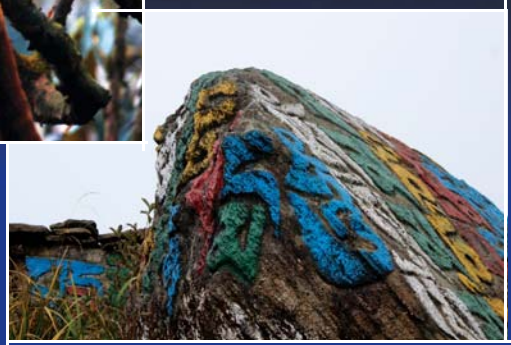
KANGCHENJUNGA LANDSCAPE NEPAL

from conservation and development perspectives



ICIMOD

KANGCHENJUNGA LANDSCAPE NEPAL

from conservation and development perspectives

Ram P. Chaudhary
Yadav Uprety
Surya P. Joshi
Krishna K. Shrestha
Khadga B. Basnet
Govinda Basnet
Krishna R. Shrestha
Kuber P. Bhatta
Krishna P. Acharya
Nakul Chettri

February 2015

All photographs by authors, unless otherwise stated.

Photographs
Front cover: Kangchenjunga mountain range; Red panda (photo by Sonam Tashi Lama);
Asian elephant (photo by Narendra B. Pradhan); A sacred stone in Ilam district
Front inside (*clockwise from top left*): Winged thorn rose, 'Jangali gulaf' (*Rosa sericea*); Indian aconite, 'Atis' (*Aconitum heterophyllum*); Himalayan marsh orchid, 'Paanch aunle' (*Dactylorhiza hatagirea*); Himalayan May apple, 'Laghu patra' (*Sinopodophyllum hexandrum*)
Back cover: A waterfall along the way to Olangchung Gola, Taplejung
Back inside: Kechana pillar in Jhapa district, the lowest point in KL Nepal

Published By
Ministry of Forests and Soil Conservation (MoFSC), Government of Nepal
Research Centre for Applied Science and Technology (RECAST), Tribhuvan University and
International Centre for Integrated Mountain Development (ICIMOD).

ISBN: 978-9937-2-9275-7 (printed)
978-9937-2-9274-0 (electronic)

Citation
Chaudhary, R.P., Uprety, Y., Joshi, S.P., Shrestha, K.K., Basnet, K.B., Basnet, G., Shrestha, K.R., Bhatta, K.P., Acharya, K.P., and Chettri, N. 2015. Kangchenjunga Landscape Nepal: from conservation and development perspectives. Ministry of Forests and Soil Conservation (MoFSC), Government of Nepal; Research Centre for Applied Science and Technology (RECAST), Tribhuvan University; and International Centre for Integrated Mountain Development (ICIMOD). Kathmandu, Nepal.

Reviewer
Dr. Ganesh Raj Joshi, former Secretary, Ministry of Forests and Soil Conservation, Government of Nepal

Editor
Mr. Deependra Joshi

Design and Printed at
Ultimate Marketing (P.) Ltd.
Ranibari, Lazimpat, Kathmandu, Nepal
4352223 | info@marketingultimate.com

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ACKNOWLEDGEMENTS

This book is based on the research experience gained through feasibility assessment study of the Kangchenjunga Landscape (KL) Nepal. We extend our sincere gratitude for the support of many individuals and organizations for their contribution in making this book possible. We are grateful to International Centre for Integrated Mountain Development (ICIMOD) for the financial and technical support that was provided to Research Centre for Applied Science and Technology (RECAST).

We express our gratitude to Mr. Sharad Chandra Paudel, Secretary of the Ministry of Forests and Soil Conservation (MoFSC), Government of Nepal (GoN) and Dr. Ganesh Raj Joshi, former Secretary of MoFSC, GoN, for their valuable comments on the Feasibility Assessment Report. The generous support of Dr. Rajan Kumar Pokharel, Director General, Department of Forests, is highly appreciated. The advice and suggestions provided by Chief District Officers Mr. Ekmani Nepal (Jhapa), Mr. Narhari Baral (Taplejung), Mr. Pradip Raj Kandel (Panchthar) and Local Development Officers Mr. Tirtha Prasad Dhital (Taplejung), Mr. Lalmani Ojha (Jhapa), Mr. Bharat Mani Pandey (Taplejung) and Mr. Bhanu Bhakta Baral (Panchthar) are greatly acknowledged. Similarly, we are thankful to the District Forest Officers Mr. Rajendra Kafle, Mr. Sagar Rimal, Mr. Bishnu Prasad Bhandari, Mr. Indra Mani Bhandari, Mr. Mahendra Chaudhary, Mr. Dhirendra Prasad Singh and the staff of the District Forest Offices of KL Nepal districts for their support during the field work. Sincere thanks are also due to Mr. Shiva Kumar Wagley, Under Secretary, MoFSC, GoN, for his coordination during the field visit. Valuable comments from Dr. Rajan Kotru, Dr. Uma Pratap, Dr. Rucha Ghate and Ms. Marjorie Van Strien of ICIMOD on earlier versions of the manuscript helped us to improve this book.

Many people have generously provided their valuable suggestions in this book during the field works, and we thank them all. Particularly, we are thankful to Mr. Laxmi Prasad Kharel, District Agricultural Development Officer, Taplejung; Mr. Lakshya Chaudhary, District Agriculture Development Office, Panchthar; Mr. Gynendra Chaudhary, Environmental Officer, District Development Committee, Jhapa; Mr. Khagendra Limbu, Chairman, Kangchenjunga Conservation Area Management Council (KCAMC), Taplejung; Mr. Sujit Kumar Shrestha, WWF Nepal, Taplejung; Mr. Hirakaji Ghale and Mr. Yogendra Shrestha of Namsaling Community Development Centre (NCDC), Ilam; Ms. Roshani Limbu, KCAMC, Taplejung; Federation of Community Forestry Users Nepal (FECOFUN) District chapters of KL Nepal; members of Women's Group, Lelep, Taplejung; commuity members of Jalthal Forest User Group, Jhapa; community members of Bahundangi village, Jhapa; members of Himsikhar Community Forest User Group, Pauwa Bhanjyang, Panchthar; participants of stakeholders' and community meetings in KL Nepal; and all the political parties of KL Nepal. We would like to thank the communities of KL Nepal who willingly shared their experience, concerns and aspirations.

We are thankful to Dr. Manohara Khadka, Dr. Keshav Sharma and Mr. Binod Parajuli for their contribution on this book. We appreciate the help received from Mr. Kabir Uddin, ICIMOD, Mr. Santosh Karki, Mr. Santosh Kumar Rana, Central Department of Botany (CDB), TU, Kirtipur for their contribution with GIS. Again, Mr. Yam Aryal and Mr. Tej Basnet from Central Department of Zoology, TU, deserve special appreciation for the preparation of the list of fauna. Similarly, contribution of Mr. Rajesh Tamang and Mr. Prabin Bhandari from CDB, TU, is acknowledged for compiling the list of flora. We are thankful to all researchers whose findings have been cited in this book.

Finally, our sincere thanks are due to Mr. Keshav Poudel, Joint Administrator of RECAST, Faculty of RECAST, staff of MoFSC and ICIMOD, for their logistics support. We highly acknowledge and appreciate the tireless efforts of Mr. Deependra Joshi, Editor, for editing, layout, and bringing this report to a close.

Authors

Government of Nepal
Ministry of Forests and Soil Conservation

Ph. 4211567, 4211892, 4211928, 4211936, 4211742
Fax. 4211862, 4211868

P.O.Box No. 3987
Singha Durbar, Kathmandu

FOREWORD

Kangchenjunga Landscape in Nepal is a part of Himalayan biodiversity hotspot which is rich in biological and cultural diversity. The landscape provides habitat for several flagship species of global importance as well as ecosystem services to millions of people living around and at transboundary scale as well as downstream. Importance of transboundary landscape has been demonstrated by the movement of snow leopard in wider areas of Nepal and India in the landscape. The landscape, however, is facing a lot of conservation and development challenges in the context of anthropogenic activities, land use and land cover changes and climate change. The Kangchenjunga Landscape Conservation and Development Initiative (KLCDI) is a collaborative initiative undertaken by the Ministry of Forests and Soil Conservation (MoFSC) with technical and financial support of International Centre for Integrated Mountain Development (ICIMOD) and Research Centre for Applied Science and Technology (RECAST), Tribhuvan University, Nepal.

Conservation of forests and natural resources at landscape level on a sustainable long-term basis has been a strategy adopted in Nepal by MoFSC, and this is being promoted by the policies and periodic plans of Nepal. Nepal is a party to multilateral environment agreement including the Convention on Biological Diversity (CDB), and is committed towards fulfillment of the commitment for conservation and sustainable use of biological diversity. MoFSC has been undertaking possible initiatives for conserving the natural and cultural heritage of the country from individual species to landscape level. Participatory forest management and protected area management programmes are getting widely encouraged by the MoFSC and is accepted by wider society that have added greater value to natural resource management. People of Nepal, including indigenous and local communities, have become more aware about conservation and development.

This book is an outcome of an effective collaboration between MoFSC, Tribhuvan University, Nepal, and ICIMOD. I am happy to see the publication and congratulate the authors for producing a high quality book. I take this opportunity to thank to ICIMOD for financial support, and to RECAST for coordinating and collaborating the KLCDI.

Last, but not the least, I thank the staff members of MoFSC for help and facilitation, ICIMOD, for technical and financial support, RECAST for coordination and collaboration of the project, and all the agencies and individual experts for their valuable suggestions. The information provided in the book will be useful to implement the project in Nepal. I am looking forward for an effective collaboration and cooperation among the partners for the implementation of KLCDI.

Sharad Chandra Paudel
Secretary

TRIBHUVAN UNIVERSITY
Kirtipur, Kathmandu, Nepal

OFFICE OF THE VICE CHANCELLOR

FOREWORD

It is my pleasure to write the Foreword to this book, which is prepared by experts from the Tribhuvan University (TU), Ministry of Forests and Soil Conservation (MoFSC), and International Centre for Integrated Mountain Development (ICIMOD) as well as independent experts under the collaborative efforts of MoFSC, ICIMOD, and Research Centre for Applied Science and Technology (RECAST) based on the interaction and research undertaken by natural resource and social scientists for the conservation and sustainable development of Kangchenjunga Landscape (KL).

The book "Kangchenjunga Landscape Nepal: From Conservation and Development Perspectives" comprises comprehensive information covering physical, socio-economic, biological and environmental aspects of Kangchenjunga Landscape in eastern Nepal, an important landscape with extraordinary biological and cultural diversity, as well as water resources. The publication covers interdisciplinary areas related to the conservation and development process such as peoples' livelihoods, ecosystem management, resource governance, climate change, etc.

The information given in the book are important for conservation and development at national and local level perspectives as well as at global and regional scales where the issues of management of transboundary resources and impact of climate change are apparent and getting more and more attention by a wider sectors of the society. I sincerely hope that this book will be interesting and valuable to the scientists, natural resources managers, planners, policy makers, and indigenous and local communities at large.

I congratulate the book authors for their outstanding contribution comprising conceptual and field-based research. I also hope that this will be a source of inspiration to others to bring out similar publications to strengthen collaboration with governmental and non-governmental organizations.

On behalf of Tribhuvan University, I would like to extend my sincere appreciation to MoFSC and ICIMOD for their assistance extended to RECAST in various ways.

Prof. Dr. Hira Bahadur Maharjan
VIce-Chancellor

Tel: 4330433/4330434, Fax: 977-1-4331964, E-mail: vcoffice@tribhuvan-university.edu.np, P.O. Box No. 8212

David Molden, Ph.D.
Director General

ICIMOD

FOR MOUNTAINS AND PEOPLE

FOREWORD

The mountains of Nepal are home to rich cultural and biological diversity and are an important source of water for the region. Government agencies, civil society, research organizations, and individuals all play an important role in conserving this unique cultural and natural heritage. In the face of emerging environmental and socioeconomic challenges, Nepal has become a leader in the implementation of innovative conservation and development approaches. Through the promotion of community forestry, introduction of species-level conservation programmes, increasing coverage of protected areas, and recent shifts toward landscape-level and zero poaching efforts, Nepal has earned a place on the global list of conservation successes.

I am delighted to see the progress our partners in the transboundary Kangchenjunga Landscape Conservation and Development Initiative (KLCDI) have made. The KLCDI is a process initiated between Bhutan, India and Nepal that seeks to conserve and sustainably manage a highly unique and special landscape through the application of the ecosystem approach at a transboundary landscape level. This initiative is making important contributions toward global conservation targets set by the Convention on Biological Diversity, and is promoting the goals and approach described in the Convention's Programme of Work on Mountain Biodiversity and the Aichi Biodiversity Targets.

ICIMOD is honoured to partner with the Ministry of Forests and Soil Conservation of the Government of Nepal, which led the preparatory phase of this important landscape initiative with technical support from the Research Centre for Applied Science and Technology (RECAST) of Tribhuvan University. This publication documents the findings of a feasibility assessment conducted in Nepal, with sound analysis from both primary and secondary information available on the Kangchenjunga Landscape in Nepal. It highlights the need for a transboundary approach to conservation and development, as well as the need to enhance landscape-level collaboration.

The book presents a rich collection of social, ecological, and environmental perspectives with comprehensive documentation of biodiversity, agricultural practices, and livelihood options in the Kangchenjunga Landscape in Nepal. It also highlights challenges to the ecosystems and communities of the landscape, including those that call for regional cooperation and collective action, such as the illegal trade of high-value plant and animal species.

I would like to express my sincere thanks to Mr. Sharad Chandra Paudel, Secretary of the Ministry of Forest and Soil Conservation, for his leadership; Mr. Krishna Acharya, Joint Secretary of the Ministry of Forest and Soil Conservation, for his guidance and support; and Prof. Ram P Chaudhary, RECAST, Tribhuvan University for steering the process. I am sure that this document will serve as the basis for future conservation and development interventions within the Kangchenjunga Landscape. Lastly, I would like to congratulate the team that made this publication possible.

David Molden, PhD
Director General, ICIMOD

International Centre for Intergrated Mountain Development
GPO Box 3226, Kathmandu, Khumaltar, Lalitpur, Nepal
TEL +977-1-5003222 **EMAIL** info@icimod.org
FAX +977-1-5003299 **WEB** www.icimod.org

समन्वित पर्वत उन्नयनेर आन्तर्जातिक संस्था
国际山地综合发展中心
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PREFACE

The natural resources, including biological diversity of Kangchenjunga Landscape (KL) Nepal, support human society ecologically, economically, culturally and spiritually. The local communities have shaped the unique cultural landscape of KL Nepal for centuries. KL Nepal is a hotspot of biodiversity containing several species and genetic diversity that provide valuable goods and services. People of KL Nepal have historically and culturally established close linkages with neighbouring countries, such as China, India as well as Bhutan.

If natural resources and cultural diversity were the measures of livelihoods, human well-being and economic prosperity, people of KL Nepal would have been rated one of the richest. However, human-induced environmental changes, from local to global scale, poverty, habitat destruction and degradation, have serious impacts on the Kangchenjunga ecosystems. It is indigenous people and local communities who suffer most when natural resources are lost. Loss and degradation of biodiversity, coupled with climate change impacts, severely threaten conservation and development efforts in KL Nepal region and beyond.

The importance of Kangchenjunga ecosystem for its biological resources has been realized since long. However, ecosystem approach to landscape level management has been initiated recently by International Centre for Integrated Mountain Development (ICIMOD). The governments of regional member countries - Government of Bhutan (GoB), Government of India (GoI) and Government of Nepal (GoN) - have been engaged in developing 'Conservation and Development Strategy (CDS)' of their respective countries; whereas ICIMOD is in the process of developing a Regional Cooperation Framework (RCF) for the conservation and development of KL Nepal.

The Kangchenjunga landscape in Nepal is in transition and faces additional challenges arising from land use land cover changes (LULC), climate change and glacier retreat, out-migration of people, human-wildlife conflict, urbanization and pollution, upstream-downstream linkages related to conservation and development. In addition to efforts at the national level, a regional cooperation at transboundary level among the partner countries would greatly expedite the efforts in addressing emerging challenges and in realizing opportunities. Such regional cooperation also offers opportunities for sharing knowledge and information, protecting indigenous knowledge of the communities, generating scientific knowledge on biodiversity and climate change contributing to policy intervention, long-term monitoring and evaluation, tourism promotion, trans-boundary trade, establishing upstream-downstream linkages, a few among many such opportunities.

Research Centre for Applied Science and technology (RECAST) is proud to bring out a book which is prepared in a consultative process with several stakeholders and in collaboration with the Ministry of Forests and Soil Conservation (MoFSC) and ICIMOD. The book presents a good collection of bio-physical, socio-economic and environmental perspectives of the KL Nepal and provides a strong foundation for the conservation and development initiative of the landscape in future.

I heartily acknowledge the support of MoFSC and ICIMOD for their relentless help and guidance in the preparation of this book, including financial support from ICIMOD. The authors sincerely thank all the experts for providing valuable information to prepare the Feasibility Assessment (FA) Report. The encouragement, inspiration and guidance received from the National Coordination Committee (NCC) and other partners during the preparation of the book is thankfully acknowledged.

I gratefully thank Mr. Sharad Chandra Paudel, MoFSC; Dr. David Molden, Dr. Eklabya Sharma and other experts of ICIMOD, for their help and support. I also acknowledge the technical team members of India and Bhutan for sharing their information during the regional meetings.

Again, I express my sincere thankfulness to all the local communities and officials working at the government line agencies, Non-governmental Organizations (NGOs) and Community-based Organizations (CBOs) for participating in the study and for sharing their valuable knowledge and concerns which has significantly contributed in finalizing this book.

Experience gained from the implementation of Kailash Sacred Landscape Conservation and Development Initiative by China, India and Nepal would be very helpful in implementing KLCDI through the meaningful participation of local communities and development partners.

Prof. Ram P. Chaudhary, PhD
Executive Director, RECAST
Collaborator - Kangchenjunga Landscape Conservation and Development Initiative (KLCDI) and
Kailash Sacred Landscape Conservation and Development Initiative (KSLCDI), Nepal

ACRONYMS AND ABBREVIATIONS

ABS	Access and Benefit Sharing
AEPC	Alternative Energy Promotion Centre
AGRBS	Access to Genetic Resources and Benefit Sharing
BPP	Biodiversity Profiles Project
CAPS	*Churia* Area Programme Strategy
CBD	Convention on Biological Diversity
CBO	Community-based Organization
CBS	Central Bureau of Statistics
CBNRM	Community-based Natural Resource Management
CCF	Conservation Community Forests
CDB	Central Department of Botany
CDO	Chief District Officer
CFUG	Community Forest User Group
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DDC	District Development Committee
DFID	Department for International Development
DFO	District Forest Office
DFRS	Department of Forest Research and Survey
DHM	Department of Hydrology and Meteorology
DoF	Department of Forests
DoHS	Department of Health Services
DNPWC	Department of National Parks and Wildlife Conservation
DPR	Department of Plant Resources
DSCWM	Department of Soil Conservation and Watershed Management
ECDF	Environment Conservation and Development Forum
EFLG	Environment-friendly Local Governance
EIA	Environmental Impact Assessment
EPA	Environment Protection Act
FECOFUN	Federation of Community Forestry Users Nepal
FY	Fiscal Year
GESI	Gender and Social Inclusion
GIS	Geographic Information System
GLOF	Glacial Lake Outburst Floods
GOs	Governmental Organizations
GoB	Government of Bhutan
GoI	Government of India
GoN	Government of Nepal
HHs	Households
HKH	Hindu Kush Himalaya
ICIMOD	International Centre for Integrated Mountain Development
IBA	Important Bird Areas
ICA	International Conservation Agreements
ICS	Improved Cooking Stove
IEE	Initial Environmental Examination
IPA	Important Plant Areas

IUCN	International Union for Conservation of Nature
KCA	Kangchenjunga Conservation Area
KCAMC	Kangchenjunga Conservation Area Management Council
KL	Kangchenjunga Landscape
KLCDI	Kangchenjunga Landscape Conservation and Development Initiative
KSLCDI	Kailash Sacred Landscape Conservation and Development Initiative
LAPA	Local Adaptation Plan of Action
LFUG	Leasehold Forest User Group
LRMP	Land Resource Mapping Project
LSGA	Local Self-Governance Act
LSMA	Land Survey Measurement Act
MAPs	Medicinal and Aromatic Plants
MEA	Multilateral Environmental Agreement
MEA	Millennium Ecosystem Assessment
MoFSC	Ministry of Forests and Soil Conservation
MoSTE	Ministry of Science, Technology and Environment
NBS	Nepal Biodiversity Strategy
NBSAP	Nepal National Biodiversity Strategy Action Plan
NCC	National Coordination Committee
NCDC	Namsaling Community Development Centre
NCSA	National Capacity Self Assessment
NGO	Non-governmental Organization
NPC	National Planning Commission
NPWCA	National Parks and Wildlife Conservation Act
NRDB	Nepal Red Data Book
NTFP	Non-Timber Forest Product
NTNC	National Trust for Nature Conservation
NWP	National Water Plan
PRC	People's Republic of China
RCF	Regional Cooperation Framework
RECAST	Research Centre for Applied Science and Technology
RPN	Red Panda Network
SHL	Sacred Himalayan Landscape
TAL	Tarai Arc Landscape
TAR	Tibet Autonomous Region
TMI	The Mountain Institute
TU	Tribhuvan University
UC	User Committee
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VDC	Village Development Committee
WUAs	Water Users' Associations
WRS	Water Resources Strategy
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

The ecosystem approach has emerged as a strategy for the management of living resources, land and water that promotes conservation and sustainable use in an equitable way. The Convention on Biological Diversity (CBD) endorsed ecosystem approach during the Fifth Conference of Parties in 2000 in order to conserve ecosystem structure and function and maintain ecosystem services. The ecosystem approach to landscape level management comprises people as an integral part of ecosystems and has become an effective means in conservation and development. In many circumstances, where the boundaries are shared among the nations with similar issues of conservation and development and the delimited area cannot restrict the movement of species and their conservation, the landscapes become transboundary. In such transboundary landscapes, the collective efforts of the transboundary countries are needed to address the issues of conservation and development.

The Kangchenjunga Complex is an important transboundary landscape in the Hindu Kush Himalaya shared by Bhutan, China, India and Nepal. The Kangchenjunga Landscape (KL), here referring to the southern part of the area around the Mt. Kangchenjunga, spreads across eastern Nepal, Darjeeling and Sikkim of India, and western Bhutan. Nepal, India and Bhutan are working together for sustainable conservation and development of the landscape by applying ecosystem conservation approaches and building on the strengths of the region while considering both the risks and opportunities of the changing climate.

