i>Anhinga melanogaster</i>	Oriental darter	NT			√	
Threskiornithidae	<i>Threskiornis melanocephalus</i>	Black-headed ibis	NT			√	
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked stork	NT			√	
	<i>Leptoptilos javanicus</i>	Lesser adjutant	VU			√	√
Turdidae	<i>Brachypteryx hyperythra</i>	Rusty bellied shortwing	NT			√	
Sittidae	<i>Sitta formosa</i>	Beautiful nuthatch	VU			√	

* CR= Critically endangered, NT= Near threatened, VU= Vulnerable
Source: GBPNIHESD (2014), RECAST (2014), WCD (2014)

Annex 2a: Legislation and policies supporting conservation and sustainable development in KL-Bhutan.

General	<ul style="list-style-type: none"> • Constitution of the Kingdom of Bhutan 2008 • DYT and GYT <i>Chathrim</i>s 2002
Biodiversity/forests	<ul style="list-style-type: none"> • Forest Policy of Bhutan 1974 • National Forest Policy 2011 (Revision of Forest Policy 1974) • Forest and Nature Conservation Act 1995 • Seed Act of Bhutan 2000 • Biodiversity Act of Bhutan 2003 • Forest and Nature Conservation Rules of Bhutan 2006
Environment	<ul style="list-style-type: none"> • Environmental Assessment Act 2000 • National Environment Protection Act 2007 • Waste Prevention and Management Act 2009 • Water Act of Bhutan 2011 • Bhutan Water Policy 2003
Livelihoods	<ul style="list-style-type: none"> • Plant Quarantine Act 1993 • Seeds Act of Bhutan 2000 • Pesticide Act of Bhutan 2000 • Land Act of Bhutan 2007 (Amendment of Land Act 1979) • Biosecurity Policy of the Kingdom of Bhutan 2010 • Economic Development Policy of the Kingdom of Bhutan 2010

Source: WCD (2014)

Note: For detailed information, please refer to the Feasibility Assessment Report of KL-Bhutan.

Annex 2b: National policies that govern conservation and sustainable use of natural resources in KL-India.

Sector	Acts	Policies and Plans
Biodiversity/forests	<ul style="list-style-type: none"> • Indian Forest Act 1927 • Wild Life (Protection) Act 1972 • Forest (Conservation) Act 1980 • National Biological Diversity Act 2002 and Rules 2004 	<ul style="list-style-type: none"> • National Wildlife Action Plan 1983 • National Forest Policy 1988 • National Biodiversity Action Plan 2008
Environment		<ul style="list-style-type: none"> • National Water Policy 1987 • National Conservation Strategy and Policy Statement for Environment and Sustainable Development 1992 • National Environment Policy 2006 • National Action Plan on Climate Change 2008 • Wetlands (Conservation and Management) Rules 2010 • Document on National Mission for Sustaining the Himalayan Ecosystem 2010
Livelihoods	<ul style="list-style-type: none"> • Provisions of the Panchayats (Extension to the Scheduled Areas) Act 1996 • Protection of Plant Varieties and Farmers' Rights Act 2001 • National Rural Employment Guarantee Act 2005 • Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 • National Food Security Act 2013 	<ul style="list-style-type: none"> • National Tourism Policy 1982 • National Agricultural Policy 2000 • National Policy for Farmers 2007 • National Livestock Policy 2013 • National Agroforestry Policy 2014

Source: GBPNIHESD (2014)

Note: For detailed information, please refer to the Feasibility Assessment Report of KL-India.

Annex 2c: State-level policies that govern conservation and sustainable use of natural resources in KL-India.