This book is based on the research experience gained through feasibility assessment study of KL Nepal. It has been prepared by integrating both primary and secondary information. The extensive field visits and consultations with the government line agencies, communities, non-governmental organizations (NGOs), private and business sectors provided valuable information to identify gaps and priorities for KL Nepal. It has been structured into nine chapters focusing on boundary delineation, physical features, socio-economic features, biodiversity and ecosystem services, resource governance system, perceptions on environmental issues, cultural values, and climate change, overview of the existing policy and enabling environment for the conservation and development of KL Nepal. It also identifies major issues and gaps, priority programmes and activities to be focused in KL Nepal. The book concludes with five outcomes envisaged for the conservation and development of KL Nepal.

The boundary of KL Nepal comprises 5,190 km^2 and covers 85 VDCs and seven municipalities in Taplejung (23 VDCs, including 4 VDCs inside Kangchenjunga Conservation Area-KCA), Panchthar (14 VDCs), Ilam (25 VDCs and 2 municipalities), and Jhapa (23 VDCs and 5 municipalities) districts. Land use and land cover pattern is as follows: forest and shrub (35%); agriculture (14%); grassland (4%); snow, ice and glacier (10%); barren land (22%) and water bodies (3%), steep terrain and hard rocks (11%). The physiography of KL Nepal varies widely from Tarai to high mountains. The landscape is occupied by one of the steepest regions of the world within a short aerial distance of 70 km. The Tamur, Kabeli, Kankai and Mechi rivers are major river systems in KL Nepal.

Some 771, 934 people, with diverse ethnicity, are residing within the boundary of KL Nepal VDCs and municipalities with higher proportion of female (52.37%). Population increases along the southern direction. The overall average annual population growth is 1.10% with remarkable net negative population growth of -0.94% and -0.39% in Taplejung and Panchthar districts respectively. Population density in the landscape VDCs/municipalities varies by a large range. Olangchung Gola VDC of Taplejung has the lowest density (0.34/km^2) and Anarmani VDC of Jhapa has the highest population density (2,323.05/km^2). The overall sex ratio is 90.94 showing implication on gender dimension of local level resource management.

People in KL Nepal districts practice both farm and off-farm based livelihoods. Agriculture is the mainstay for the majority of the people. People follow mixed farming systems comprising crop production and animal husbandry. However, major means of livelihoods vary geographically. In the bordering villages like Olangchung Gola, people almost rely exclusively on transboundary trade with Tibet. Similarly, at higher elevation settlements, contribution of animal husbandry is more compared to the settlements of lower elevation, where crop production is the major economic activity. Although commercialization of agriculture is increasing, farming is largely of subsistence nature. KL Nepal districts are food sufficient and have recorded a commendable reduction in poverty over the last decade. Over the years, large cardamom (*Amomum subulatum*) cultivation has become one of the major economic activities which has transformed the socio-economic condition in the region. Trade of Non-Timber Forest Products (NTFPs) also contributes considerably to livelihoods. Besides natural resource and agriculture based economic

activities, one of the major livelihood options has been foreign employment for youths, especially in the last decade. Tourism has a long history in the region and possesses huge potential for livelihoods improvement, if developed sustainably. Extensive road networks have been developed in the districts that may provide opportunities for the diversification of livelihood options.

KL Nepal comprises four ecoregions, 11 bioclimatic zones and 23 forest types. Several important bird and plant areas have been identified. A review of the literature shows that KL Nepal districts harbour 102 species of mammals, 354 species of birds, 98 species of herpetofauna, 44 species of fish, 391 species of insects and 186 species of butterflies. Similarly, there are 56 species of lichens, 292 species of bryophytes, 257 species of pteridophytes, 15 species of gymnosperms and 2,448 species of angiosperms. Several species of animals and plants are endemic, rare and threatened.

Forest encroachment for the extension of agriculture, habitat loss and fragmentation due to deforestation, erosion and landslide, introduction of invasive alien species, over-grazing and over-exploitation, and poaching and illegal trade, and unsustainable utilization of commercially important species are some of the threats to biodiversity throughout KL Nepal. The Kangchenjunga Conservation Area, the only protected area of KL Nepal, has significant contribution in the conservation of biodiversity. Several wetlands, including Mai Pokhari Ramsar site, have been bridging cultural and biological diversity in KL Nepal.

Panchthar district has the highest proportion of forests (47.30%) followed by Ilam (47.26%), Taplejung (30.72%) and Jhapa (8.25%) distributed under different forest management categories: government managed forests, community forests, private forests, religious forests and leasehold forests. Community forests managed by 199 community forest user groups cover about 11% of the total forests in these districts. Community involvement in conservation initiatives is evident in KL Nepal region. In addition to the DFO, several other governmental organizations, NGOs, CBOs and eco clubs have been actively involved in conserving biodiversity of the region. The culturally diverse communities of KL Nepal have been managing their natural resources in their own traditional systems, among which *kipat* is the most notable.

Issues related to the utilization and management of forest resources in KL Nepal can be broadly categorized as: i) slash and burn agriculture in high elevation (above 3,000m) forests; ii) forest encroachment to convert forest areas to agricultural land; iii) overgrazing on the alpine meadows; iv) extensive illegal tree logging for household cooking, heating and construction; v) illegal and overharvesting of NTFPs; vi) invasive alien species; vii) forest fire; viii) poaching, retaliatory killing and illegal trade of wildlife; and (viii) over-exploitation of *Churia* resources. Human-wildlife conflict is a serious problem in KL Nepal.

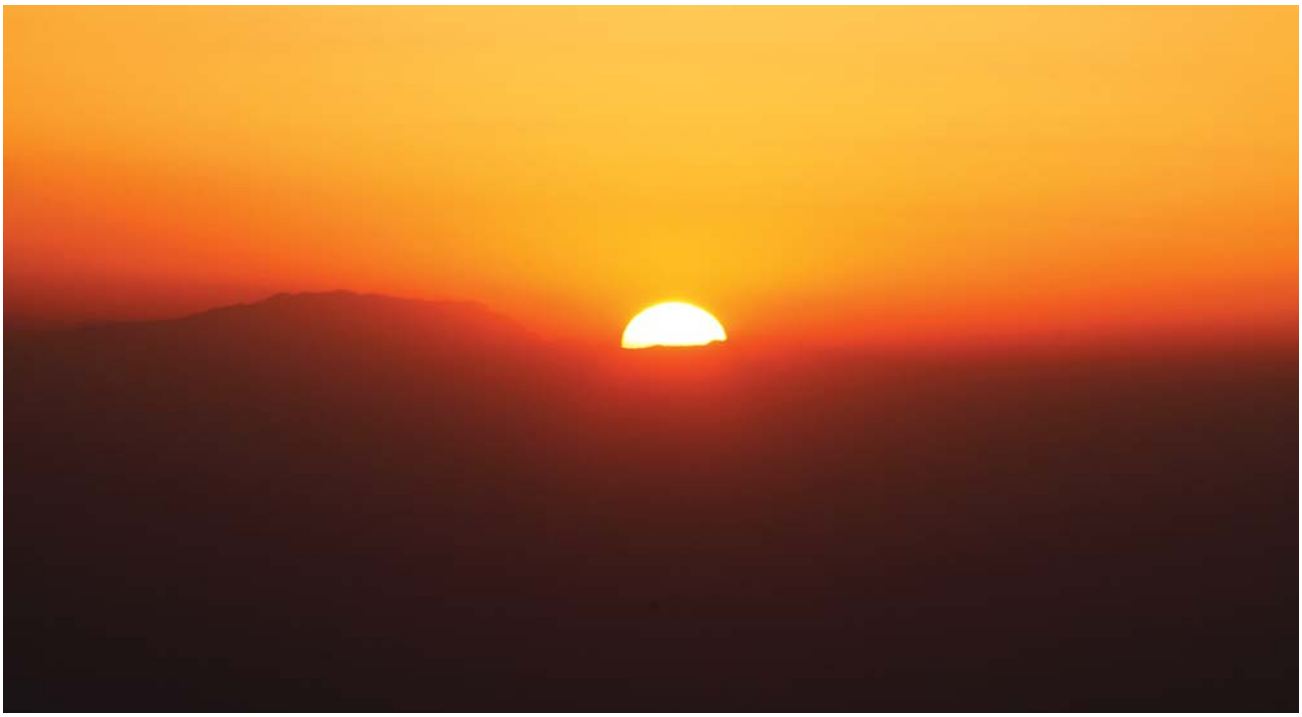
Local people have observed many evidences and identified climate change related issues. Gradual increase in temperature; decreased rainfall and prolonged dry season; irregularities in rainfall pattern; increased evidences of new pests and diseases in crops; increased number of mosquitoes in residential areas, etc. are some of the observations of the local communities. Such changes have resulted in low productivity of farmlands, drying-up of cash crops, invasion of new weeds and increased evidences of new pests and diseases.

Several policies and acts formulated in different sectors such as forest resources, biodiversity, water resources, wetland, agriculture and development in general create enabling environment for the development and implementation of transboundary level conservation and development initiatives. Several inconsistencies and gaps exist in the policies, strategies and legislations regarding to landscape conservation and development.

Issues, gaps and priorities are identified and organized into five thematic areas, namely, socio-economy and livelihoods; biodiversity and ecosystem services; resource governance and access to genetic resources and benefit sharing; long-term socio-ecological and environmental monitoring; and enabling environment, knowledge management and regional cooperation. KL's strategic vision is to conserve bio-physical and cultural heritage, strengthen climate change resilience and enhance people's well-being. Its goal and five outcomes have been envisaged for the conservation and development of KL Nepal. An attempt to define development in the context of landscape conservation and development has been made in the book emphasizing on ecosystem integrity and eco-friendly development as the key pillars of conservation and development initiatives. Development in this context should be understood as initiatives and interventions that are manageable at local level, based on the management of ecosystem goods and services, which contribute to attaining healthy ecosystem, livelihoods and human well-being in a sustained manner.

Forests in KL are vital for species conservation and livelihoods

Chapter 1 Introduction



Sunrise as seen from Kangchenjunga landscape

1.1 Background

The Kangchenjunga Complex (Figure 1.1) is an important transboundary landscape in the Hindu Kush Himalaya shared by Bhutan, China, India and Nepal. The Kangchenjunga Landscape (KL) here refers to the southern part of the area surrounding Mt. Kangchenjunga that is spread across eastern Nepal, Darjeeling and Sikkim of India, and western Bhutan. Mount 'Kangchenjunga,' the third highest mountain peak of the world (8,586m), is culturally regarded as the Five Treasures (repositories of God) of Snow: gold, silver, gems, grain and holy books. The mountain is called 'Sewalungma,' in Limbu language meaning 'the mountain that we offer greetings to.' Further, the strategic location of KL among the three countries makes it an appropriate conservation landscape that requires regional transboundary cooperation (Chettri and Sharma 2005).

The KL, a part of the Himalayan biodiversity hotspot, is rich in biological and cultural diversity (WWF and ICIMOD 2001). The hotspot is one among the 34 global biodiversity hotspots (Mittermeier et al. 2004). This transboundary landscape is spread over more than 25,000 km^2 in the southern part of Mt. Kangchenjunga representing 9 global ecoregions. Nepal, India and Bhutan have given high priority for the conservation and development of KL, which provides a range of ecosystem services supporting millions of people (Phuntsho et al. 2012). It provides pristine habitat for several umbrella and charismatic species, including Asian elephant

(*Elephas maximus*), Musk deer (*Moschus chrysogaster*), Red panda (*Ailurus fulgens*), Snow leopard (*Uncia uncia*), Takin (*Budorcas taxicolor*), Tiger (*Panthera tigris*) and many other threatened and endangered plant species, including Paanch aunle (*Dactylorhiza hatagirea*), Kutki (*Neopicrorhiza scrophulariiflora*), Laghupatra (*Sinopodophyllum hexandrum*) and Lauth salla (*Taxus wallichiana*). Most of the protected areas within the landscape are isolated without connectivity. Generally, the people in KL are economically, physically and socially vulnerable (Chettri et al. 2008a, Phuntsho et al. 2012). Recognizing its global and regional significance and challenges, the Kangchenjunga Landscape Conservation and Development Initiative (KLCDI) programme has been proposed in Bhutan, India and Nepal. The aim of this programme is to contribute to the sustainable development of KL by applying transboundary ecosystem approaches while considering both the risks and opportunities of climate change.

This book is an attempt to present the assessment of bio-physical, socio-economic and environmental situation of KL Nepal. Based on this assessment, issues, gaps, and conservation and development prioritites are discussed. The approaches and way forward for the sustainable conservation and development of the landscape have also been presented.

1.2 Methodology and approach

The data and information presented in this book are based on both primary and secondary information. Primary information was collected from the field study through consultations, interaction meetings, focused group discussions and field observations.

The following processes were adopted for the preparation of the book:

Literature review: Secondary information was generated through literature review. In addition to the literature directly related to the area, other documents such as policies, plans and Acts relevant with the scope of work were also reviewed. In order to facilitate the review, an annotated bibliography of KL Nepal was prepared (Poudel 2013).

Field visits: Three rounds of field visits were conducted in KL districts for stakeholders' consultations which were focused mainly on national boundary delineation and identification of conservation and development opportunities, issues and gaps. Checklists and guidelines for such interaction meetings were prepared. Interviews/ discussions were audio-recorded to facilitate transcription and content analysis whenever consent was granted by the participants; otherwise notes were taken.

Field visits covered stakeholders' consultations at two levels: district level at the district headquarters and community level at the villages. The participants were representatives from relevant governmental and non-governmental organizations, local communities, including Community Forest User Groups (CFUGs), women groups, Community-based Organizations (CBOs), Non-Timber Forest Products (NTFPs) traders and herders. Major issues discussed in the meetings were related to sustainable livelihoods, gender and social inclusion, tourism, conservation and development, biodiversity, culture, transboundary trade, climate change and related challenges, and potential solutions for the proposed landscape programme.

Key informants consultations: Apart from the district level stakeholders' meetings and community level interactions, key informants were also interviewed. These included NTFP traders in Phungling (Taplejung), members of Kangchenjunga Conservation Area Management Council (KCAMC) at Olangchung Gola, members of Mothers' Group (Lelep), herders (Lelep), community members (Lungthung and Iladada) and governmental and non-governmental officials in all districts. These consultations were focused on particular issues related to the knowledge of respective informants. In general, the conservation and development challenges, issues, gaps and priorities were discussed. Ethical norms such as prior informed consent, privacy and confidentiality were maintained while interacting and interviewing with communities/stakeholders.

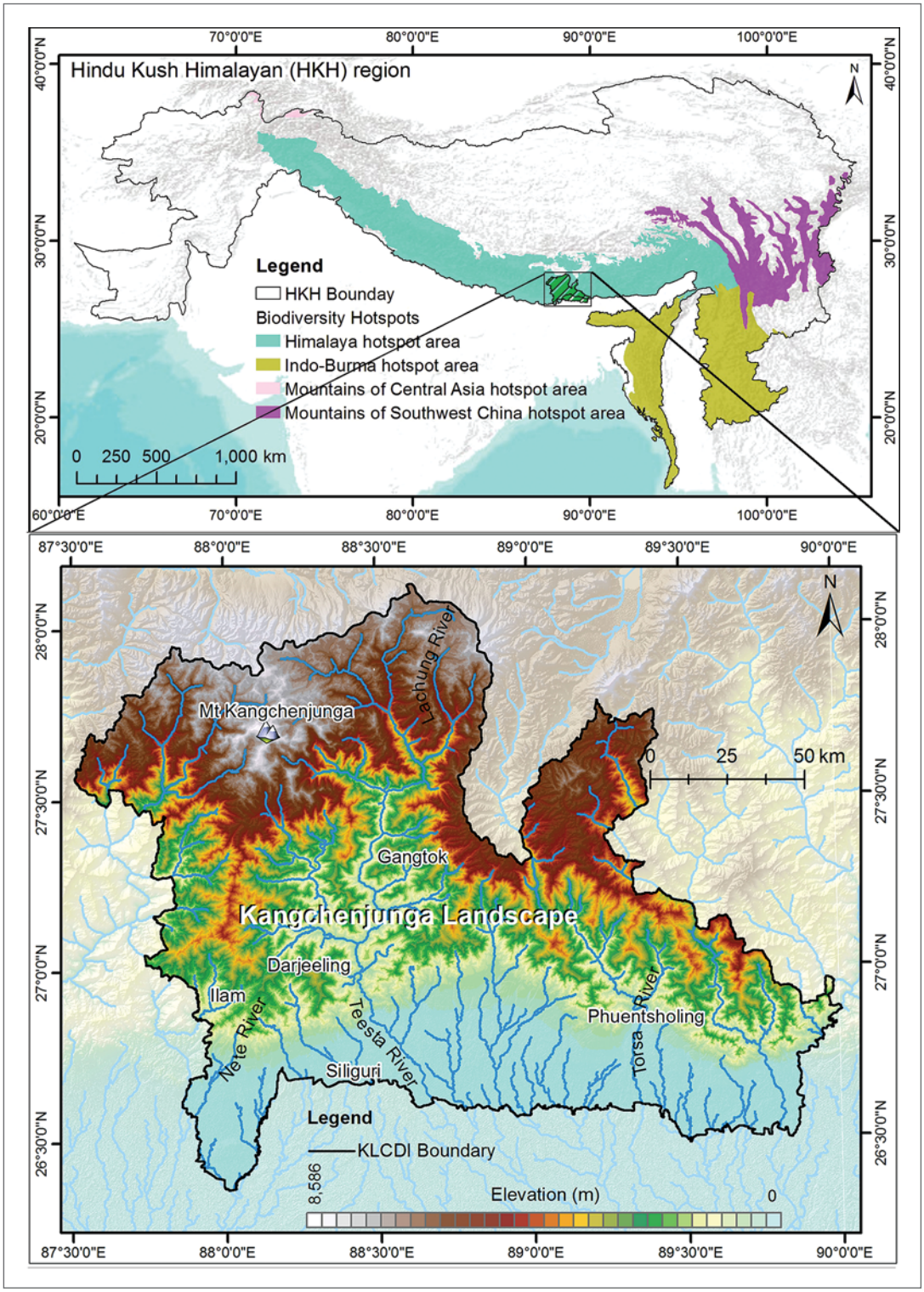
Data analysis: The data and information collected through literature review and field study were analyzed using qualitative and quantitative tools. Audio records of interaction meetings and interviews were transcribed and contents were analyzed (May 2002). Secondary

Local stakeholders' consultation during field visit in Ilam district

data on population and demography, economy and bio-physical features collected from official sources were analyzed. Grey literature complemented data and analysis. These analysis were complemented by GIS, particularly of land use and land cover status. Topographic data available from the Department of Survey and Remote Sensing images were used.

Experts' review: The draft was shared and discussed in a series of meetings held with the high ranking officials of the Government of Nepal and experts from ICIMOD. In addition, independent experts reviewed the draft and provided valuable and critical suggestions.

Figure 1.1: Map showing Kangchenjunga Landscape within the Hindu Kush Himalayas



A lush green tea garden as seen from Ilam Bazaar, Ilam district

Chapter 2 The Kangchenjunga Landscape Nepal

The head stream of Mai in Ilam district

2.1 Boundary delineation

The process of boundary delineation of KL Nepal was initiated by ICIMOD in 2002. This initiative resulted into a Participatory Conservation Corridor Development Strategy and Action Plan for Transborder Areas along the Kangchenjunga Landscape in Eastern Nepal document (NCDC 2005) where priority VDCs to be included in the landscape initiative from Ilam, Panchthar and Taplejung districts were identified (Figure 2.1).

Consultation on Transboundary Biodiversity Management in Kangchenjunga Landscape was held in Gangtok, Sikkim, from August 16—18, 2012. During the preparatory phase of stakeholders' consultation meetings in KL Nepal districts and inception meeting on August 25, 2013, at the Ministry of Forests and Soil Conservation (MoFSC) Nepal, the possibility of including Jhapa district was further discussed. It was realized that the proposed boundary of KL Nepal should be revisited to include other potential VDCs in Jhapa, Ilam, Panchthar and Taplejung districts. It also recommended to incorporate a wider range of ecosystems and cultural heritage of neighbouring districts at the landscape level to establish proper upstream-downstream linkages, address transboundary issues, including biological corridor and connectivity, and conserve the only typical tropical forest in Jalthal of Jhapa district.

2.2 Criteria for landscape boundary

For boundary delineation of the Kangchenjunga Landscape Conservation and Development Initiative (KLCDI) in Nepal, criteria were developed through an iterative and consultative process at national level stakeholders' workshop held in Kathmandu. These criteria for delineation were first developed for Kailash Sacred Landscape Consevation and Development Initiative (KSLCDI) and then adopted for the delineation of Kangchenjunga Landscape in Nepal. These criteria were basically clustered into three thematic areas: (i) ecological or abiotic and biotic; (ii) cultural; and (iii) planning and management (Table 2.1).

Table 2.1: Criteria used for boundary delineation of KL Nepal

Thematic areas and references	Criteria
Ecological or abiotic and biotic (Olson and Dinerstein 1998, Primack 2006, Chisholm 2010, Ervin et al., 2010, ICIMOD 2010, TU/CDB 2010, Sgro et al. 2011, Cardinale et al. 2012, Green and Garmestani 2012)	• Transboundary ecosystem services and ecosystem contiguity • Climatic zone, altitudinal gradient • Protected areas, wilderness areas, wetland (particularly Ramsar Sites) and other conservation priority areas • Watershed and river basin coverage for the headwater areas of major rivers originating from the landscape • Key biodiversity areas/hotspots/representativeness, including migratory habitats and potential biodiversity corridors and connectivities • Agrobiodiversity • Species endemism, indicator/flagship, distinctiveness, rare, endangered and threatened species (and their habitat range) • Species of utilitarian value • Infra-specific population and genetic diversity
Cultural (ICIMOD 2010, TU/CDB 2010)	• Culture, cultural heritage/sites, ethnicity, existing and potential ecotourism areas • Indigenous knowledge
Planning and management (ICIMOD 2010, TU/CDB 2010, Green and Garmestani 2012)	• Vulnerabilities of and threats to the area (globalization, migration, climate change, urbanization and infrastructure development (current and planned) • Feasibility from management perspectives with VDC as smallest unit • Proximity of resource users and resource base

2.3 Delineation of the landscape

The area for KL Nepal comprises 5,190 km^2 and covers 85 VDCs and seven municipalities: 23 VDCs (including 4 VDCs inside Kangchenjunga Conservation Area-KCA) in Taplejung district, 14 VDCs in Panchthar district, 25 VDCs and two municipalities in Ilam district and 23 VDCs and 5 municipalities in Jhapa district (Table 2.2). KL Nepal includes tropical to alpine region which supports a wide range of vegetation and fauna, and is a part of the Himalayan Biodiversity Hotspot, including some important ecoregions of the Eastern Himalaya (Table 2.3). The area also maintains connectivity between the KCA and Makalu Barun National Park in Nepal.

Table 2.2: Village Development Committees (VDCs) and municipalities of KL Nepal

Districts	No. of VDCs & Municipalities	Area (km^2)	VDCs and Municipalities*
Taplejung	23	3,863	Ambegudin, Angkhop, Chaksibote, Dumise, Ikhabu, Kalikhola, Khebang, Lelep, Limbundin, Mamangkhe, Mehele, Papung, Pedang, Sablakhu, Sadewa, Sikecha, Sinam, Surumkhim, Tapethok, Tellok, Thumedin, Olangchung Gola and Yamphudin
Panchthar	14	539	Chilingdin, Chyangthapu, Ektin, Lungrupa, Memeng, Nagin, Oyam, Pauwasartap, Phalaicha, Prangbung, Ranitar, Sidin, Tharpu and Yangnam
Ilam	25+2	849	Barbote, Chamaita, Godak, Gorkhe, Irautar, Jamuna, Jirmale, Jogmai, Kolbung, Laxmipur, Mabu, Maimajhuwa, Mai Pokhari, Namsaling, Nayabajar, Pashupatinagar, Puwamajhuwa, Pyang, Sakhejung, Samalbung, Shantipur, Shriantu, Soyang, Sulubung, Sumbek (VDCs); Ilam and Suryodaya (Kanyam, Paanchakanya, Phikkal) (Municipalities)
Jhapa	23+5	939	Bahundangi, Balubadi, Baniyani, Budhabare, Chakchaki, Chandragadhi, Dangibari, Dhaijan, Duwagadhi, Garamani, Gherabari, Goldhap, Haldibari, Jalthal, Jyamirgadhi, Kechana, Khudunabari, Maheshpur, Pathamari, Pathariya, Prithvinagar, Rajgadh, Shantinagar (VDCs); Bhadrapur, Mechinagar, Birtamod (Anarmani and Charpani), Sani-Arjun (Sanischare and Arjundhara) and Kankai (Surunga and Ghailadubba) (Municipalities)

* Suryodaya, Birtamod, Sani-Arjun and Kankai are newly declared municipalities by including VDCs given in the parantheses.
Also see Annex I for the area of VDCs and Municipalities with their location.

Figure 2.1: Map of KL Nepal

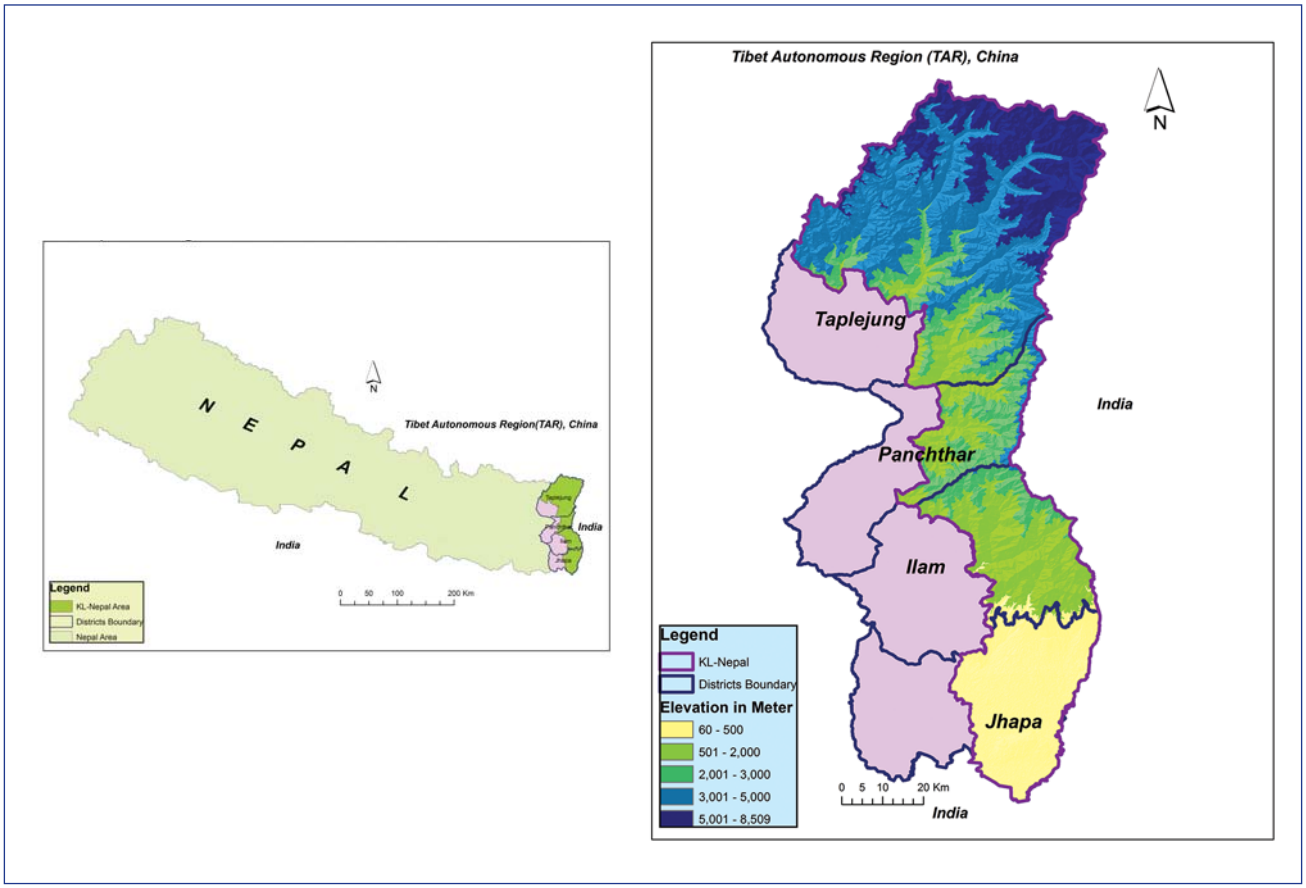


Table 2.3: Important features of KL Nepal

Area (km²)	5,190
Elevation Range	60m to 8,586m
Average temperature	Summer temperature more than 34°C (Jhapa) to winter temperature less than –10°C in Olangchung Gola (Taplejung)
Average rainfall	Less than 1,000mm in some parts of Taplejung to 2,700mm in Jhapa
Major river systems	Ghunsa, Kabeli, Mai Khola, Mechi, Simbua Khola and Tamur
Landscape level biodiversity features	Includes a Ramsar Site, 3 IBAs (KCA, Mai Valley forests, Tamur Valley and watershed (Baral and Inskipp 2005); 18 IPAs; Important cultural sites, characteristic tropical forest in Jalthal VDC, most elephant-conflicted VDCs in Jhapa
Land use pattern	Forest and shrub (35%); agriculture (14%); grassland (4%); snow, ice and glacier (10%); barren land (22%); water bodies (3%); steep terrain and rocks (11%)
Population within KL Nepal VDCs/municipalities	40,196 (Taplejung); 65,995 (Panchthar); 162,540 (Ilam); 503,203 (Jhapa) Total: 771,934
Caste/ethnic composition	Brahmin, Chhetri, Dhimal, Gurung, Lepcha, Limbu, Meche, Newar, Rai, Rajbansi, Sherpa, Tharu
Major cultural sites	Dhiki Chhyoling monastery at Olangchung Gola, Pathivara (Taplejung); Timbung Pokhari (Taplejung/Panchthar), Mai Pokhari (Ilam), Prithivi Nagar, Kichakbadh, Arjundhara (Jhapa)

Tamur River, one of the major river systems of KL Nepal

Chapter

3 Physical Features

Lelep village in Taplejung district

3.1 General introduction of the area

Physiography of KL Nepal varies widely from around 60m elevation to the south to about 8,000m to the north. KL Nepal districts can be divided into the following physiographic regions:

Tarai region (about 60m to 150m): Extending up to the Nepal-India border in the south, it is a northern portion of the Gangetic plain. Kechana, the lowest point of Nepal, is located in Jhapa district. The plain area of the Tarai occupies about one-fourth of KL Nepal and more than two-third of Jhapa district. Being a sediment deposition zone, the fertile soil makes this part suitable for intensive cultivation.

Bhabar region (about 150m to 300m): At the border of Ilam and Jhapa districts, the region is mainly covered with forest. The Bhabar region occupies about a quarter of KL Nepal (Figure 3.1). Shantinagar (381m) in Jhapa is the highest location of this region.

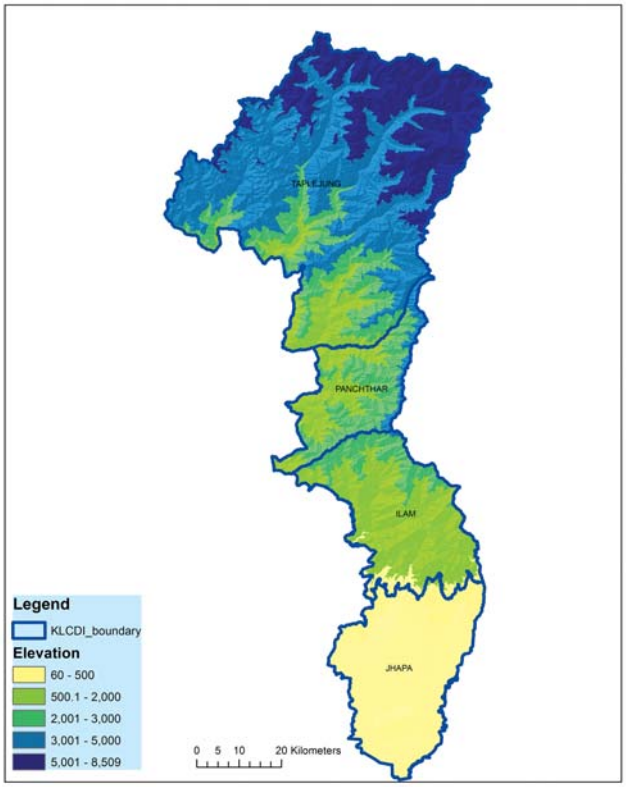
***Churia* and mountainous region (about 300m to 3,000m):** It is the area dominated by mountainous environment, including *Churia* and the Mahabharat range. The *Churia* is the most fragile region which is situated in Jhapa and Ilam districts. Panchthar district and some parts of Ilam district lie in the mountainous region.

High mountain/Himalayan region (from 3,000m to more than 8,000m): The region is dominated by the mountains extending up to Kangchenjunga (8,586m),

the third highest peak of the world. There are 10 peaks higher than 7,000m (Kangchenjunga, Kambachen, Jongsang, Tent Peak, Talung, Jannu, Dom, Tewinus, Kabu Peak and Pyramid) in Taplejung district. North-east border between Nepal and India is represented by the Singhalila mountain range.

The region is occupied by one of the steepest landscapes of the world within a short aerial distance of 70 km. All the mountain ranges with alpine climate have some deep valleys with subtropical climatic conditions. Taplejung district has valleys that go down to as low as 550m. Topographical variation has very close linkage with climate (Figure 3.1).

Figure 3.1: Elevation gradient of KL Nepal



3.2 Hydro-meteorology

The hydro-meteorological network of KL Nepal covers elevation range starting near Kechana (60m) to 4,242m at Olangchung Gola.

Figure 3.2: Hydrometric and meteorological network with relatively long-term data, and river network in and around KL Nepal

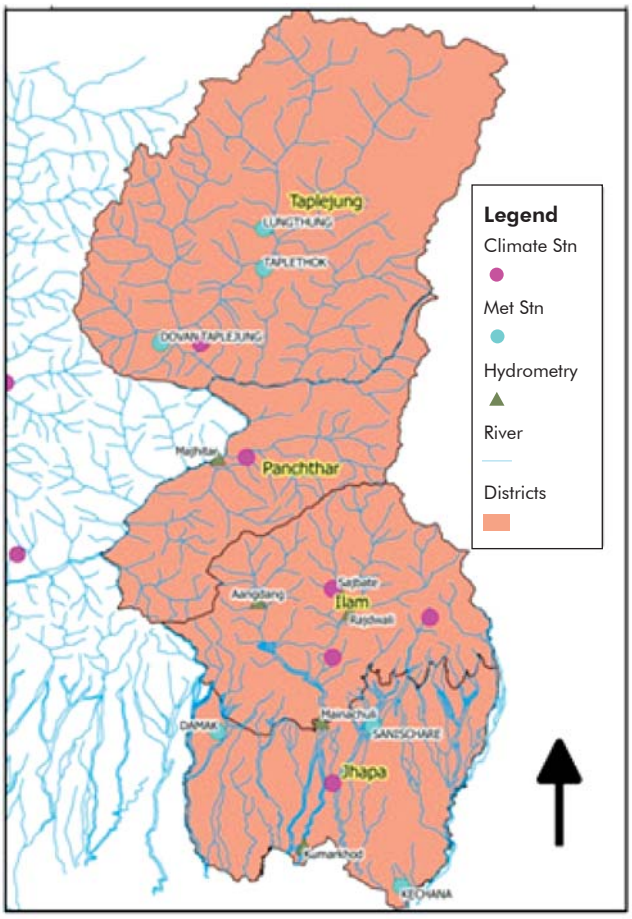


Table 3.1 presents the basic description of hydrometric stations in KL Nepal. Only the stations located at Majhitar, Sajbate, Rajdwali and Mainachuli operate on a regular basis with long-term climatic data records.

3.2.1 Temperature

Data from 22 meteorological stations are available in KL Nepal. The length of record varies significantly from six years to 66 years (Table 3.1). Some of the stations are equipped with thermometers as well providing climatic features based on temperature and precipitation (Figure 3.2). Stations at Ilam and Taplejung provide data on wind speed (daily average) and wind direction (instantaneous).

Table 3.1: Basic description of hydrometric stations in KL Nepal districts

SN	River	Location	Latitude	Longitude	Elevation (m)	Area (km²)	Instruments	Start of record
684	Tamur	Majhitar	27° 09′ 30″	87° 42′ 45″	533	4050	S, C ,R, Rg	01-01-96
728	Maikhola	Rajdwali	26° 52′ 45″	87° 55′ 45″	609	377	S, C	01-01-83
730	Puwa Khola	Sajbate	26° 55′ 00″	87° 54′ 40″	802	107	S, C	01-01-65
738	Deumai Khola	Aangdang	26° 54′ 00″	87° 46′ 15″	-	-	S, C	-
799	Kankai	Kumarkhod	-	-	-	-	S	05-01-87
795	Kankai	Mainachuli	26° 41′ 12″	87° 52′ 42″	125	-	S, C, R, Rg	05-01-71

S = Staff Gauge; C = Cableway; R = Water Level Recorder; Rg = Rain Gauge

Based on the temperature records available in the landscape area, the average maximum temperature in the Tarai area goes as high as 34.2°C. The average temperature in the Tarai varies from 16.4°C in winter to 30°C in summer, which is close to the tropical type of climate. Temperature records available at Olangchung Gola station shows that the minimum temperature goes down to almost –5°C in winter to more than 15°C in summer months—June to September (Figure 3.3). Figure 3.4 to Figure 3.7 indicate subtropical type of climate in the valleys, hilly region and in the Tarai.

3.2.2 Precipitation

Precipitation is strongly influenced by monsoon as well as topography. Rain shadow effect is visible in the mountainous area behind the major Mahabharat range which is exemplified by the rainfall pattern in the eastern part of Nepal (Figure 3.8).

Some parts of the mountains facing southwest monsoon receive high precipitation. For example, Num and Tashigaon area of Sankhuwasabha district, west of Taplejung district, is one of the wettest areas of Nepal in terms of monsoon as well as annual precipitation.

Figure 3.3: Monthly variation of maximum, minimum and average temperature (1961–1976) at Olangchung Gola

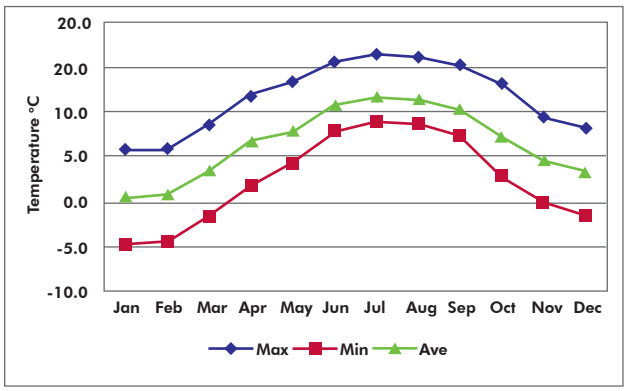


Figure 3.4: Monthly variation of maximum, minimum and average temperature (1962–1976) at Tapethok

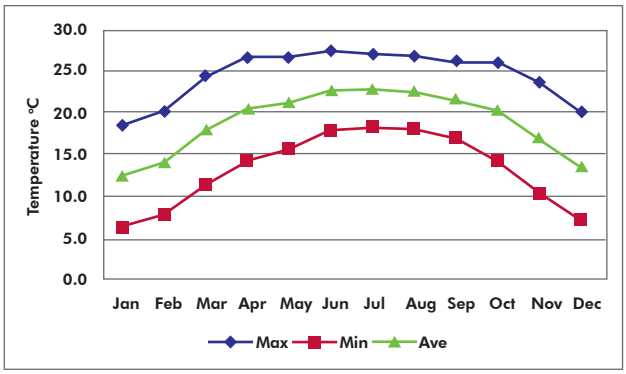


Figure 3.5: Monthly variation of maximum, minimum and average temperature (1961–2013) at Taplejung (District headquarters)

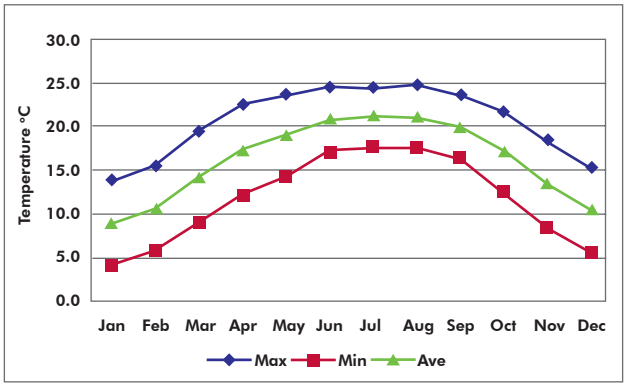


Figure 3.6: Monthly variation of maximum, minimum and average temperature (1971–2013) at Ilam

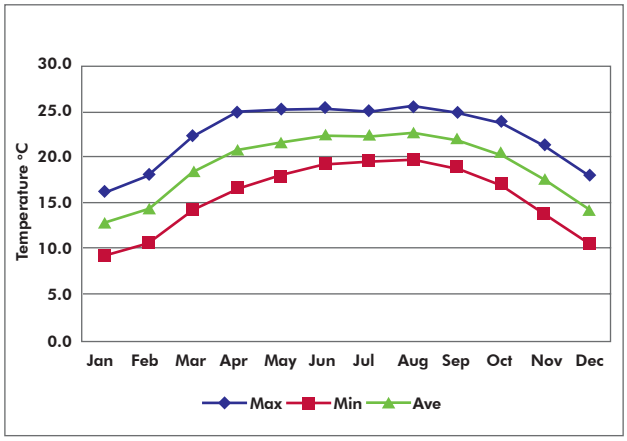
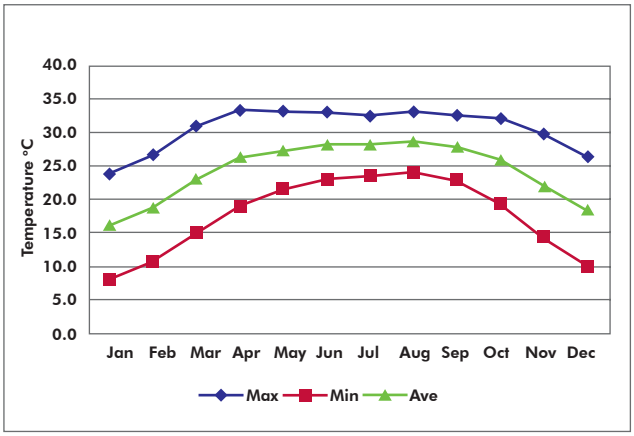


Figure 3.7: Monthly variation of maximum, minimum and average temperature (1984–2006) at Gaida at Jhapa



Cross-sectional variation of precipitation from the Tarai to the high mountains is illustrated in Figure 3.9. The figure shows that monsoon precipitation is significantly higher in the southern part of KL Nepal, whereas winter precipitation is not much different. Precipitation during southwest monsoon as the percentage of average annual precipitation is presented in Table 3.2.

Figure 3.8: Distribution of annual precipitation in the eastern part of Nepal

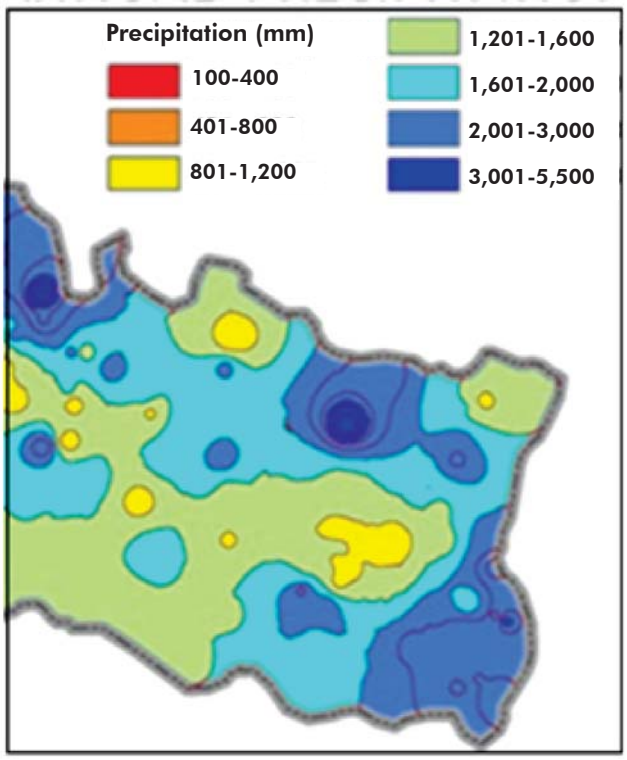


Table 3.2 shows that southern part of KL Nepal (Ilam, Chandragadi and Gaida) receive 80–81% of precipitation during monsoon season. This is lower in the high mountain areas ranging from 67–77%. Data from high elevation areas, however, are limited (less than ten years).

3.2.3 Evaporation and sunshine duration

No long-term recording of evaporation and sunshine duration is available in KL Nepal area. The closest station with the availability of such data is the station located in Bhojpur. The average sunshine duration and evaporation rate based on the available records from 1981 to 1995 is presented in Figure 3.10. The figure shows that sunshine duration exceeds seven hours during March-April and October-November with minimum values during south-west monsoon. Similar pattern is followed by evaporation with highest rate in the month of April.