Sikkim	<ul style="list-style-type: none"> • Joint Forest Management 1998 • State Green Mission 2006 • Ten Minutes to Earth 2009 • Glacial Commission 2007 • Himal Rakshak (Mountain Guard) 2007 • State Action Plan on Climate Change • Sikkim Ecotourism Policy 2012 • Sikkim Biodiversity Action Plan 2012 • Economic valuation of forest products 2010
North Bengal (Darjeeling, Jalpaiguri and Alipurduar districts)	<ul style="list-style-type: none"> • West Bengal Private Forest Act 1948 • West Bengal Protected Forest Rules 1956 • West Bengal Forest-Produced Transit Rules 1959 • West Bengal Forest (Establishment and Regulation of Saw Mills and other Wood-based Industries) Rules 1982 • West Bengal Inland Fisheries Act 1984 • West Bengal Inland Fisheries (Amendment) Act 1993 and 2008 • West Bengal Ground Water Resource (Management, Control and Regulation) Act 2005 • West Bengal Biological Diversity Rules 2005 • West Bengal Trees (Protection and Conservation in Non Forest Areas) Act 2006 • West Bengal Trees (Protection and Conservation in Non Forest Areas) Rules 2007 • National Bamboo Mission 2007 • West Bengal State Action Plan on Climate Change 2010 • West Bengal Food Processing Industry Policy 2011 • West Bengal Wetlands and Water Bodies Conservation Policy 2012 • Biotechnology policy of West Bengal 2013 • STI Policy for women 2013

Source: GBPNIHESD (2014)

Note: For detailed information, please refer to the Feasibility Assessment Report of KL-India.

Annex 2d: Legislation and policies supporting conservation and sustainable development in KL-Nepal.

Sector		Acts	Policies and Plans
Biodiversity/forests	Constitution of Nepal 2015 Periodic National Plans: 11th Plan; 12th Plan Approach Paper; 13th Plan Approach Paper	<ul style="list-style-type: none"> • Aquatic Animals Protection Act 1961 • National Park and Wildlife Conservation Act 1973 • Forest Act 1993 	<ul style="list-style-type: none"> • National Parks and Wildlife Conservation Regulation 1974 • Himalayan National Parks Regulations 1980 • Master Plan for Forestry Sector 1988 • Forest Regulations 1995 • Buffer Zone Management Regulations 1996 • Conservation Area Management Regulation 1997 • Revised Forest Policy 2000 • Nepal Biodiversity Strategy 2002 • Leasehold Forest Policy 2002 • Herbs and Non Timber Forest Products Development Policy 2006 • Sacred Himalayan Landscape-Nepal Strategic Plan 2006-2016 • National Bio-safety Framework 2007 • Churia Area Program Strategy 2008 • Forestry Sector Gender and Social Inclusion Strategy 2008 • Kangchenjunga Conservation Area Management Regulation 2008 • Forest Fire Management Strategy 2010 • Rangeland Policy 2012 • Forest Encroachment Control Strategy 2012 • Forestry Sector Protection/Security Plan 2013
Environment		<ul style="list-style-type: none"> • Soil and Watershed Conservation Act 1982 • Electricity Act 1992 • Water Resources Act 1992 • Environment Protection Act 1996 • Plant Protection Act 2007 	<ul style="list-style-type: none"> • Water Resources Regulation 1993 • Drinking Water Regulations 1998 • Environmental Protection Regulation 1999 • Water Resources Strategy 2002 • National Water Plan-Nepal 2005 • Climate Change Policy 2011 • National Wetlands Policy 2012 • Environment Friendly Local Governance Framework 2013
Livelihoods		<ul style="list-style-type: none"> • Pasture Land Nationalization Act 1974 • Tourism Act 1978 • Seed Act 1988 • Nepal Tourism Board Act 1997 • Livestock Health and Livestock Services Act 1998 • Local Self Governance Act 1999 	<ul style="list-style-type: none"> • Lands Regulation 1964 • Land Acquisition Regulation 1969 • Electricity Regulation 1993 • Agriculture Perspective Plan 1995 • Local Self Governance Regulation 2000 • Land Survey and Measurement Regulation 2002 • Sustainable Development Agenda for Nepal 2003 • Irrigation Regulations 2003 • National Agriculture Policy 2004 • National Agrobiodiversity Policy 2007 • Tourism Policy 2009 • National Land Use Policy 2012 • Irrigation Policy 2013

Source: RECAST (2014)

Note: For detailed information, please refer to the Feasibility Assessment Report of KL-Nepal.



United Nations Decade on Biodiversity

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ISBN 978 92 9115 480 7