Figure 3.9: Cross-sectional variation of precipitation from the Tarai to the High Mountains (see Table 3.1 for station location)

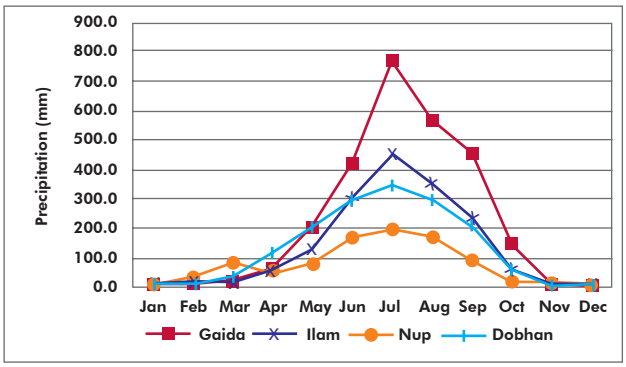
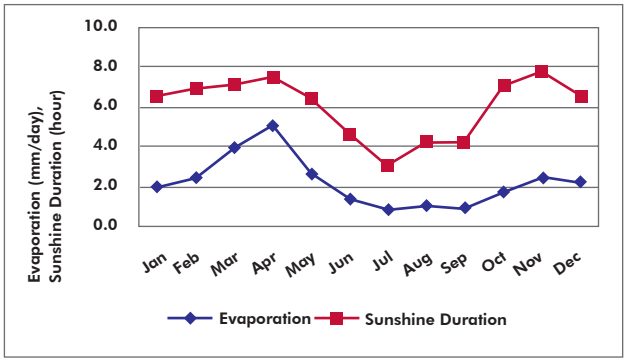


Figure 3.10: Average (1981-1995) evaporation rate and sunshine duration in Bhojpur



3.3 River systems

The Tamur River, originating from the Kangchenjunga glacier, is the major river draining almost one-third of the area. Except the southeast part, where Taplejung district is bordered by the Kabeli River, upper Tamur watershed characterizes Taplejung district. The Kabeli River is the major tributary of Tamur which borders Taplejung and Panchthar districts.

Kankai Mai is the major river draining Ilam. Ilam district is delineated by the upper watershed of Kankai River. Some of the major tributaries of Kankai in Ilam district are Deumai, Mai Khola and Puwa Khola.

Table 3.2: Average annual precipitation and average precipitation during southwest monsoon

Station	Annual (mm)	Monsoon (mm)	Monsoon (% of annual)	Data duration
Nup (1,414)	972	647	67	1947-1953
Olangchung Gola (1,401)	1,663	1,213	73	1947-1975
Tapethok (1,404)	2,595	1,999	77	1947-2013
Dobhan (1,420)	1,665	1,168	70	1947-2013
Ilam (1,407)	1,696	1,360	80	1947-2013
Chandragadi (1,412)	2,144	1,730	81	1947-2013
Gaida (1,421)	2,723	2,218	81	1947-2013

Grey-shadow areas have greater influence of southwest monsoon with precipitation equal to or exceeding 80% of the annual total.

In Jhapa district too, Kankai is the major river flowing almost in the middle of the district. Several other flashy rivers, including Biring and Ratuwa rivers, originating from the Mahabharat region, join Kankai only after crossing the Nepal-India border. The Ratuwa River forms the border between Ilam and Jhapa districts. In addition, Mechi River originating from the Mahabharat range is the border between Jhapa (Nepal) and West Bengal (India).

Regularly gauged rivers in KL Nepal are the Tamur and the Kankai. Based on the available records, average discharge of Tamur at Majhitar (4,050 km^2) is 245m^3/s and average discharge on the Kankai at Mainachuli (1,148 km^2) is 63.2m^3/s. The average discharges at the tributary of the Kanakai are: the Mai at Rajdwali (377 km^2) is 5m^3/s and the Puwa Khola at Sajbate (107 km^2) is 8m^3/s. The total discharge at these points is more than half of the flows on the Kankai River.

Tamur is a snow-fed river whereas Kankai and the rivers originating in the Mahabharat range are rain-fed. Under the influence of snow as well as rain, the average Tamur hydrograph peaks in August (Figure 3.11). In the case of rain-fed rivers, the average discharge in July is comparable with the average discharge in August indicating lower storage capacity of rain-fed rivers compared to snow-fed rivers (Figure 3.12).

Figure 3.11: Monthly average streamflows on Tamur River at Majhitar

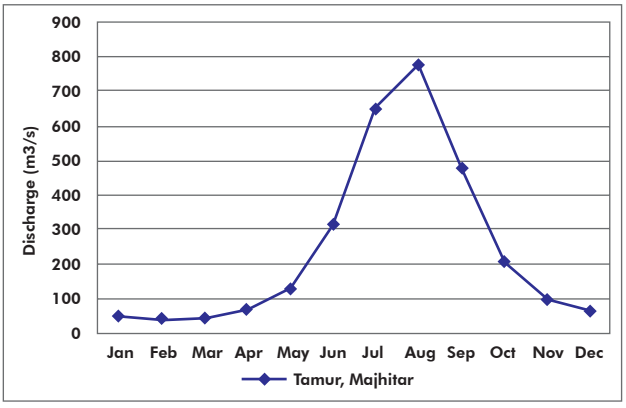
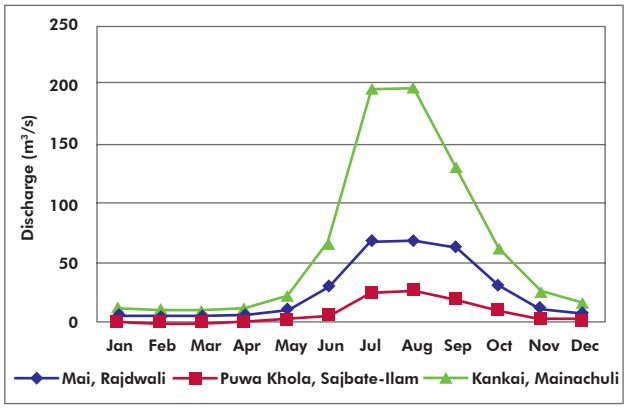


Figure 3.12: Monthly average streamflows on the Mai Khola at Rajdwali, Puwa Khola at Sajbate and the Kankai Mai at Mainachuli (1963- 2011)



Several lakes are also found in KL Nepal districts. Some of the important lakes are: Timbung Pokhari (4,481m) in Taplejung, Mai Pokhari (2,100m) in Ilam, Birat Pokhari and Gaura Daha in Jhapa at lower elevation. The total lake area is estimated at 2 km^2.

3.4 Snow, ice and glaciers

As seen from the aerial feature, 732 km^2 of the Tamur River basin lies above 5,000m elevation, an average snowline in eastern Nepal. A total of 479 km^2 of KL Nepal is covered by permanent ice, snow and glaciers. Area covered by snow, ice and glaciers is hence more than half of the area above 5,000m.

Based on the detailed assessment of glaciers and glacial lakes in the Himalaya, ICIMOD has made inventories in 2001 (Mool et al. 2001) and in 2011 (ICIMOD 2011). The 2001 report presents the inventory of 261 glaciers in the Tamur basin covering an area of about 474 km^2. The size of the reported glacier ranges from 0.01 km^2 to 94.51 km^2. Some other significantly large glaciers include Yalung Glacier (81.91 km^2), Yamatari Glacier (14.08 km^2), Kumbhakarna Glacier (18.13 km^2) and Lhonak Glacier (16.7 km^2). Eight glaciers occupy areas exceeding 10 km^2. The total volume of ice reserves of these glaciers is estimated at 57 km^2.

The inventory of glacial lakes published by ICIMOD in 2011 differs from that of 2001 (ICIMOD 2011). Based on the 2009 survey, the 2011 publication reports 209 glacial lakes covering 6.57 km^2 in the Tamur basin. Again, as per the 1999 survey, the 2001 ICIMOD report identifies 356 glacial lakes covering 7.32 km^2 in the Tamur basin. The explanation given to such differences include different data sources and the adoption of different methodologies.

3.5 Hydro-meteorological related issues and gaps

KL Nepal has several advantages in terms of hydrological and meteorological observations compared to other parts of Nepal. Hydro-meteorological observations were established in this area as early as 1947. Record length, hence, extends to almost 66 years with valuable

information on climate change studies. Despite such advantages, there are several gaps that need to be addressed to understand hydrological and meteorological processes in the region. Some of the major gaps, issues and priorities can be described as: (i) there is scanty information and data recording system about the area covered by snow and glaciers; (ii) there is inadequate information and recording systems on hydrological cycle of groundwater which is the major water source in Jhapa district; (iii) meteorological stations for recording wind and solar radiation measurements are not existent in KL Nepal; (iv) only 14 stations out of 21 established meteorological stations are operational; (v) the stations are not representatively distributed to record weather data from different locations, and only the Kankai station at Mainachuli has been upgraded with the real time data transmission; and (vi) these stations are not well equipped.

3.6 Land use and land cover

Land use pattern in KL Nepal is determined by an interplay of multiple factors. As the land use pattern has changed over the years, the land use and land cover pattern of KL Nepal was analyzed using landset images of 1990 and 2010 (Figure 3.13). The land use and land cover pattern of KL Nepal districts in 2010 is presented in Table 3.3 and that of the landscape VDCs/ municipalities is presented in Table 3.4.

3.7 Minerals and soil types

Because of varied geological structure, various types of minerals have been reported in KL Nepal districts (Table 3.5). The Department of Mines and Geology (DoMG) has identified Taplejung and Ilam districts as some of the mineral-rich districts of Nepal (Chapagain et al. 2002). Nevertheless, mining activities have not been undertaken.

Extreme altitudinal variations, monsoonal climate and young geology are playing role in the formation of different soil types and soil textures in KL Nepal. The Tarai area (below 500m) in Jhapa district is dominated by recent and sub-recent alluvial sediments. The Tarai sediments with favourable climate has created conducive environment for intensive agriculture and deciduous forest. Soils in the Tarai region are mostly acidic to neutral. Hilly areas with

Table 3.3: Land use pattern in KL Nepal districts (ha)

Land use	Taplejung	Panchthar	Ilam	Jhapa	Total	%
Forest	112,256	53,182	72,214	13,239	250,891	30.47
Shrub	56,362	14,369	31,649	1,863	104,243	12.66
Agriculture and grassland	70,946	54,078	64,595	141,795	331,414	40.26
Water bodies	405	181	236	778	1,600	0.19
Barren land	37,757	326	2,873	6,517	47,473	5.77
Snow	60,115	29	0	0	60,144	7.31
Others	27,496	0	0	0	27,496	3.34
Total	**365,337**	**122,165**	**171,567**	**164,192**	**823,261**	**100**

Source: CBS (2012a)

Table 3.4: Land use and land cover in KL Nepal VDCs and municipalities (km²)

Land use and land cover	Taplejung	Panchthar	Ilam	Jhapa	Total	Percentage
Dense forest	318.22	202.15	395.89	111.05	1,027.30	19.79
Sparse forest	364.48	78.86	211.81	131.02	786.16	15.15
Agriculture land	90.56	48.04	70.42	535.20	744.22	14.34
Grassland	32.90	13.00	111.77	44.30	201.96	3.89
River and water bodies	103.58	2.77	7.64	45.70	159.70	3.08
Sand and river beds	13.97	0.02	0.36	10.26	24.61	0.47
Barren land	843.35	190.79	48.97	61.09	1,144.20	22.05
Snow and glaciers	531.93	0.09	1.66	0.00	533.68	10.28
Steep terrain and hard rocks	563.94	3.50	0.93	0.00	568.37	10.95
Total	**2,863**	**539**	**849**	**939**	**5,190.19**	**100**

elevation ranging from 300m to 1,500m are dominated by metamorphic and sedimentary rocks. Soil textures fall in the category of loams, silt-clay and silt-loam with mostly acidic reaction. Mountainous areas in the range of 1,500m to 5,000m possess igneous and metamorphic rocks. The region with stony soils is dominated by acidic sandy loam, clay loam and silt clay loam. The high mountain areas above 5,000m of Taplejung district are usually covered by snow/ice with thin, coarse and loose soils of glacial origin.

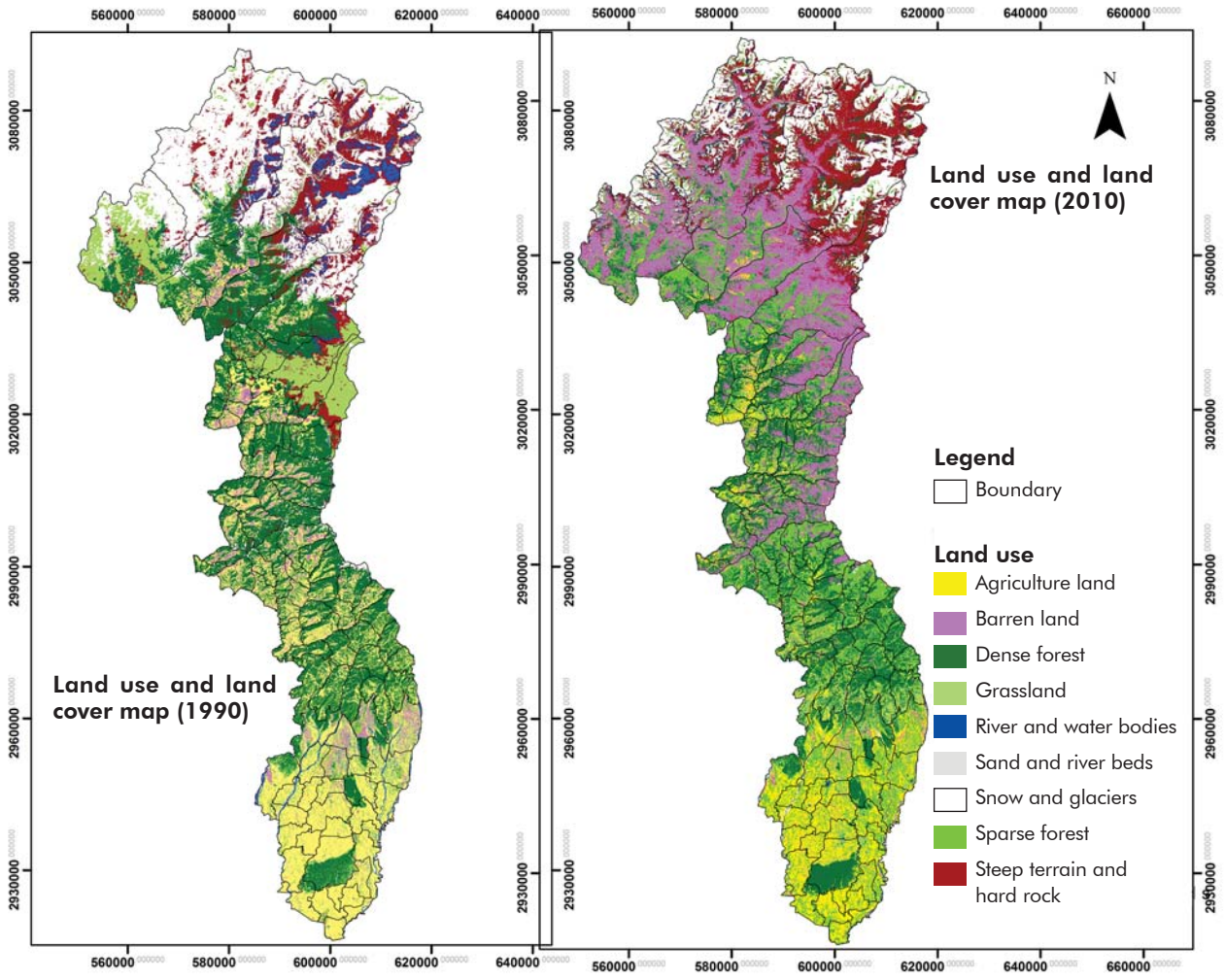
Extreme relief and intense monsoon precipitation are the causes of extensive soil erosion and landslides. Some sediments get deposited along the river banks creating sandy or sandy-loam soil.

Table 3.5: Mineral resources of KL Nepal districts

Districts	Metallic minerals	Non-metallic minerals			Fuel minerals and thermal springs
		Chemicals, fertilizers, ceramics, refractories and abrasives	Germ minerals	Construction materials	
Taplejung	Arsenic, copper, iron, lead, tantalum-noibium	Corundum, garnet, graphite, mica	Aquamarine/beryl, quartz, tourmaline	Granite, marble	
Panchthar		Garnet	Tourmaline		
Ilam	Arsenic, bismuth, copper, gold, lead, nickel, silver, tungsten, zinc	corundum, graphite, mica, pyrite	Tourmaline		
Jhapa		Mica			Coal, oil and gas

Source: CBS (2012a)

Figure 3.13: Land use and land cover changes in KL Nepal



Olangchung Gola, one of the major trading routes of KL Nepal

Chapter

4 Socio-economic Features

A local market place of Phikkal, Ilam district

4.1 Demography

According to 2011 census, the total population of the VDCs and municipalities within KL Nepal is 771,934. Out of this, male population is 367,651 (48%) and female population is 404,283 (52%) (CBS 2012b). The population size in four districts of the landscape varies greatly with the least population of 40,196 in Taplejung district and the highest population of 503,203 in Jhapa district. The size of population increases along the southern direction. However, the number of VDCs/ municipalities in these districts is also more in Ilam and Jhapa compared to Taplejung and Panchthar districts.

The average annual population growth between 2001 and 2011 in these VDCs/municipalities is 1.10%. However, there is a net negative population growth in Taplejung (-0.94%) and Panchthar (-0.39%) districts. All the VDCs except one in Taplejung have negative population growth rate. In Panchthar, three VDCs have positive growth rate. Population growth rates in Ilam and Jhapa are 0.29% and 1.85% respectively. Of the 29 VDCs/municipalities in Ilam district, 12 VDCs have negative growth rate. All the VDCs/municipalities in Jhapa district have positive growth rate. Over the years, the number of absentee population has been increasing owing largely to foreign employment. The total absentee population from these VDCs/municipalities is 129,746 according to 2011 census. Within the landscape, 31% households have one or more absentee members. Male constitutes overwhelming majority (87.5%) of the absentee population.

Overall sex ratio in the landscape VDC/municipalities is 91, which is below the national average of 94. The sex ratio has declined from 100 within a span of a decade indicating the trend of change in demography. Population density in the landscape VDCs/municipalities varies by a large range. Olangchung Gola VDC of Taplejung district has the lowest density of 0.34/km^2 and Anarmani VDC (now a part of Birtamod municipality) has highest population density of 2,323.05/km^2 within the landscape (CBS 2012b). The average household size is 4.42. The detailed demographic features of the landscape VDC/municipalities are listed in Annex II & III.

Ethnic diversity: The landscape exhibits rich diversity in culture, caste/ethnicity and religion. According to 2011 census, Brahmin and Chhetri account for 35%, ethnic groups (*Janajatis*) 55%, Dalits 4% and others account for 5% of the total population within the landscape VDCs and municipalities. *Janajatis* constitute the largest group in Taplejung, Panchthar and Ilam districts whereas Brahmins and Chhetris are the largest group in Jhapa district (Table 4.1). The ethnic groups living in the landscape are Limbu, Rai, Magar, Gurung, Tamang, Majhi, Sherpa, Lepcha, Sunuwar, Bhote, Newar, Sanyasi, Yakkha and Bhujel in hilly districts. In Jhapa district, Rajbanshi and Marwadi also constitute major ethnic groups. Major religions followed in the region are Kirati, Hindu and Buddhism. Cultural diversity also ensures diversity in indigenous knowledge on resource management and utilization. Among other languages such as Tharu, Tamang, Magar, Sherpa, Gurung, Limbu and Rai, Nepali language is also widely spoken in KL region.

Table 4.1: Population by caste/ethnicity (% of the total) in KL Nepal

Districts	Dalits	*Janajatis*	Brahmin and Chhetri	Others
Taplejung	7.5	64.99	26.16	1.35
Panchthar	4.89	77.55	16.69	1.17
Ilam	3.35	60.65	30.03	5.97
Jhapa	5.57	44.56	42.67	7.20

Source: CBS (2012b)

4.2 Livelihoods and economic activities

People in KL Nepal districts practice a range of both farm and off-farm based livelihood activities. Agriculture is the mainstay for the majority of people. People follow mixed farming systems comprising crop production and animal husbandry. However, major livelihood means vary geographically. In the bordering villages like Olangchung Gola, people almost exclusively rely on transboundary trade with Tibet. Similarly, at higher elevation settlements, contribution of animal husbandry is more compared to the settlements of lower elevation. In the lower elevation villages, crop production is the major economic activity. Although commercialization of agriculture is increasing, agriculture is largely of subsistence in nature. Over the years, large scale cultivation of large cardamom (*Amomum subulatum*) has become one of the major economic activities in the region, which has transformed the socio-economic condition of the people, particularly in hilly districts.

Cultivation of large cardamom–one of the major sources of income to the people of KL Nepal districts

4.2.1 Agricultural system

General crops

Crop production is the major occupation for majority of the people. Major crops grown are paddy, millet, maize, wheat and buckwheat. Rice is the main staple food. Millet is grown mostly for brewing. In the higher elevation villages, potato is grown as a major crop. Other minor crops grown are pulses, soybean, oilseeds, etc. In the villages at higher elevation, maize, wheat and millet are the major crops. Slash and burn agriculture is practised in the slopes of higher elevation. Maize used to be the major crop of slash and burn agriculture but Chiraito (*Swertia chirayita*) has now become the major crop of this farming practice. Area and production of major crops grown in KL districts are shown in the Table 4.2.

Cropping pattern

Availability of irrigation facility is one of the defining factors in the selection of crops. Paddy is the preferred crop wherever irrigation facility is available. Cropping pattern varies largely depending on the elevation, type of land (*khet/bari*), and the availability of irrigation facility. Three crops are grown in the river valleys where irrigation facility is available. In some areas, paddy is grown twice a year. In *bari*, maize and finger millets constitue the major crop. In higher elevations, only one crop is grown.

Cash crop production

Cash crop cultivation is one of the major livelihood options for the people. Some of the major cash crops grown are large cardamom, tea and coffee. Crops like

ginger, chilli and broom grass are also grown as cash crops. Area and production of major cash crops grown in the region is shown in Table 4.3. Among the different crops, large cardamom is the major cash crop grown from Ilam to lower parts of Lelep VDC of Taplejung district in the areas of adequate water availability.

The rural economy has been greatly improved by large cardamom cultivation. However, the cultivation of large cardamom has declined in some parts of Panchthar and Ilam districts because of the occurrence of fungul and bacterial diseases (Partap et al. 2014). People have converted many traditional rice terraces for large cardamom plantation. Shade trees maintained/ grown with large cardamom have improved vegetation coverage and availability of firewood. Large cardamom is generally exported to India via collection agents in the district headquarters.

Tea plantation is increasing steadily in KL Nepal region. The tea industry is one of the major agriculture based industries of Nepal. Jhapa is the major tea producing district contributing 87% of the total tea production of the country. In the year 2010/2011, Nepal exported tea worth Rs. 1,549 million. The cultivation of coffee has been gaining momentum in recent years. Similarly, the cultivation of *Chiraito* has also become an important economic activity in Taplejung and Panchthar districts. It is cultivated in community forests as an important crop through 'slash and burn' farming practice. In addition,

Round chillies (Akbare)–widely cultivated in KL Nepal

Table 4.2: Area (ha) and production (Mt) of major crops in KL Nepal districts (2011/2012)

Crop	Taplejung		Panchthar		Ilam		Jhapa	
	Area	Production	Area	Production	Area	Production	Area	Production
Paddy	10,477	22,167	11,500	23,000	14,825	45,690	89,400	321,840
Maize	16,075	38,116	12,800	21,760	31,480	77,500	24,600	72,460
Millet	3,050	3,508	5,000	9,350	3,000	3,000	1,800	2,160
Wheat	1,210	2,783	4,000	7,580	4,620	13,398	7,500	25,150
Barley	240	280	494	593	55	55	8	6
Buckwheat	155	170	60	42	28	20	1,300	1,300
Potato	3,615	42,437	1,830	24,119	6,815	90,950	10,140	163,820
Oilseed	564	627	622	512	780	700	3,500	3,582
Lentil	25	20	101	85	80	50	2,005	2,187
Black gram	345	408	670	569	503	308	1,275	1,079
Soybean	175	200	580	445	121	95	143	101
Vegetables	770	8,625	1,307	12,924	3,085	43,608	7,445	123,659
Citrus	537	4,883	652	7,123	387	4,420	45	250
Summer fruits	115	1,033	207	2,529	364	2,289	6,043	70,773
Winter fruits	664	3,740	153	1,297	243	2,003	-	-

Source: MoAD (2012)

Table 4.3: Area (ha) and production (Mt) of major cash crops in KL Nepal districts (2011/2012)

Crops	Taplejung		Panchthar		Ilam		Jhapa	
	Area	Production	Area	Production	Area	Production	Area	Production
Large cardamom	2,925	1,755	1,500	630	1,700	694	-	-
Tea	-	-	920	255	5,638	1,805	9,500	15,955
Coffee	-	-	33	8.1	47	15.5	-	-
Ginger	200	2,800	200	2,240	3,170	56,000	374	4,562
Chilli	125	1,500	49	290	155	540	135	665

Source: MoAD (2012)

commercial vegetable production has also become a major economic activity along the roadhead and in local market areas.

4.2.2 Animal husbandry

Animal husbandry is an integral part of farming system. Common types of livestock kept are cow, buffalo, goat, sheep and pig. Pure and crossbreeds of yaks are kept in the higher elevation villages like Olangchung Gola, Lelep and Yamphudin. In areas like Kalikhola, herds of cattle are kept and moved at different elevations following seasonal movement. Flocks of sheep are also kept following seasonal grazing. However, the seasonal movement of animal husbandry has greatly reduced over the years. In the settlements too, people largely follow stall-feeding where the intensity of grazing has diminished. Many dairy cooperatives have been established and milk production has become one of the major economic activities in the region. The number of different types of animals raised in KL Nepal is shown in the Table 4.4.

Yaks in Olangchung Gola of KL Nepal

4.2.3 Foreign employment, migration and remittance

Besides agriculture and natural resource-based economic activities, another major livelihood option has been foreign employment for youths, especially in the last one decade or so. The 2011 census showed a total absentee population of 129,746 from these four districts. Youths migrating for foreign employment constitute large portion of this absentee population.

Carpet weaving–a major source of income in Olangchung Gola of KL Nepal

Remittance from foreign employment has become an important feature of the rural economy. Internal migration from remote areas to urban and semi-urban centres also shows an increasing trend.

4.2.4 Weaving and knitting

Weaving and knitting also constitutes an important occupation of the people in KL Nepal districts, although transfer of indigenous knowledge on weaving and knitting is declining due to the limited interest of younger generation to engage in the occupation. While women in the high mountain areas of Taplejung are involved in carpet weaving, their involvement is high in weaving/knitting of shawls and bags from cotton fibre using indigenous handicraft weaving techniques in Panchthar and Taplejung districts.

4.3 Food security

Production of major cereal crops and total food requirement in the districts in the year 2010/2011 is shown in Table 4.5. Since there is no available data at the VDC level, production and requirement data at the district level is taken as an indicator of the existing food security scenario in the area. The table shows that among the four districts, Panchthar has comparatively less food balance with production and requirement both combined. However, rice has become the major food commodity and other cereals are becoming less important constituents of food. Therefore, food availability is to be assessed in relation to rice rather than the total production of cereal crops. Millet is grown almost exclusively for brewing local alcohol rather than consumption as food in these districts.

Table 4.4: Number and types of animals raised in KL Nepal districts

District	Cattle	Buffalo	Yak/*chauri*	Sheep	Goat	Pig	Fowl
Taplejung	73,154	45,795	2,890	14,589	143,321	32,972	220,592
Panchthar	110,266	50,208	1,095	4,106	170,435	42,081	557,190
Ilam	88,601	30,737	110	5,792	140,067	22,318	352,218
Jhapa	320,814	135,257	0	30	228,166	47,611	1,164,302

Source: MoAD (2012)

Table 4.5: Food availability and requirement (2010/2011)

Districts	Cereal production (Mt)							Requirement (Mt)	Balance
	Rice	Maize	Millet	Wheat	Barley	Buck-wheat	Total edible		
Taplejung	11,964	29,396	2,851	2,265	77	138	46,691	24,440	22,251
Panchthar	12,392	14,208	7,656	6,103	163	34	40,555	39,798	757
Ilam	24,889	61,436	2,431	11,021	15	16	99,807	59,734	40,073
Jhapa	175,827	50,675	1,757	20,800	2	1,053	250,113	149,338	100,775

Source: MoAD (2012)

Easy access to markets with the development of rural road networks and availability of cash improved by cultivation of cash crops and remittances from foreign employment has contributed to improve food security. These factors have to be taken into account in assessing food security in addition to the local food production/availability.

4.4 Human development and poverty

Generally, KL Nepal districts fare well in terms of Human Development Index (HDI) and Human Poverty Index (HPI). The national average HDI and HPI is 0.490 and 31.12 respectively. The percentage of poor people has declined sharply in ten years period. The percentage of poor in Taplejung, Panchthar, Ilam and Jhapa districts in 2001 (2058 BS) was 39.7, 52.5, 51.8 and 13.4 respectively. Ten years ago, they ranked 69th, 70th, 35th and 6th, and now they rank 42nd, 7th, 2nd and 6th respectively indicating decline in the number of poor people in these districts. Table 4.6 shows the percentage of poor and development indices in different landscape districts.

Table 4.6: Development and Poverty Index for different districts

Districts	HDI	HPI	Per capita income ($)	% of poor
Taplejung	0.494	26.42	1,313	27.0
Panchthar	0.496	33.66	1,082	11.4
Ilam	0.526	26.96	1,260	7.3
Jhapa	0.518	21.82	1,226	10.6

Source: CBS (2013), GoN/UNDP (2014)

4.5 Tourism

Tourism has a long history in the region that dates back to early attempts to climb Mt. Kangchenjunga. As early as 1899, an expedition team led by Douglas Freshfield completed the first high level circuit of the mountain. Although the region became the attraction for tourism since long, tourism has not yet become a major activity. The establishment of the KCA in 1998 has added impetus to the growth of tourism in the region. Current tourism activities are mostly limited to climbing Mt. Kangchenjunga, trekking in the KCA and along the recently promoted Great Himalayan Trail in Taplejung district. In some parts, small scale tourism is developing and local people are engaged in it. Additionally, road network is also being developed rapidly reducing the role of pack animals in transportation.

Kichakbadh in Jhapa district–one of the religious sites of KL Nepal

KL Nepal is also the eastern gateway for the Great Himalayan Trail. The number of tourists visiting KCA in the years 2009, 2010 and 2011 were 592, 556 and 702 respectively. Although these figures are not significant compared to other tourist destinations in Nepal, there is a huge potential for tourism growth in this region. Domestic tourism can be promoted through agri-based tourism in Ilam and religious/ heritage and cultural tourism in all the districts of KL Nepal.

Dhiki Chhyoling Monastery at Olangchung Gola

Table 4.7: Some potential sites for tourism promotion in KL Nepal districts

Districts	Places of natural attraction	Sacred places	Historical places
Taplejung	Kangchenjunga Conservation Area, Mt. Kangchenjunga, Ghunsa, Red panda habitats, 5 IPAs (see 5.1.6), Important Bird Areas (see 5.1.4)	Pathivara, Dhiki Chhyoling Monastery at Olangchung Gola	Pathivara Olangchung Gola Taplejung Bazaar
Panchthar	Timbung Pokhari, Pauwa Bhanjyang, Red panda habitats, 5 IPAs (see 5.1.6), Important Bird Areas (see 5.1.4)	Kabeli, Mahadevsthan, Siddha Devisthan, Tin Maule, Aangejung Gumba, Pathivara Devisthan, Shivalaya Mandir, Timbung Pokhari, Jor Pokhari, Gadidevisthan, Phatikeshor Mahadevsthan, Labrekuti Mandir, Thakle Mandir, Hastapur Devisthan	Jorsal, Aahalgarhi, Aatare Hewakholapati, Jorpati, Tindharepati, Gadi, Chala Sekuwadada, Phaudarpati, Chaklepati, Simrahapati, Jorsalpati
Ilam	Tea gardens, Shree Antu, Sandakpur (also known as Sandakphu in India), Kanyam, Gajurmukhi, Todke jharana, Red panda habitats, 5 IPAs (see 5.1.6), Important Bird Areas (see 5.1.4)	Mai Pokhari	Larumba
Jhapa	Tea gardens, Jalthal forest, 3 IPAs (see 5.1.6).	Kichakbadh, Arjundhara, Birat Pokhari, Kankaimai, Krishna Thumki, Shatasidham	Kichakbadh, Arjundhara, Birat Pokhari, Samayegadh, Chandragadhi and Kechana

Natural landscapes, rich fauna and flora, sacred temples (e.g. Pathivara temple) and other religious/ natural sites such as Timbung Pokhari and rich cultural heritage make KL Nepal one of the attractions for heritage tourism (Table 4.7). Tourism promotion in the region is also linked with tourism activities along the bordering areas of Nepal-India. Highly developed tourism sector in KL India (Darjeeling and Sikkim) could also be a boon for KL Nepal if tourism activities are well coordinated.

4.6 Transboundary trade

In addition to crop production and animal husbandry, people practice a wide variety of activities to sustain their livelihoods, ranging from small scale cottage industries to trade at the local level as well as cross-border trade. Most of the households combine these different strategies to minimize livelihoods' risk and optimize the use of natural and economic resources (Müller-Böker and Kollmair 2000, WWF 2006).

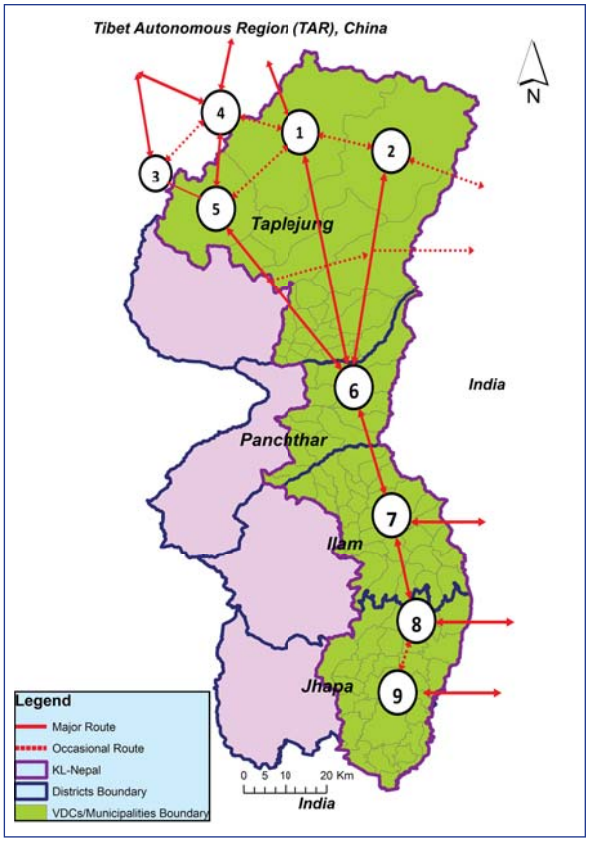
Domestic as well as cross-border trade of forest, agriculture and animal husbandry products is an old practice in KL Nepal region. However, trade pattern has significantly changed over a few decades, especially regarding the traded items, their volume, market channel and trade routes (Fürer-Haimendorf 1975, Müller-Böker and Kollmair 2000, NCDC 2010a).

Similarly, transborder trade pattern varies along the elevation gradient. Transborder trade of the lower elevation region like Ilam and Jhapa is mainly oriented towards India (Sikkim region) and also towards Bhutan. Trade items mostly include NTFPs (mainly medicinal plants), cash crops (large cardamom, potato, pulse, broom grass, etc.), dairy products (usually yak butter, cheese, *chhurpi* (dried cheese), other yak products), while the daily life commodities, chemical fertilizers (in the case of Jhapa), textile products, etc. are imported from India. At the higher altitudinal belt (above 2,500m), trade with Tibet and Sikkim is one of the major off-farm activities of the people. Trade with Tibet is done generally during autumn. Mostly, men are involved in transboundary trade. People also maintain settlements at different places according to their livelihood strategies in different seasons.

The long stretch of Kangchenjunga–Singhalila Complex separates India (Darjeeling and Sikkim) and Nepal. The border between India and Nepal is open and there are a number of trade routes and points for trade and movements. Trade of basic commodities and movement of livestock and tourists in the area have been continuing for many years.

Trade in Taplejung district with Tibet takes place through high altitude alpine passes (Chettri et al. 2008a). Along the border with Tibet, there are several trading points such as Olangchung Gola, Topkegola and Papung of Taplejung; and Pauwakhola, Chepuwa and Thudam of Sankhuwasabha district (Figure 4.1). However, due to the extremely rugged and remote terrain on the northern border, there is less interaction with local people in China compared to the interaction with India (NCDC 2010a). Major trade routes in KL Nepal region and major traded items are shown in Table 4.8.

Figure 4.1: Major trade routes in KL Nepal



Local trade points on the routes:
1. Olangchung Gola, 2. Ghunsa,
3. Pawakhola, 4. Chepuwa,
5. Papung, 6. Panchthar (Prangbung, Memeng),
7. Ilam (Pashupatinagar), 8. Charali/Birtamod,
9. Chandragadhi

Table 4.8: Major trade routes with different types of exported and imported items

Trade points	Routes followed	Export	Import
From 6 to 1	Panchthar (Prangbung, Memeng)–Olangchung Gola–Tibet	Medicinal plants/NTFPs, wildlife products, dairy products, yaks, potato	Salt, rice, wheat flour, sugar, fat, wool, kerosene, clothes, horses
6 to 2	Panchthar (Prangbung, Memeng) – Ghunsa–Tibet (via Chabu La, Kang La, and Tripta la)	Medicinal plants/NTFPs, wildlife products, dairy products, yaks, potato	Salt, rice, wheat flour, sugar, fat, wool, kerosene, clothes, horses
5 to 1	Papung–Olangchung Gola–Tibet	Medicinal plants/NTFPs, wildlife products, dairy products, yaks, potato	Salt, rice, wheat flour, sugar, fat, wool, kerosene, clothes, horses
6 to 5 & 4	Panchthar (Prangbung, Memeng)–Papung–Chepuwa–Tibet (mainly via Kimathanka)	Medicinal plants/NTFPs, wildlife products, dairy products, yaks, potato	Salt, rice, wheat flour, sugar, fat, wool, kerosene, clothes, horses
6 to 5 & 3	Panchthar (Prangbung, Memeng)–Papung–Pawakhola–Tibet (via Kimathanka)	Medicinal plants/NTFPs, wildlife products, dairy products, yaks, potato	Salt, rice, wheat flour, sugar, fat, wool, kerosene, clothes, horses
1 to 2	Olangchung Gola–Ghunsa–Darjeeling (across Shinghalila ridge)	Medicinal plants/NTFPs, wildlife products, dairy products, yak products, cash crops	Daily life commodities
3 to 5	Pawakhola–Papung–Darjeeling via bordering VDCs of Panchthar	Medicinal plants/NTFPs, wildlife products, dairy products, yak products, cash crops	Daily life commodities
6 to 7	Panchthar (Prangbung, Memeng)–Ilam (Pashupatinagar)–Darjeeling	Medicinal plants/NTFPs, wildlife products, dairy products, yak products, cash crops	Daily life commodities, chemical fertilizer, textile products
6 to 8	Panchthar (Prangbung, Memeng)–Ilam–Charali/Birtamod–Siliguri via Mechinagar	Medicinal plants/NTFPs, wildlife products, dairy products, yak products, cash crops	Daily life commodities, chemical fertilizer, textile products
8 to 9	Charali–Chandragadhi–Bhadrapur–Siliguri via Galgaliya post	Medicinal plants/NTFPs, wildlife products, dairy products, yak products, cash crops	Daily life commodities, chemical fertilizer, textile products

4.6.1 Trade of plant species

Present trade of plants and/or products mainly includes NTFPs; including the endangered and protected plants and/or their parts like *Dactylorhiza hatagirea, Neopicrorhiza scrophulariiflora*, lichens collected from trees and *Taxus wallichiana*. Other important traded species are *Aconitum* species, *Valeriana jatamansi, Viscum album* and *Zanthoxylum* species. Plants and/or parts from *Daphne bholua, Edgeworthia gardneri, Rhododendron anthopogan, Rubia manjith, Swertia chirayita, Valeriana jatamansi,* and *Zanthoxylum* species are traded following legal procedures. Collection of plants and/or parts for local use is limited in the region. The collected plant material is normally sold to middleman (local trader) and only a few collectors sell/export the materials directly at the local and cross-border markets (NCDC 2010a).

Of the 363 species of NTFPs reported from KL Nepal (Uprety et al. submitted), some are important sources of income to the local people and have long been traded both legally as well as illegally across the local, regional and transborder areas. Trade often includes some of the CITES Appendix listed species like Sunakhari (Orchids), Kutki (*Neopicrorhiza scrophulariiflora*) and Lauth salla (*Taxus wallichiana*). Trade also includes some plant species legally protected under the Forest Act, 1993, like Orchids, Champ *(Michelia champaca)*, Jatamansi (*Nardostachys grandiflora*), Jhyau *(Lichens)* and Sughandhawal (*Valeriana jatamansi*). Plant and/or parts mainly collected from the government managed and community managed forests are traded to India via local collectors and a limited amount of those items are also exported to Tibet (NCDC 2010a).

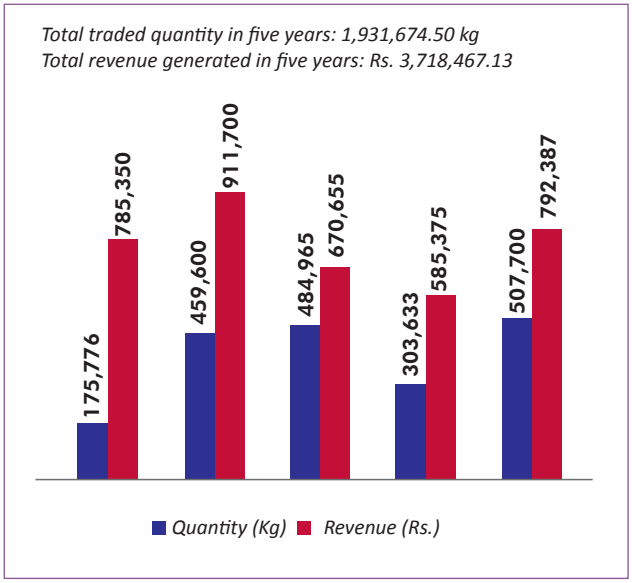
4.6.2 Traded species/potential species and their volume

In addition to the local use, species like *Daphne bholua, Edgeworthia gardneri, Swertia chirayita, Taxus wallichiana, Valeriana jatamansi*, *Paris polyphylla* and *Zanthoxylum armatum* are collected and traded in bulk. Among these species, *Swertia chirayita* is collected in huge amount with quantity of 5,650 kg/year and having local price of Rs. 1,507,646. *Zanthoxylum armatum* is collected with an amount of 1,240 kg/year and has the total local value of Rs. 248,000. *Taxus wallichiana* and *Valeriana jatamansi* are collected in smaller amount as compared to other species (NCDC 2010a). Apart from this, the government data reveals a limited amount of legal trade of the NTFPs/MAPs from the region. Only 17 species of NTFPs/MAPs were under frequent trade during the five-year period 2008–2012 (2064/2065-2068/2069 BS), in which the largest amount of NTFPs/MAPs was exported from Panchthar district whereas none of the plant/product was legally traded from Jhapa district. Study has shown that NTFPs trade data records of GoN (DoF 2008–2012) are far below than the situation in the field (Pyakurel and Oli 2013). Of these five years, the highest amount of NTFPs/MAPs was traded in

Argeli (Edgeworthia gardneri) used in making hand-made paper as a raw material

Satuwa (Paris polyphylla)–one of the major traded NTFPs in KL Nepal

Figure 4.2: Amount of traded NTFPs/MAPs and revenue generated in five years in KL Nepal districts



Source: DFO Panchthar, Ilam and Jhapa (2008–2013); MoFSC (2013)

2011/012 (2068/2069) whereas the lowest amount was traded in 2008/2009 (2064/2065). Similarly, highest and lowest amount of revenue was generated during 2009/2010 (2065/2066) and 2010/2011 (2067/2068) respectively (Figure 4.2).

4.7 Drinking water and sanitation

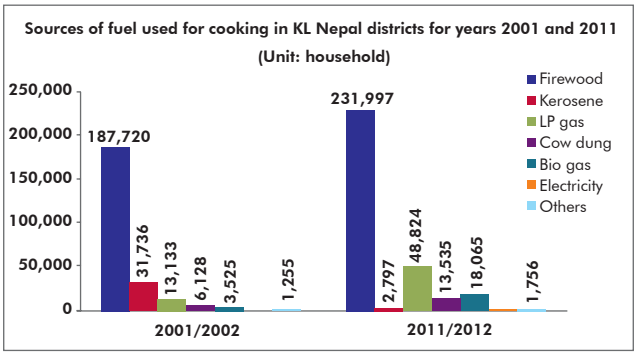
Tap/piped water supply is the main source of drinking water for majority of the population in Ilam, Panchthar and Taplejung districts. In Jhapa district, the main source of drinking water is tube-well/hand pump. The percentage of households having access to tap/piped water in the landscape VDCs/municipalities in Taplejung, Panchthar, Ilam and Jhapa districts is 91, 93, 92 and 31 respectively. In Jhapa district, about 69% households have access to water through tubewell and hand pumps. Over the years, the district headquarters are increasingly facing water scarcity. In 2011, the percentage of households without toilet facilities in these districts was 30, 8.5, 5 and 27 respectively. However, in recent years, the 'open defecation free' campaigns in these districts have increased people's access to improved sanitation facilities.

4.8 Road network

All KL Nepal districts are linked by all season black-topped roads. Many of the VDCs in the hilly and mountainous regions are also connected by earthen roads. Road linkage has helped in transforming the socio-economic conditions of these areas. However, some VDCs in Taplejung and Panchthar districts have not yet been connected by road network. Two airports exist in KL Nepal—Chandragadhi in Jhapa and Suketar in Taplejung districts. Increase in flight frequency in Taplejung could contribute to enhance tourism development of the region.

Pushpalal mid-hills highway in Panchthar district

Figure 4.3: Pattern of fuel consumption for cooking



Source: CBS (2012c)

4.9 Energy sources and utilization

4.9.1 Major energy sources

Firewood is the major source of energy followed by Liquified Petroleum (LP) gas, biogas, cow dung and electricity in KL Nepal districts. Although overall consumption of firewood for cooking is reduced by about 4% from year 2001 to 2011, still 72.66% of the households in KL Nepal region depend upon firewood as a source of energy (CBS 2012c). In addition to firewood, the use of kerosene has reduced substantially while the use of other alternative sources of energy like LP gas, biogas and electricity has increased from 2001 to 2011 (Figure 4.3, Table 4.9). A case study, including nine bordering VDCs of Taplejung, Ilam and Panchthar districts (Taplejung—Aangkhop,

Table 4.9: Households using different sources of fuel for cooking (comparison between 2001 and 2011)

Sources of fuel	Year	Taplejung (HH)	Panchthar (HH)	Ilam (HH)	Jhapa (HH)
Total	2001	24,763	37,260	54,566	125,949
	2011	26,471	41,176	64,477	184,384
Firewood	2001	24,167	35,663	42,797	83,092
	2011	25,287	37,916	58,179	108,604
Kerosene	2001	477	1,518	8,711	21,030
	2011	128	330	455	1,884
LP gas	2001	0	0	2,238	10,895
	2011	849	2,368	3,775	41,832
Cow dung	2001	0	0	0	6,128
	2011	5	134	108	13,288
Biogas	2001	0	0	175	3350
	2011	63	196	1,527	16,279
Electricity	2001	NA	NA	NA	NA
	2011	2	12	36	104
Others	2001	0	0	434	821
	2011	6	80	50	1,620
Not stated	2001	119	80	212	634
	2011	131	140	349	773

Source: CBS (2012c)

Kalikhola, Sadewa; Panchthar—Chyangthapu, Memeng, Sidin; and Ilam—Gorkhe, Jamuna, Mai Pokhari) has revealed firewood as the main source of energy for cooking purpose in all the VDCs. Virtually, all households in the districts use firewood for cooking and the highest value of annual consumed firewood comes from Taplejung district, which is the coldest district (Table 4.9) (Pant et al. 2012).

The source of firewood collection varies with VDCs–the main source being private and community forests (NCDC 2010b). The total amount of firewood collected from the private forest is 61,210 *bhari*/year, which is followed by 9,535 *bhari*/year from the community forest. The total amount of firewood used in the entire area is estimated to be 72,060 *bhari* (1 *bhari*=approx. 40 kg). Limited information exists with the concerned government agencies (District Forest Offices) regarding the collection and sale of firewood.

4.9.2 Technology utilization in energy generation

Energy consumption can be classified into two sectors: domestic and commercial. The domestic sector includes household level energy consumption while the commercial sector includes energy consumption in hotels, lodges, shops and other establishments. Energy consumption in domestic sector is mainly for performing different activities, *viz*. cooking, water boiling, space heating, lighting, etc., which is mainly from traditional sources of energy, *i.e*, firewood, dung cake, biomass, etc.

Technology is the key for efficient and judicious use of energy resources according to the need of the people. Various technologies adopted by the people are as follows:

Traditional stove

Traditionally, villagers have been using traditional stoves for cooking which is generally situated at the corner of the kitchen. For space heating purpose, they use iron tripod (*agena*). Since firewood is burnt in open air, its consumption is found to be relatively higher than the improved stove. Because of increased firewood consumption, most of the villagers have switched over to more efficient stove.

Improved cooking stoves

Improved Cooking Stoves (ICS), with efficiency of 18 to 28%, have been developed in Nepal since early eighties. These devices are more efficient in cooking than the traditional stoves and hence save firewood and provide smokeless environment in the kitchen. The number of ICS installed in KL Nepal districts till 2013 was 31,637 (Table 4.10).

Table 4.10: ICS, biogas and micro-hydropower installations in KL Nepal districts

SN	Districts	No. of ICS installed	Biogas plants	Mico-hydro power plants	
				No. of units	Capacity (kW)
1.	Taplejung	8,957	87	71	864
2.	Panchthar	8,341	644	126	1,334
3.	Ilam	14,339	3,609	298	1,130
4.	Jhapa	NA	20,821	1	3
	Total	**31,637**	**25,161**	**496**	**3,331**

Source: AEPC (2013)

As firewood requirement for water boiling shares upto 90% of the total energy consumption in Taplejung district, it is realized that there is a need for an appropriate household ICS. Alternative Energy Promotion Centre (AEPC) of the Ministry of Science, Technology and Environment works with local partner organizations such as NGOs or private sectors for the promotion of ICS in rural areas. These organizations have ICS promoters who provide technical backstopping and monitoring services after the installation of stoves. Because of these services, cookstoves are working properly. Apart from this, the GoN is providing subsidy of Rs. 4,000 in the metallic ICS in high altitude areas above 2,000 metres. NCDC is AEPC's regional service provider for Eastern Development Region and, hence, it promotes ICS programmes in the region. Similarly, other organizations like Alternative Energy Development Centre (AEDC) is promoting ICS, Solar Home System (SHS), micro-hydro power programmes in Panchthar district while ECDF is promoting similar programmes in Taplejung district.

Kerosene stove

Kerosene stove is common in the study area but as people have sufficient firewood, biomass, agriculture residue, cow dung, etc., they use kerosene for lighting purpose only. The average kerosene oil consumption per household for lighting purpose is 3 litres per month.

Biogas

Biogas is also a common source of energy in KL Nepal districts. The number of installation of biogas plants in KL Nepal districts was 25,161 till 2013 (Table 4.10).

4.9.3 Mini/micro-hydro power in KL Nepal districts

Mini-hydro power is defined as the schemes that generates electric power from 100 kW to 1MW capacity and serves nearby households through mini-grid. Micro-hydro power is defined as an isolated grid connected hydropower system that generates power

Table 4.11: Solar dryer/cooker and SHS installation in KL Nepal districts

SN	Devices	Taplejung	Panchthar	Ilam	Jhapa	Total
1.	Solar Home System units	4,800	6,330	2,727	118	13,975
2.	Capacity Wp of SHS units	160,712	259,183	121,588	3,976	545,459
3.	Solar dryer/cooker	7	NA	37	NA	44
4.	Solar *tuki* (<10w SHS units)	741	125	144	293	1,303
5.	Capacity Wp of solar *tuki*	3,675	440	400	490	5,005

Source: AEPC (2013)

upto 100 kW electrical powers and serves nearby households through a grid. This includes pico-hydro schemes upto 5 kW capacity. Table 4.10 presents the district-wise installation of micro-hydro power plants in KL Nepal.

4.9.4 Solar energy technologies

Mainly, two types of solar energy technologies (solar thermal and solar photovoltaic (PV) systems) are available in Nepal. Solar thermal systems include solar water heaters, solar dryers and solar cookers. Similarly, solar PV systems include solar communication system, solar electrification system and solar water pumping system. Table 4.11 presents district-wise solar dryer/cooker and SHS installations in KL Nepal. Solar energy is mostly used for lighting purpose in KL Nepal districts. About 60% households inside KCA have access to solar power.

4.9.5 Energy deficits

About five and half million households still need access to clean energy options for cooking, lighting and heating in Nepal (AEPC 2013). The energy mix pattern of Nepal shows that 87% of the total energy comes from firewood. In KL Nepal region, still 73% of households depend upon firewood as a source of energy compared to 64% national average (CBS 2012a). Firewood is mainly used for domestic cooking, space heating, animal feed preparation and other agro-processing purposes. Firewood does not provide the type of energy required for working, reading, communication and other basic services essential for improved quality of life. For this purpose, alternative energy technologies like micro-hydro power, solar, biogas and improved cooking stoves have been used in KL Nepal districts.

AEPC has been providing subsidy to renewable energy technologies with focus in rural areas. AEPC ensures outreach through the engagement of local bodies, sub-national and national service providers and private sector. NCDC of Ilam has been serving as the Regional Renewable Energy Service Centre (RRESC) of AEPC in KL Nepal region.

4.10 Pollution

4.10.1 Air pollution

All KL Nepal districts have extensive road networks and so have some traffic related hazards. Regional polluting substances such as aerosols are reported to be increasing in the region, for example, the presence of accelerated rate of melting glaciers because of black carbon deposits. Air pollution may increase in future along with increased road networks and socio-economic activities.

4.10.2 Water pollution

Major settlements and district headquarters do not have sewerage treatment plants and sewage is directly drained to the major river systems. Arsenic contamination of tube well/hand pump water in Jalthal region is posing serious health hazards. Distribution of pipe water without treatment is not safe (DDC Jhapa (2013), DDC Ilam (2013), DDC Panchthar (2013) and DDC Taplejung (2013).

4.10.3 Solid waste

Managing solid waste is one of the major challenges in the district headquarters and trekking routes. Local authorities have not initiated solid waste treatment facility. Plastics are often burned without considering environmental hazards. Tourist routes are also affected by solid waste pollution whereas problem of water and beer bottles as well as local wine is seen in towns and villages.

4.10.4 Chemicals and fertilizers

Use of chemical fertilizers and pesticides is widespread in KL Nepal districts. Application of pesticides is very common in areas close to the roadheads. The total amount of pesticides used in Ilam and Panchthar districts for 2012/2013 was 735 and 2,890 litres respectively.

4.11 Public health

The overall situation of public health in KL Nepal districts is fair. Hospitals, health centres and Ayurvedic clinics provide services to the people. Among the four districts, incidence of tuberculosis, malaria and HIV infection is reported highest from Jhapa and lowest from Taplejung (DoHs 2011). Water-borne diseases are also observed

Table 4.12: Literacy rate and education accessibility by gender in KL Nepal districts

KL Nepal districts	Population aged 5 & above (total no.)		Literacy rate (% of total)		SLC or equivalent (% of total)		Graduate or equivalent degree (% of total)	
	Women	Men	Women	Men	Women	Men	Women	Men
Taplejung	60,490	54,077	64	79	6.7	8.6	0.3	1.2
Panchthar	93,077	81,486	66	80	7.3	8.2	0.5	1.4
Ilam	139,094	130,666	72	84	7.4	8.1	0.8	1.8
Jhapa	394,198	349,759	69	82	8.9	10.1	1.1	2.6
Total	**686,859**	**615,988**	**68**	**82**	**7.6**	**8.7**	**0.7**	**1.7**

Source: CBS (2012b)

throughout all the districts. A large proportion of high altitude population uses medicinal plants for health care as there are no service providers (Sherpa 2001). The use of medicinal plants is also significant in lower altitudes of KL Nepal thereby considerably contributing to the traditional health care systems (Parajuli 2013).

4.12 Gender and social inclusion

4.12.1 Literacy and education status by gender

The 2011 census reveals that gender gap is remarkable with regard to literacy rate and education opportunity. As shown in Table 4.12, the average literacy rate in KL Nepal districts is lower for women (68%) compared with 82% for men. In addition, access to higher education opportunity by women is lower (0.7% of the total population aged 5 and above) compared with 1.7% for men. By districts, Ilam and Jhapa have more literate and educated women than Panchthar and Taplejung districts.

4.12.2 Women's access to productive resources

Access to productive resources such as land, technologies/machine, house, livestock and cash determines the status of men and women in communities (Meinzen-Dick et al. 2011). Access to these resources by women especially enables them not to be dependent on their husbands and other male members of the household.

Women's access to productive resources is shown in Table 4.13. It is found that women's ownership to land and house is very nominal. For example, in 2011, only 9.5% of the total households have land in women's name/ownership. Only 11% of the total households have land and house in the name of women members, which is very low compared to the national average of 20% (CBS 2002, CBS 2012c).

However, the households with ownership of land and/or land and house both have seen an increasing trend. On an average, 26% of the total households in KL Nepal districts are headed by women. Among KL Nepal districts, Ilam has lower number of women-headed households compared to other three districts. This could be due to relatively less number of men absentee in the district and their limited share of power in household headship.

Table 4.13: Women's ownership of key assets in KL Nepal districts

District	2001			2011		
	Total HH (No.)	Property owned by women (% of total HH)		Total HH (No.)	Property owned by women (% of total HH)	
		Land only	Land and house		Land only	Land and house
Taplejung	24,764	8.1	5.6	26,471	10.2	9.5
Panchthar	37,260	6.3	2.9	41,176	8.9	7.0
Ilam	54,565	5.4	2.7	64,477	5.7	8.1
Jhapa	137,301	6.9	6.3	184,384	13.0	17.7
Average (%)		**6.7**	**4.4**		**9.5**	**10.6**

Source: CBS (2002), CBS (2012c)

Chapter

5 Biodiversity and Ecosystem Services

A kaleidoscopic view of Singhalila ridge in KL Nepal

5.1 Biodiversity

Biodiversity consists of three fundamental and hierarchical categories–ecosystem diversity, species diversity and genetic diversity (Raven 1992). These three components of biodiversity have equal values, linked with each other and commonly share similar features (Gaston and Spicer 1998). Exploration, documentation, identification and conservation of biodiversity are global concerns. The importance of biodiversity and the services they provide are highlighted by the United Nations by declaring May 22 as the "International Day of Biodiversity". The current decade (2011—2020) has been declared as the "Decade of Biodiversity" and the year 2010 was celebrated as the "International Year of Biodiversity". The signatory countries of the Convention on Biological Diversity (CBD) have committed to conserve and sustainably use biodiversity of their respective countries and achieve biodiversity targets by 2020.

The biogeographic regions comprising rich biodiversity, high proportion of endemic, rare and threatened species and habitats are considered as "Biodiversity hotspots" (Myers et al. 2000, Mittermeier et al. 2004). As mentioned earlier in the introductory chapter, the Kangchenjunga Landscape is a part of the Himalayan region, which is among the 34 global Biodiversity Hotspots (Mittermeier et al. 2004). Faunal and floral diversity (species richness and endemism) in the Eastern Himalaya is rich due to the effect of Indo-Malayan and Palearctic realms, and includes several globally significant ecoregions and centres of plant diversity (Yonjon 2000).

This section focuses on the status of ecoregions, major ecosystems, vegetation and forest types, documents faunal and floral diversity, and presents these status of endemic and threatened species of animals and plants in KL Nepal.

5.1.1 Ecoregions

The Himalaya, particularly the Hindu Kush Himalaya, is considered as one of the high biodiversity areas with four global biodiversity hotspots, 60 ecoregions, 488 protected areas, 13 world heritage sites and 27 Ramsar sites (www.geoportal.icimod.org/symposium2010). KL Nepal represents four Eastern Himalayan ecoregions: (i) Eastern Himalayan alpine shrubs and meadows, (ii) Eastern Himalayan conifer forests, (iii) Eastern Himalayan broadleaved forests and (iv) Tarai-Duar grasslands and savannas. More than 15 years ago, Wikramanayake et al. (1998) assessed habitat conditions, fragmentation and conservation status of these ecoregions, which have changed drastically since then. A new assessment is needed to update the information about these ecoregions (Table 5.1).

Box 5.1: Jalthal forest: A unique patch of tropical vegetation in Jhapa district

The Jalthal forest, located in southern Jhapa, is the unique tropical mixed forest patch of KL Nepal. It covers ca. 6,300 ha at an altitude of 60m. The forest is composed of Sal (*Shorea robusta*) as a dominant tree species with other associates such as *Artocarpus chama, Lagerstroemia parviflora, Dillenia pentagyna, Terminalia bellerica, T. chebula, Sizygium cuminii*, etc. The forest is unique due to the presence of species like *Castanopsis* species (Katus), *Schima wallichii* (Chilaune), *Madhuca longifolia* (Mahuwa), etc. which are out of their normal distribution range. It is also a habitat for rare and endangered species like *Cycas pectinata* (Thakal), *Dalbergia latifolia* (Satisal), *Michelia champaca* (Champ), *Rauvolfia serpentina* (Chandmaruwa), *Bombax ceiba* (Simal), etc. A preliminary survey documented 57 species of trees, 17 species of shrubs, 67 species of herbs and 10 species of climbers representing 129 genera under 76 families (Bhattarai 2013). A detailed biodiversity assessment will help to formulate effective management plans of this unique forest.

Table 5.1: Ecoregions and their conservation status within KL Nepal

Ecoregions	KL Nepal districts	Habitat loss	Fragmentation	Conservation status of KL Nepal
Eastern Himalayan alpine shrubs and meadows	Taplejung, Panchthar	Degraded	Low level of fragmentation	• The upper part of KL (KCA in Taplejung and north-east of Panchthar) is relatively intact. • Southern part of Ilam is vulnerable. • Parts of Jhapa included in KL are endangered.
Eastern Himalayan subalpine conifer forests	Taplejung, Panchthar, Ilam	Small size, relatively intact	Medium level fragmentation	
Eastern Himalayan broadleaved forests	Taplejung Panchthar, Ilam	Relatively intact	Small stands still exist	
Tarai-Duar grasslands and savannas	Jhapa	Heavily altered and replaced	High level fragmentation	

Sources: Wikramanayake et al. (1998, 2001)

5.1.2 Major ecosystems, vegetation and forest types

KL Nepal comprises 11 bioclimatic zones, ranging from lower tropical (ca. 60m) to Nival zone (above 5,000m), representing four physiographic zones: lowland (below 1,000m), mid hill (>1,000m–<3,000m), high mountains (>3,000m–<5,000m) and High Himal (>5,000m). KL Nepal comprises vegetation types from lower tropical zone (as low as 60m) in Jhapa, subtropical to temperate vegetation zone in Ilam, Panchthar and Taplejung districts, subalpine to alpine zone in Panchthar and Taplejung and Nival zone in Taplejung. In general, 23 forest types (Annex IV) have been identified in KL Nepal from lowland Jhapa (Box 5.1) to highland of Panchthar and Taplejung districts.

The KCA alone is characterized by various types of ecosystems/habitats (glaciers, snow, rock; wetlands; alpine meadows with grasses and sedges; Mesohygrophile dwarf Rhododendrons (*Rhododendron anthopogon*, *R. nivale*); Shrublands with Rhododendrons; Upper subalpine Rhododendron shrublands; Lower subalpine silver fir (*Abies spectabilis*) forest; Larch (*Larix griffithiana*) forest; Hemlock (*Tsuga dumosa*) forest; Mixed Broad-leaved forest; Hygrophytic forest with *Quercus lamellosa*; Hygrophytic *Schima wallichii*; and Hygrophytic *Schima wallichii–Castanopsis indica*, and 8 types of vegetation (Upper alpine meadow; Moist alpine scrub; Fir forest; Larch forest; Mixed Rhododendron-Maple forest; East Himalayan Oak-Laurel forest; Schima-Castanopsis forest; and Hill Sal forest) (Dobremez 1972, Stainton 1972).

Some important ecosystems, including wetlands and rangelands are discussed in the section ecosystem services (section 5.2 of this chapter).

5.1.3 Forest coverage

The average forest area of KL Nepal districts is about 32.15% (Table 5.2). Of the total forest cover of Taplejung, Panchthar and Ilam districts, 19%, 54% and 36%

Table 5.2: Forest coverage of KL Nepal districts

Districts	Forest (ha)	Total area (ha)	% of total area of the district
Taplejung	112,262	365,337	30.72
Panchthar	57,794	122,165	47.30
Ilam	81,083	171,567	47.26
Jhapa	13,557	164,192	8.25
Total	264,696	823,261	32.15

Source: MoFSC (2013)

respectively is recorded from the transborder areas (Chettri et al. 2008b).

An old *Limbu* saying, "*ghar odar ho*, *ban bhandar ho*" or "the house is a shelter whereas the forest is a store house," indicates that the whole Kirat community has a culture and life-support system based entirely on forests. The ethno-cultural fabrics of the region are rich in traditional practices and consequently, the local residents of KL Nepal have been using a vast array of these natural resources in various ways for their subsistence (see Section 5.2 for the provisioning services obtained from forest ecosystems).

5.1.4 Important Bird Areas

Important Bird Areas (IBAs) are globally recognized as important habitats for the conservation of birds. These areas are determined by an internationally agreed set of criteria. At least three IBAs, including KCA, Mai Valley forest, and Tamur Valley and watershed are partially/fully within KL Nepal but they are closely linked with other three IBAs, including Makalu-Barun National Park, Dharan Forest and Urlabari Forest Groves (Baral and Inskipp 2005) as described below:

I. Kangchenjunga Conservation Area

The KCA is one of the major IBAs providing shelter for some restricted range species, globally threatened species, Eurasian High Montane biome species, Sino-Himalayan temperate forest biome species and Sino-Himalayan subtropical forest biome species. It supports more than 300 species of birds that are characteristics to the Eastern Himalaya. There are several reasons why faunal diversity particularly birds is high in this IBA. They include: (i) physiographical variations (e.g., river valleys, slope, and mountain ridges) and high altitudinal range (1,200m–8,586m); (ii) vegetation types from subtropical to alpine zones; (iii) diverse land use patterns, including cultivated and abandoned agriculture land of KCA; (iv) at least 12 different types of ecosystems, including river valleys such as the Simbuwa Khola, Ghunsa, Kabeli and Tamur; and (v) regular implementation of conservation activities of KCA since 1997.

II. Mai Valley forests

The Mai Valley forests are located in Ilam covering some parts of Jhapa in the south. The total area of forest is 30 km^2 and the altitudinal range is 70–3,050m. The Mai Valley watershed falls entirely within Ilam district but it extends from the confluence of the Kankai River in the tropical zone to Darjeeling border at 3,050m in the subalpine zone. Forests in the upper Mai Valley lie mainly in the lower and upper temperate zones, whereas lower Mai Valley comprises tropical and subtropical zones. A remnant of tropical evergreen forests also exists in the lower part of the Mai Valley. Thus, the Mai Valley forests include moist broadleaved oak (*Quercus* species) and mixed broadleaved forests comprising *Lithocarpus* species, *Castanopsis* species, and *Rhododendron* species with a bamboo understory, and the tropical evergreen and semi-evergreen forests, which are important for birds. Because of diverse habitats, diversity of bird species is very high. Around 200 species of birds have been recorded from this area. These forests are important for rare, globally threatened and restricted range species of birds (Table 5.3). Several species recorded in the small remnant tropical evergreen forests are either very rare in Nepal (e.g., Asian fairy bluebird) or have been only found in this locality (e.g., Pale headed woodpecker). Similarly, Lesser adjutant and White-rumped vulture also breed at the edge of the forests. Besides, rare, globally threatened and restricted range species, these forests also support Sino-Himalayan temperate forest biome species, Sino-Himalayan subtropical forests biome species, Indo-Chinese tropical moist forest biome species and Indo-Malayan tropical dry zone biome species. Besides birds, other wildlife species of the area include globally threatened Assamese macaque, Red panda, Asiatic black bear, Golden jackal, Common leopard, Barking deer, Nepal grey langur, Black giant squirrel and Yellow-throated marten.

III. Tamur Valley and watershed

Tamur Valley is another IBA site, which is partially included within the boundary of KL Nepal. The Tamur forms a major watershed extending from the confluence of the Koshi River at 100m in the tropical zone in Dhankuta district to the border above 3,800m in the alpine zone of Taplejung district. This IBA, with an area of 20 km^2 includes Tinjure-Milke-Jaljale (TMJ) Rhododendron Conservation Area, which is outside KCA. The Upper Tamur, however, lies within KCA. The Tamur watershed has an extensive area of broadleaved forests of *Quercus lamellosa*, *Castanopsis* species and mixed broadleaved forests. TMJ area is known for Rhododendron forests. *Quercus semecarpifolia* and *Abies spectabilis* are other species of the upper temperate forests.

Table 5.3: Globally threatened and restricted range species of birds in Important Bird Areas (Note: KCA= Kangchenjunga Conservation Area, MVF= Mai Valley Forest, TVW=Tamur Valley Watershed, NT=Nearly Threatened, V=Vulnerable, SRS=Short Range Species, End=Endemic, P=Present)

Species	Status	KCA	MVF	TVW	Remarks
Satyr tragopan	NT	P	P	-	Resident in KCA, but rare in MVF
Gallinago nemoricola	V	P	P	-	Altitudinal migrant, resident
Turdoides nipalensis	SRS, End	P	P	P	Altitudinal migrant, resident
Actinodura nipalensis	SRS	P	P	P	Altitudinal migrant, resident
Indicator xanthonotus	NT	-	P	P	Rare, resident
Buceros bicornis	NT	-	P	-	Uncommon resident
Gyps bengalensis	Critical	-	P	P	Rare breeding resident, near settlements
Gyps tenuirostris	Critical	-	P	-	Rare breeding resident, near settlements
Sarcogyps calvus	NT	-	P	-	Uncommon resident, open country
Aegypius monachus	NT	-	P	-	Rare winter visitor in open country
Circus cyaneus	NT	-	P	-	Rare passage migrant
Aquila clanga	V	-	P	-	Rare passage migrant
Falco naumanni	V	-	P	-	Rare passage migrant
Leptoptilos javanicus	V	-	P	P	Frequent breeding resident
Spelaeronis caudatus	NT; SRS	-	P	-	Resident in mossy rocks and ferns
Phylloscopus cantator	SRS	-	P	-	Rare winter visitor, broadleaved evergreen forests

Source: Baral and Inskipp (2005)

Tamur Valley and watershed supports several globally threatened and restricted range species of birds (e.g., *Gyps bengalensis, Indicator xanthonotus, Leptoptilos javanicus, Turdoides nipalensis, Actinodura nipalensis*), Eurasian high montane biome species, Sino-Himalayan temperate forest biome species and Sino-Himalayan subtropical forests biome species. Other wildlife species of the area include globally threatened Assamese macaque, Nepal grey langur, Chinese pangolin, Clouded leopard, Grey wolf, Common leopard, Leopard cat, Barking deer, Yellow-throated marten and several species of birds, herpetofauna, fish, insects and butterflies (also see 5.1.7).

5.1.5 Wildlife corridor and connectivity

Wildlife corridor is a conservation tool that maintains connectivity with other reserves within a country and/or across border developing a network of corridors and providing additional resources like food and space to wildlife species and also opportunity of exchanging genes among several population within the network. Thus, corridors are meant for the successful conservation of biodiversity. KL Nepal, bordering India and Tibet Autonomous Region (TAR) of China, is a transboundary landscape. For example, the KCA and Khangchendzonga National Park in Sikkim and Quomolongma Preserve in Tibet, and the area between Panchthar-Ilam and Shinghalila National Park and Darjeeling in West Bengal, are the existing and potential sites of transboundary complexes and corridors of KL Nepal (Basnet 2003a). Within the country, Ilam-Panchthar and Ilam-Jhapa broadleaved forests can provide habitats for north-south corridors.

5.1.6 Important Plant Areas

Important Plant Areas (IPAs) are the sites exhibiting exceptional botanical richness and/or supporting an outstanding assemblage of rare, threatened and/or endemic plant species and/or vegetation of high botanical value. IPAs are important in the sense that they provide a site-based approach for the conservation of plants and form a subset of Key Biodiversity Areas. Extensive botanical explorations and literature review have allowed to identify 18 IPAs in KL Nepal (Table 5.4).

5.1.7 Faunal diversity

Physiographic variation from the tropical to the alpine zone and associated altitudinal variations combined with climatic conditions have resulted in different forest types and habitats, which provide home to many wildlife species. Preliminary assessment of the landscape through literature review and field visits show that KL Nepal is rich in faunal diversity, which includes more than 102 species of mammals, 354 species of birds, 98 species of herpetofauna, 44 species of fish, 391 species of insects and 186 species of butterflies (see Annex V).

Protected and threatened faunal species

Several protected and threatened wildlife species are reported from KL Nepal districts. They include mammals, birds and herpetofauna, which are described seperately below.

Mammals

Mammals are relatively more explored group of animals. Out of more than 102 species of mammals recorded in

Table 5.4: Important Plant Areas of KL Nepal

District	Important Plant Areas and their characteristic vegetation
Taplejung	• Yamphudin – Hellok (Yamphudin VDC): *Arundinaria* species, *Catanopsis tribuloides-C. hystrix* forest • Gyapla – Ghunsa (Lelep VDC): *Rhododendron* species, *Daphne* species, *Acer* species • Ghunsa – Kambachen (Lelep VDC): *Larix griffithiana - Abies spectabilis – Pinus wallichiana* forest • Sarju Pokhari – Olangchung Gola (Lelep/Olangchung Gola VDC) • Dorangding – Ramje; Chairam - Yalung (Simbua Valley): Oak-Laurel forest, *Juniperus* species – *Betula utilis* forest
Panchthar	• Timbung Pokhari (Phalaicha VDC): *Nardostachys grandiflora*, *Aconitum* species, *Saussurea* species • Lam pokhari - Suke pokhari - Ose (Chyangthapu VDC): *Michelia* species and *Magnolia* species, *Zanthoxylum armatum* • Bhaise pokhari - Jaljale-Surketham (Memeng VDC): *Michelia* species and *Magnolia* species, *Taxus wallichiana* • Mejartham – Chiwabhanjyang (Chyangthapu VDC): *Aconitum* species, *Rhododendron* species • Tinsimana – Gorkhepani - Fokte (Memeng VDC): *Taxus wallichiana, Castanopsis hystrix*
Ilam	• Hangetham (Jamuna VDC): *Taxus wallichiana, Castanopsis hystrix, Arundinaria* species. • Kala pokhari (Mabu VDC): *Michelia* species and *Magnolia* species, *Swertia chirayita, Zanthoxylum armatum* • Chintapu (Mai Majhuwa VDC): *Taxus wallichiana, Aconitum* species • Sandakphu (Mai Majhuwa VDC): *Aconitum* species • Dhupi- Guranse (Mai Majhuwa): *Aconitum* species, *Rhododendron* species
Jhapa	• Ghorwa – Sanischare (Sanischare VDC); *Shorea robusta, Eriocaulon* species, *Cycas pectinata* • Gauriganj – Kathgara (Gauriganj VDC) • Jalthal forest (Jalthal VDC): Mixed Sal forest

this assessment, 54 species from 19 families belong to different threat categories and several of them are not evaluated or reported due to information gap. The list shows that 15 species are protected by the National Parks and Wildlife Conservation (NPWC) Act 1973, 33 and 20 species are included in different threat categories of Nepal Red Data Book (NRDB) (BPP 1995) and IUCN respectively, and 40 species are in the list of CITES. Many species of mammals are listed as data-deficient suggesting that more biological and ecological information is required to understand about these species. Major mammal species that are globally threatened, rare and endangered and/or protected include Asian elephant *(Elephas maximus)* (Box 5.2), Himalayan black bear *(Ursus thibetanus)*, Assamese macaque *(Macaca assamensis)*, Nepal grey langur *(Semnopithecus schistaceus)*, Red panda *(Ailurus fulgens)* and Musk deer *(Moschus* species), Snow leopard *(Uncia uncia)*,Grey wolf *(Canis lupus)*, Clouded leopard *(Pardofelis nebulosa)*, Himalayan serow *(Capricornis sumatraensis)*, Golden jackal *(Canis aureus)* and Common leopard *(Panthera pardus)*.

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Red panda–one of the flagship species in KL Nepal

Box 5.2: The Asian Elephant

The Asian elephant *(Elephas maximus)*, a mega-herbivore, is one of the globally threatened species. Classified as an endangered species in IUCN threat category, the Asian elephant is protected from international trade by listing it in Appendix I of CITES. In Nepal, it is categorized as an endangered species by NRDB and protected by NPWC Act, 1973. The KL, including its vicinity, has two residential population of elephants such as Koshi Tappu population of 13-16 individuals and Jhapa population of 9-11 individuals (Ram 2014). Seasonal migratory herds are large with 85–400 individuals, which come from West Bengal during maize and paddy seasons.

As part of reducing human-wildlife conflict in Jhapa district, the National Trust for Nature Conservation (NTNC) is constructing electric fencing at ecological boundaries and human settlements that will help in enhancing environmental and ecosystem quality of wildlife corridors and preventing elephants from destroying crops and property in the affected areas.

Endemic mammalian species is not known from KL Nepal. In fact, there is only one mammalian species (*Apodemus gurkha*) which is endemic to Nepal. However, there is a possibility of finding endemic species in KL Nepal because small mammalian species with restricted distribution have not been explored as yet.

Birds

Literature review shows that there are 354 species of birds in KL Nepal representing 176 genera and 42 families. Many of them are globally threatened. Studies suggest that bird species richness is highest in the Eastern Himalaya (Baral and Inskipp 2005). The Eastern Himalayan broadleaved forests and Tarai-Duar grasslands and savannas are important sites for many rare and globally threatened bird species (Inskipp 1989). Moreover, range distribution of several species, including pheasants such as Blood pheasant *(Ithaginis cruentus)* and Kalij pheasant *(Lophura leucomelana),* and babblers such as Spiny babbler *(Turdoides nepalensis)* and Black-headed shrike babbler *(Pteruthius rufiventer)* overlap to create hotspots for bird species (Wikramanayake et al. 2001). The number of IBAs with their threatened bird species in the Eastern Himalaya of Nepal also supports that this region is a hotspot for avian diversity. Spiny babbler, an endemic bird species of Nepal, occurs in all KL Nepal districts.

Herpetofauna

KL Nepal supports a good diversity of herpetofauna with more than 98 species under 64 genera and 19 families of Amphibia and Reptilia. Several of them are scarce, rare and occur occasionally, and include two species protected by NPWC Act, 1973 (e.g., *Varanus flavescens* and *Python molurus*), two species endemic to Nepal (e.g., *Limnonectes pierrei* and *Paa rostandi*), and Nepal black-throated frog (*Mycrohyla ornate*), the smallest frog of Nepal (Shah and Tiwari 2004). At least 10 species of frogs, lizards and turtles, and snakes found in KL Nepal are included in CITES List.

Fish

A total of 44 fish species belonging to six families and 22 genera are reported from Kangchenjunga landscape and its vicinity (Bhattarai et al. 2008, Shrestha et al. 2009 and Siwakoti et al. 2012). Among them, one species, Mahaseer *(Tor putitora)* falls under vulnerable category and two species Rohu *(Labeo coeruleus)* and Sidre *(Semiplotus semiplotus)* are in susceptible category of 'National Red Data Book'. Endemic species, *viz*. Titemacha *(Psilorhynchoides pseudecheneis)* was the most common species all over the region. Similarly, other common species were Faketa *(Barilius shacra)*, Poti *(Barilius bendelisis)*, Chachale *(Barilius barila)* and Chuche asala *(Schizothoraichthys labiatus)*.

Arthropoda (Insects and Butterflies)

KL Nepal harbours more than 391 species of insects representing 234 genera of nine orders. Similarly, 186 species of butterflies representing 120 genera and nine families have been recorded from the landscape (Smith 1994, Thapa 1998, Bhuju et al. 2007). Among them, a single species (*Papilio krishna*) falls under the endangered category, four species under vulnerable category and 23 species under susceptible category of the National Red Data Book. Likewise, two species, Golden birdwing (*Troides aeacus*) and Common birdwing (*Troides helena*) are included in CITES List. Globally, none of these species falls under the threat categories.

5.1.8 Threats and gaps in wildlife conservation

Faunal diversity in KL Nepal is threatened by multiple factors spanning from poaching and illegal wildlife trade to climate change (Table 5.5). Important areas of biological significance also exist outside the protected area system. They include Eastern Himalayan subtropical forests, which support 183 breeding bird species (Inskipp 1989), remnant stands of evergreen forests, Lithocarpus forest beween 2,600m–3,000m in Panchthar and Ilam (Bhuju et al. 2007), Red panda habitats of more than 207 km^2 in Panchthar and Ilam districts (Yonzon 2000), and all IBAs of about 2,085 km^2 within the landscape (Baral and Inskipp 2005).

Most of the information on faunal diversity came from the KCA and IBAs, which cover just a small area of KL Nepal. Studies are conducted mainly on limited species of mammals and birds and all other groups are under-explored. Small mammal birds like Black-necked crane (threatened species), Chestnut-breasted patridge and Grey-crowned prinia, wildlife-livestock interactions, poaching and illegal trade of wildlife, and impact of climate change are other important areas of research for conservation and development planning. There is a big gap in species research particularly on invertebrate fauna. The temperate region of the landscape is potential for high diversity of some non-flying arthropod species like Carrabidae beetles and other invertebrates possibly with new and endemic species for Nepal. Human-elephant conflict in Jhapa district still remains a big issue (also see section 6.3.1).

5.1.9 Floristic diversity

The wide altitudinal gradients and diverse ecological habitats such as marshes, river, gullies, steep slopes with crevices, and dry alpine grasslands in the Kangchenjunga region give rise to a high diversity of plant species (Shrestha and Ghimire 1996b, Shrestha and Shengji 1997). This region is phytogeographically unique which contains mixed Sino-Japanese and Sino-Himalayan elements.

Table 5.5: Major threats to wildlife species

SN	Threats	Districts	Justifications and references
1	Poaching and illegal wildlife trade	T	Poaching and illegal trade are major threats to wildlife species of KL. Snow leopard, Musk deer and Pangolin are some of the species which are illegally hunted for various reasons–local use, commercial purpose like traditional medicine, retaliatory killing (Jnawali et al. 2010)
2	Habitat loss and degradation	T, J	Due to various human activities such as deforestation and overgrazing that are common in the Eastern Himalayan alpine shrubs and meadows and Tarai-Duar grasslands and savannas (Wikramanayake et al. 1998)
3	Decline in prey base	T	Ungulate species are declining due to habitat shrinkage and slow dispersion; increasing livestock predation is a good evidence (Ikeda 2004)
4	Human-wildlife conflict	All	Conflicts arise due to crop raiding (e.g., elephant, deer) and livestock predation by wildlife (e.g., Snow leopard, Common leopard) which inflicts serious problems to local farmers. Occasionally, some wildlife species also kill people. Often, local people resort to retaliatory killings of wildlife species (Basnet 2003b).
5	Transmission of diseases	T, J	Livestock and wildlife with overlapping habitats and diets may transmit diseases to each other. Local people in the KCA observed the death of 100 Blue sheep during 1995–96 due to eye disease, which was also common in domestic yak during that period (Timilsina and Basnet 2001)
6	Small isolated populations	T,P, I,J	Small and isolated wildlife populations suffer from demographic and stochasticity (Purvis et al. 2000), which should be studied on Snow leopard and Red panda
7	Research/information	P,I	Research base information is poor in all KL Nepal districts
8	Climate change	All	WMO has predicted that 20–30% species are likely at a higher risk of extinction with increase in temperature due to climate change (IPCC 2007). Habitat shift and upward migration severely affect high altitude species like Snow leopard (Forrest et al.2012), depletion of wetlands may cause many species vulnerable

Note: KL Nepal districts T=Taplejung, P=Panchthar, I=Ilam, J=Jhapa

Documentation of Nepal's rich floristic diversity began as early as 1802—1803, when Sir Buchanan-Hamilton initiated botanical exploration, followed by Nathalien Wallich during 1820—21 in Central Nepal. The credit for the initiation of the botanical exploration in Eastern Nepal goes to J.D. Hooker, who collected plants from Olangchung Gola and the vicinities of Taplejung in 1848. An extensive collection of vascular and non-vascular plants from Eastern Nepal, including plants from Jhapa to Taplejung, was carried out by Japanese botanists, under the leadership of H. Hara of Tokyo University. Based on several collections from Eastern Nepal, Eastern India and Bhutan, three series of Flora of Eastern Himalaya were published during 1966—1975 (Hara 1966 & 1971, Ohashi 1975).

The recorded species of flowering plants in the KCA are 1,026, including 13 globally significant species (Shakya and Joshi 2008). Vascular plant diversity is relatively well explored in Taplejung compared to Panchthar, Ilam and Jhapa districts (Shrestha 1994, Shrestha and Ghimire 1996, Shrestha 2003, Pandey 2009, Rajbhandary 2010, Tamang 2013). A few studies are carried out in Mai Pokhari, a Ramsar site (Rai 1999, 2005, 2009, Basnet 2003).

Based on the preliminary literature, it has been revealed that KL Nepal comprises 56 species of Lichens, 292 species of Bryophytes, 257 species of Pteridophytes, 15 species of Gymnosperms and 2,448 species of Angiosperms (Table 5.6, Annex VI). This number represents almost one third of Nepal's total flowering plant diversity. 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, including two species of *Begonia* (*Begonia dolichoptera* and *B. Panchtharensis)* were reported as new to Nepal (Shrestha et al. 2008). This fact further signifies the importance of KL Nepal. Nevertheless, studies on non-vascular plants are still very limited.

New records of flowering plants to Flora of Nepal, reported from the Kangchenjunga—Singhalila ridge include *Acronema ioniostyles* (*Apiaceae*), *Asparagus filicinus* var. *lycopodineus* (Asparagaceae), *Begonia flaviflora* (Begoniaceae), *Calamogrostis lahulensis* (Poaceae), *Carex cruciata* var. *argocarpa* (Cyperaceae), *Castanopsis longispina* (Fagaceae), *Juncus clarkei* (Juncaceae), *Juncus khasiensis* (Juncaceae), *Potentilla sundaica* (Rosaceae), and *Rubia hispidicaulis* (Rubiaceae), *Strobilanthes helicta* (Acanthaceae) and *Swertia wardii* (Gentianaceae).

Table 5.6: Synopsis of floristic diversity of KL Nepal

Taxonomic group	Taxa	Overall
Gymnosperms	Family	6
	Genera	10
	Species	15
Angiosperms	Family	172
	Genera	970
	Species	2,448
Pteridophytes	Family	25
	Genera	90
	Species	257
Bryophytes	Family	54
	Genera	127
	Species	292
Lichens	Family	4
	Genera	7
	Species	56

Sources: Hara (1966, 1971), Ohashi (1975), Shrestha and Ghimire (1996), Press et al. (2001), Rai (2004), Kunwar et al. (2008), Rajbhandari and Adhikari (2009), Rajbhandari and Dhungana (2010, 2011), Gautam (2011), Tamang (2013)

Endemic flowering plant species

Nepal's flora is comprised of nearly 6,500 species of flowering plants, of which 283 species are endemic (Rajbhandari and Adhikari 2009, Rajbhandari and Dhungana 2010, 2011). Twenty two species of flowering plants are endemic to KL Nepal and at least seven species have doubtful status (Figure 5.1 & Annex VII). Doubtful endemic species are determined because of the lack of comprehensive data.

Rare and threatened plant species

A total of 30 species of protected and threatened species are reported from KL Nepal (Annex VIII). In Kangchenjunga—Singhalila ridge alone, some 22 species of flowering plants were recorded as threatened based on IUCN, CITES and GoN's threat categories. Among them, 18 species belong to IUCN threat category, 10 species belong to CITES category and 6 species belong to GoN's protected species category (Shrestha and Joshi 1996, Kunwar et al. 2008).

Invasive alien species

As in other parts of Nepal, invasive alien species are also problematic in KL Nepal districts. The invasion by such species can be observed throughout KL Nepal. *Ageratum conyzoides, Ageratina adenophora, Chromolaena odorata, Eichhornia crassipes, Lantana camara, Mikania micrantha, Parthenium hysterophorus*, etc. are some common invasive species in the region.

Invasion of Mikania micrantha–one of the major threats to the Kangchenjunga landscape

5.1.10 Threats to floral diversity

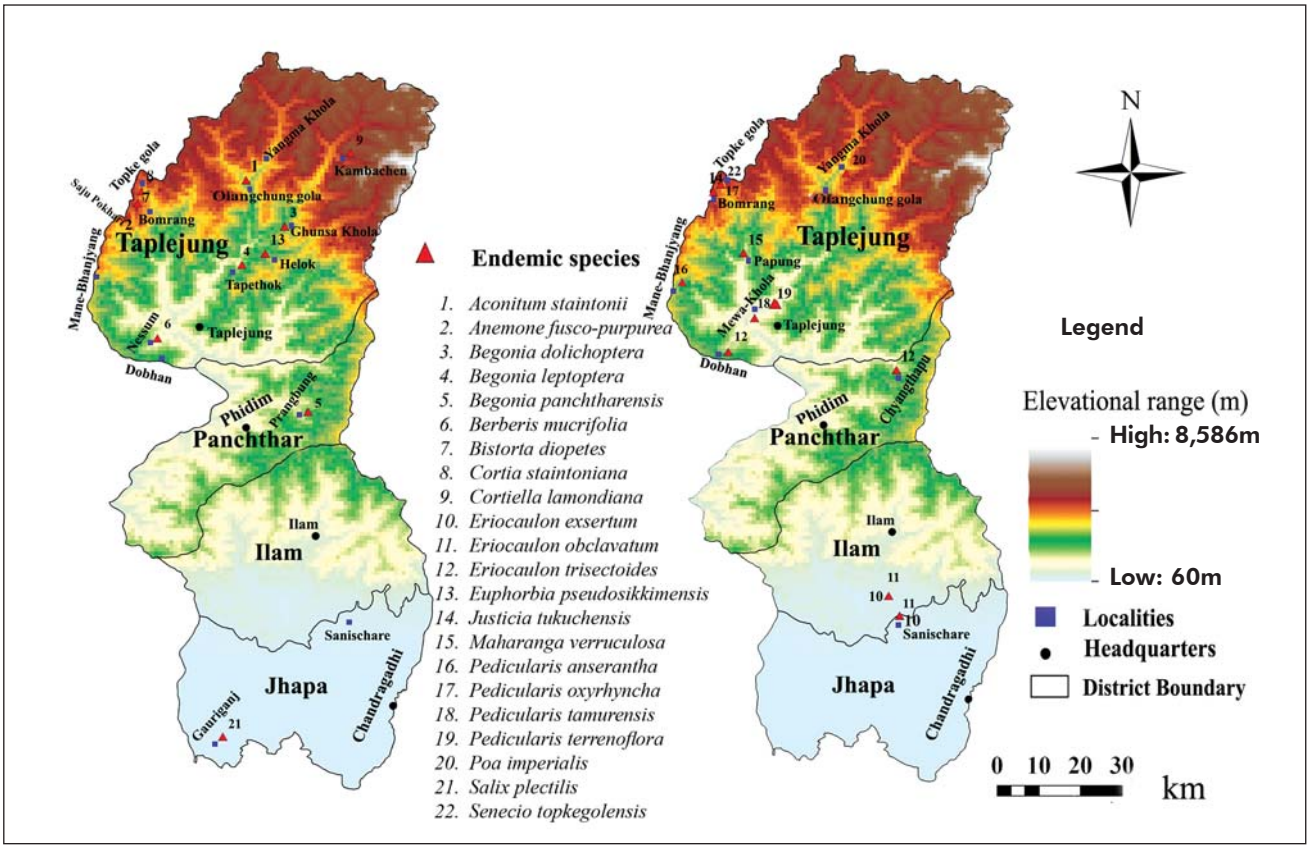
Forest encroachment for expansion of agriculture, habitat loss and fragmentation due to deforestation, erosion and landslide, introduction of invasive alien species, over-grazing and over-exploitation or unsustainable utilization of commercially important species are some of the threats to floral biodiversity throughout KL Nepal.

5.1.11 Agrobiodiversity

Variation in climate, physiography and ethnic diversity within the landscape contribute to rich agrobiodiversity. Agrobiodiversity has both cultural and natural dimensions. Since about 85% of the farmers still practice subsistence agriculture (NCDC 2005), they grow different types of crops and domesticate livestock suitable in the given agro-climatic regime for domestic consumption and meeting household expenses. As such, the region exhibits rich agrobiodiversity. However, over the years, gradual shift to commercialization of agriculture, change in agricultural practices and changing food habits have started impacting agrobiodiversity. This has mostly impacted on minor food crops and some livestock. Minor crops like barley, buck wheat, naked barley, millets, horse gram, traditional vegetables are declining from the area. Some crop varieties like *jhale* potato, favoured for its taste in northern Ilam, is also rapidly declining.

With the shift in food habit of a large section of the people to predominance of rice, cultivation of other crops is also affected. Even among major crops like paddy, wheat, maize and potatoes, few varieties promoted by agricultural extension agencies have led to the decline in the varietal diversity as reported by farmers. Strong cultural affiliation to crops have helped to retain some crops like finger millets. However, finger millet, nowadays, is almost exclusively used for brewing local alcoholic products resulting into decline in other traditional uses such as porridge making. The area which still has less access to markets growing crop types

Figure 5.1: Distribution of endemic flowering plants of Kangchenjunga Landscape



and varieties practised in recent past would be continued in some years. Although diversity of some crops have declined, types and numbers of fruits and vegetables grown in KL Nepal have increased. Similarly, owing to factors like declining grazing areas, changing rural economic system, declining availability of labour has forced sheep raising to a sharp decline over the years.

Major crops grown in the region vary along the elevation gradient. In Jhapa district, paddy is the predominant crop whereas in high elevation zone in Taplejung district maize, wheat and potatoes are major crops. Over the years, large cardamom has become major cash crop in Ilam, Panchthar and Taplejung districts. Major crops grown are paddy, maize, wheat, finger millet, potato; vegetables like cauliflower, cabbage, radish, green mustard, tomato, chilli, bean, pea, onion, gourd, carrot, cress; pulses like lentil, blackgram, pigeon pea, chick pea, soybean; oil seeds like mustard, niger; fruits like mango, banana, peach, plum, pear, papaya and apple are grown (Table 5.7). In case of major crops, areas close to market centres grow improved varieties promoted by the Agriculture Development Office and other NGOs.

Major types of livestock raised are cow, buffalo, goat, sheep, pig and poultry. Villagers at higher elevation of Taplejung district raise yak and crossbreeds of yaks with cows. Gradually, over the years, in most of the villages farmers have shifted to stall-feeding from grazing and consequently the number of livestock kept has declined. Similarly, the number and size of flocks have also declined.

Table 5.7: Crops grown in KL Nepal districts

Crop group	Crops
Cereals and pseudocereals	Paddy, wheat, maize, barley, naked barley, buckwheat
Millets and minor millets	Finger millet, foxtail millet, sorghum
Pulses	Blackgram, lentil, pigeon pea, chickpea, horsegram, soybean
Oilseeds	Mustard, niger
Vegetables	Potato, tomato, cauliflower, cabbage, radish, gourd, bean, chayote, chilli, pea, onion
Spices and condiments	Large cardamom, ginger, turmeric
Fruits	Orange, pear, plum, peach, walnut, areca nut, banana, kiwi, papaya

5.2 Ecosystem services

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water supply; 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 (MEA 2005). People living in KL Nepal districts are highly dependent on rangeland, forest and wetland ecosystem services for their subsistence and well-being (see Shakya et al. 2011 and Pant et al. 2012 for economic evaluation of ecosystem services). An assessment of the condition of ecosystems, the provision of services and their relation to human well-being requires an integrated approach. This enables a decision process to determine which service or set of services is valued more and how to develop approaches to maintain these services by managing the system sustainably (MEA 2005).

An assessment of regulating services (climate regulation, disease regulation, water regulation and purification, pollination, etc.) and supporting services (soil formation, nutrient cycling, primary production, etc.) has not been done so far for KL Nepal. Nevertheless, different ecoregions, ecosystems, vegetation and forest types of KL Nepal provide many regulating and supporting services (Pant et al. 2012). Some information on provisioning services (food, fiber, timber, etc.) and cultural services (non-material benefits obtained from ecosystems such as spirituality and material benefits from tourism) can be interpreted. Furthermore, it is hard to exactly categorize the ecosystems or their components based on the services they provide. For example, wetlands provide all kinds of ecosystem services. Therefore, based on goods and services obtained by the people, the following section describes the ecosystem services available in KL Nepal:

5.2.1 Provisioning services

Provisioning services are the products obtained from ecosystems. Some major provisioning services provided by ecosystems and their components of KL Nepal are as follows:

Timber and poles

Among the several provisioning services obtained by the local people from the forests of KL Nepal, timber is the most prominent one. Timber is mainly extracted from community and private forests and is used for the construction of houses, making furniture and traded at the regional level. Government data on the sale of timber from government-managed forest show that about 2,831 ft^3 of timber was sold to generate over Rs 1.57 million revenue in 2012/2013. Similarly, a total of 847,000 ft^3 timber was sold from private forests in the region during the same period to generate revenue of Rs. 17.4 million. The total amount of timber collected and used in the nine bordering VDCs (Taplejung–Aangkhop, Kalikhola, Sadewa; Panchthar–Chyangthapu, Memeng, Sidin; Ilam–Gorkhe, Jamuna, Mai Pokhari) of the three districts is 114,480 ft^3 per year (NCDC 2010). Villagers living in the corridor area (22 VDCs of Taplejung, Panchthar and Ilam districts) harvest poles, firewood and timber from the forest (Regmi 2008). Of all the timber items, poles played a relatively minor economic role. The aggregate value of timber and other wood products was Rs. 1,396 million with the highest value generated in Panchthar and the lowest in Taplejung that on an average contributed about 20% of the total household income from forest ecosystem (Pant et al. 2012).

Popular timber species used in KL Nepal include Champ *(Michelia champaca)*, Chilaune *(Schima wallichii)*, Falant *(Quercus glauca)*, Khair *(Acacia catechu)*, Sal *(Shorea robusta)*, Sisam *(Dalbergia sissoo)* and Utis *(Alnus nepalensis)*. However, of these frequently used species, Champ, Khair and Sal are protected by the GoN under the Forest Act 1993.

Firewood, forage, fodder and leaflitter

Firewood is the principal source of energy and is used to meet domestic energy needs and for enterprises like processing of large cardamom, brewing and and making *chhurpi* (dried cheese) (Chettri et al. 2008b). A study conducted in 22 eastern VDCs of Taplejung (Lelep, Olangchung Gola, Yamphudin, Aangkhop, Surungkhim, Kalikhola and Sadewa); Panchthar (Chyangthapu, Memeng, Phalaicha, Prangbung and Sidin); and Ilam (Gorkhe, Jamuna, Jirmale, Jogmai, Mabu, Mai Majhuwa, Mai Pokhari, Pashupatinagar, Samalbung and Sriantu), revealed firewood as one of the most important provisioning forest ecosystem services in the region, comprising the largest economic value among the wood products (Pant et al. 2012). Farmers also harvest forest resources as biomass for animal husbandry and for use in the farming system. Forest-based intermediate inputs include leaf fodder and grass for livestock feed, leaf litter for livestock bedding, biomass for crop mulching and composting.

A survey conducted in the above VDCs for the economic valuation of the provisioning forest services revealed that tree fodder generated the highest average annual value among all provisioning forest services, more than three times than that of the wood products harvested (Pant et al. 2012). The value of biomass for animal husbandry was equivalent to 72% of household income, and that of timber and wood was equivalent to 22%. Medicinal and Aromatic Plants (MAPs) help to generate cash income for households.

Non Timber Forest Products

In addition to agriculture and animal husbandry, people depend heavily on forests, including NTFPs, for their livelihoods. KL Nepal is endowed with the wealth of NTFPs and local communities of the region have long been using these for their subsistence. Major NTFPs that provide provisioning services in KL Nepal are: bamboo *(Dendrocalamus* species, *Phyllostachys* species); broom grass *(Thysanolaena maxima)* and fibre (bark of *Daphne bholua; Edgeworthia gardneri*); foods such as: mushrooms *(Agaricus* species), bamboo shoots *(Dendrocalamus* species), other vegetables such as: fern *(Diplazium esculentum)* and water cress *(Nasturtium officinale)*, edible fruits (*Berberis* species, *Castanopsis indica, Hippophae tibetana, Myrica esculenta, Rubus ellipticus,* etc.); and medicinal plants *(Aconitum palmatum, Asparagus racemosus, Bergenia ciliata, Dactylorhiza hatagirea, Heracleum nepalense, Nardostachys grandiflora, Neopicrorhiza scrophulariiflora, Swertia chirayita, Taxus wallichiana, Valeriana jatamansi, Zanthoxylum armatum,* and several other rare species of medicinal plants from subalpine and alpine rangeland (NCDC 2010, Pant et al. 2012). Medicinal plants are used in traditional medicinal practices and are also traded usually across the border. Among the aromatic plants, *Juniperus indica* and *Juniperus recurva* are collected more frequently than *Buddleja asiatica, Matricaria chamomilla* and *Valeriana jatamansii*.

Chiraito (Swertia chirayita)–one of the widely traded plant species of KL Nepal

Fibre-yielding plants–*Daphne bholua, Edgeworthia gardneri* and *Giardiana diversifolia* are more prevalent in the area close to the Indian border. Wild edibles collected by villagers are mostly the food supplements such as nuts of *Castanopsis indica*, rhizome/bulbs of *Dioscorea* species and fruits of *Lindera neesiana*. Besides the use of NTFPs as medicine, fibre and wild edibles, bark of *Alnus nepalensis, Pinus wallichiana* and *Rubia manjith* are used to produce dye. Many ornamental species along with beverages like *Thea sinensis* and spices such as *Cinnamomum tamala* are also cultivated as NTFPs (NCDC 2010). Over-harvesting of some species has increased the threat to many of the species (Uprety et.al. submitted). Mostly NTFPs, including MAPs, are collected from the wild. However, different community forest user groups and individual households have recently established nurseries to cultivate NTFPs/MAPs.

5.2.2 Supporting services

Supporting services are the services necessary for the production of all other ecosystem services. Rangelands of KL Nepal districts are discussed in this section.

Rangelands

KL Nepal districts have a vast extent of open meadows. These have traditionally been used by both wild and domestic herbivores and are also important areas in terms of transboundary conservation (LRMP 1986, Pei and Sharma 1998, MoFSC 2002). Rangelands support the livelihoods of several communities in KL Nepal districts. Substantial number of livestock has been using transborder open pastures as the main source of forage. However, such practices are now constrained by policy changes, which are bringing challenges to the people dependent on livestock-based livelihoods, especially those living in high altitude areas (Chettri et al. 2008b, Parajuli et al. 2013). In addition, acute water shortage, limited forage and fodder availability, livestock disease and livestock depredation by wildlife are limiting livelihood options in these fragile ecosystems (Chettri and Sharma 2006). Sustainable use of the rangeland resource is critical not only to sustaining the socio-economy of the local communities but also to the conservation of rare fauna and flora, water and carbon sequestration (Chettri et al. 2008b, Rawat et al. 2013).

Rangelands of three districts (Taplejung, Panchthar and Ilam) occupy about 417 km^2, (>23%) area of the districts, of which 24 bordering VDCs of Taplejung (9 VDCs), Panchthar (5 VDCs), and Ilam (10 VDCs), cover about 265 km^2 of rangelands and pastures. Among the three districts, Taplejung has the highest (58% of the total area of the district) proportion of rangeland/pasture followed by Panchthar (11%) and Ilam (5%) (Figures 5.2 and 5.3) (Oli 2003). Among all

the bordering VDCs, Taplejung district alone harbours more than 86% of the total pastureland of the VDCs (Figure 5.2).

Figure 5.2: Pastureland in KL Nepal region

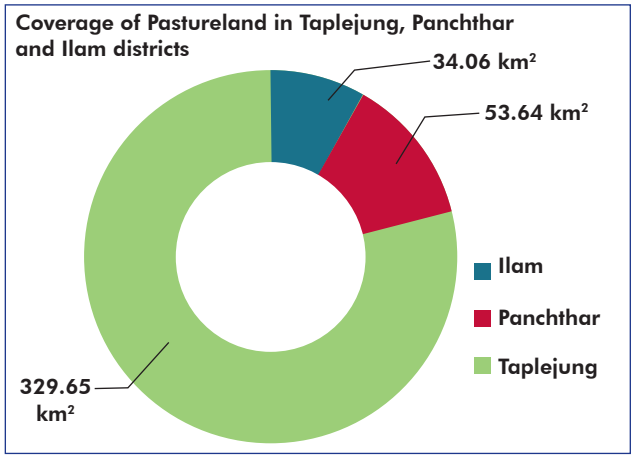
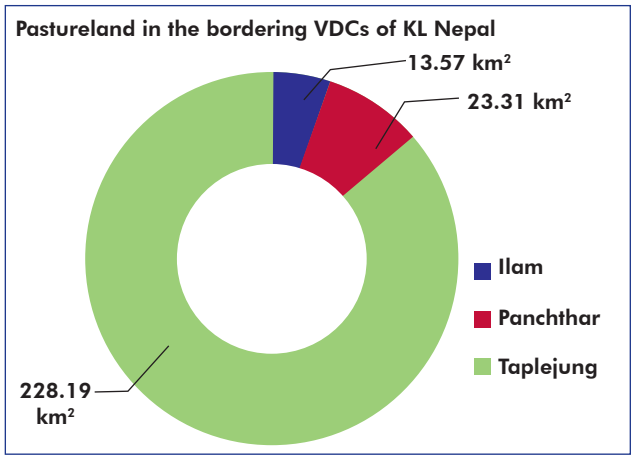


Figure 5.3: Pastureland in 24 bordering VDCs of KL Nepal region



High altitude pastures in KL Nepal districts are important common property resources mainly for seasonal grazing (Figure 5.4). Warm temperate rangelands, however, are used extensively by both transhumance and stall feeders without resting periods or regeneration of pasture species. Similarly, subtropical rangelands are used extensively during winter months. Implementation of community forest policy in lower elevation has resulted in the conversion of open pastures to forests, suppressing the growth of desirable pasture species. In some areas, CFUGs forbid the use of traditional migratory routes followed by animal herders. With the abolition of *kipat*[1] and customary arrangements, the sense of ownership and affection of the traditional community for their inherited pastoral resources has been weakened, leading to haphazard grazing and mismanagement of pastures (Chettri et al. 2008a).

Spatial distribution of pasturelands

Pasturelands in KL Nepal districts are divided into three major categories (Oli 2008):

- Alpine/subalpine pasturelands, called *Himali Kharka*, generally extend up to 4,500m (located between 3500m–5000m in some places) and are important resources for transhumance livestock;
- Temperate pasturelands, called *Lekali Kharka*, occur between 2,000m–3,500m; and
- Subtropical rangelands located between 1,500m–2,000m.

In KL Nepal region, large extension of alpine/subalpine rangelands *(Himali Kharkas)* are in the Kambachen, Selele and Ramche region between 4,200m–4,600m where the typical rangeland species like *Agrostis myriantha, Carex* species*, Festuca rubra, Juncus effusus, Poa annuna, Trisetum spicatum,* etc. are abundant with several important MAPs. The rate of grazing area expansion is largest between 3,000m–4,000m, where species like *Calamogrostis* species*, Carex* species*, Festuca* species and *Trisetum* species are abundant (Rastogi et al. 1997). Mainly yaks, *chauris*, sheep and mountain goats graze in the *Himali Kharka* from June to mid–October (Oli 2003).

Most grazing areas in *Lekali Kharkas* have a slope ranging between 15 to 30 degree and with an open area of 5–300ha along with shrubs and bushes. These rangelands are used for grazing livestock such as cattle, buffaloes, sheep, goats, yaks and *chauris* for about six months from October–November, February–March, and May–June. They are also used as corridor when animals are moved to pastures of different elevations. Yaks are wintered there. For this reason, the temperate rangelands are overgrazed and do not get required resting period for regeneration.

Rangelands in the upper part of Panchthar district like Pauwa Bhanjyang, Silauti, Ravi, Varapa and Chyangthapu are rich for medicinal and aromatic herbs. Chyangthapu VDC has some important rangelands, namely, Chaitya, Chautara, Golpole, Chiruwa, Saththumke, Deurali, Dahdeli, Lasune, Bhawan, Tham, etc. Some of them are under private and the others are under governmental ownership. Rangelands in the bordering areas of Ilam and Panchthar like Pauwasarathap, Puwa Majhuwa and the highland of Ilam are traditionally famous for the breeding of Tibetan horse and Tibetan dogs (Khatri 2004).

In Panchthar district, large areas of barren lands were used as *kharkas* (rangelands) in the past. These were under the control of local *Subbas* as their *kipat* land. The joint shareholders of the property have registered some parts of the land. However, some other parts were not registered in land survey. Thus, the community head distributed such *kharkas* to the participating community, which remained unproductive and uncultivated.

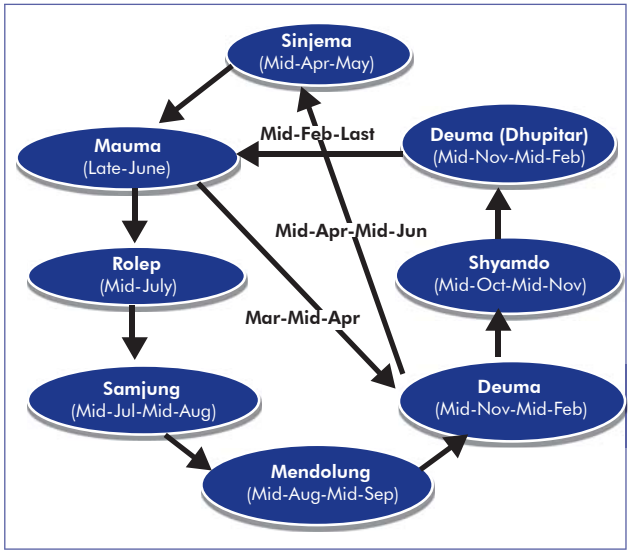
1. The kipat is a customary system of communal land ownership through which a group of families hold land titles. It represents a communal form of land tenure inherited by the same communities from their ancestors.

Transhumance system of animal rearing

One of the common forms of traditional farming in the upper mountain slopes of KL Nepal is extensive rearing of sheep, yaks and *chauris* and hill cattle. This system covers much of the grazing land in the high altitude of Taplejung and Panchthar, and significantly contributes to the socio-economy of the mountain communities. Together with early forest clearances and random forest fires, low intensity livestock rearing was responsible for the mosaic of evergreen scrub, conifer forest and rough pasture. These grazing areas are vegetated with grass, shrubs and forests with understory grass. Thus, a proportion of this area is more suited for sheep, yak and cattle grazing, while other parts are better for goats and wild ungulates. The system is efficient as there is very little input to it and the productivity of these natural grasslands is low (Oli 2003). However, transhumance grazing of animals in high altitude areas of eastern Nepal Himalaya declined after late 1980s (Oli 2003).

Livestock in KL Nepal area is highly mobile and its management system has been changing over the years. Owing to several factors, the number and size of herds has been decreasing. Over the years, stall feeding is increasing, especially in the villages of lower altitude. However, transhumance is practised for livestock types such as yaks, crossbreeds of yaks, sheep and cattle, especially in higher elevation areas. Cattle is rarely taken beyond the altitude of 3,200m and seasonally moved at lower altitude when the availability of grass for grazing deckines in the *Lekali Kharka*. On the other hand, *chauris* reach up to 4,000m while yak and sheep reach even higher (Oli 2003). Typical annual cycle of transhumance migration of grazing animals begins from mid–March, from subtropical grazing areas and reaches temperate pasture or *Lekali Kharka* by mid–May. Cattle, buffaloes and goats remain at those *kharkas* until the end of September, while sheep and yaks are moved further up to *Himali Kharkas* and with the beginning of October, both types are gradually brought down. During colder months, yaks and sheep are wintered in the temperate pastures and other animals are brought back to subtropical areas. Animals owned by different owners are collectively herded. This system of animal keeping is followed mainly in parts of high altitude areas of Ilam bordering India, Memeng, Chyangthapu and Phalaicha VDCs of Panchthar and all northern VDCs of Taplejung district.

Figure 5.4: Seasonal grazing pattern of herders of Gola village of Olangchung Gola VDC



Each box represents 'goth/kharka' and time of the stay of cattle in the 'goth'; 'goths' ranging from c 3900-4200m elevation

Source: ECCA Nepal (2008)

Transhumance trend

Since the traditional transhumance grazing method is practised throughout much of the high-altitude grazing lands, they are constantly subject to changes affecting their succession processes. Aggressive growth of weeds resulting from heavy grazing of palatable species has caused loss of pasture biodiversity and livestock productivity thereby rendering the habitat open to invasive weed species (Chettri et al. 2008a). Over the years, transhumance system is declining as a response to several factors including opportunities in other sectors like foreign employment and cash crop cultivation. Along the transborder areas, the governments of neighboring countries have been establishing protected areas restricting livestock in those areas.

5.2.3 Regulating services

These are the benefits obtained from the regulation of ecosystem processes. As an example, the protected area of KL Nepal is discussed in this section.

Kangchenjunga Conservation Area

The KCA is the only protected area in KL Nepal. Named after Mt. Kangchenjunga (8,586m), the third highest peak in the world, KCA shares borders with Sankhuwasabha district in the west, Khangchendzonga National Park of Sikkim (India) in the east and TAR (China) in the north. It was established in 1997 and covers 2,035 km^2 of land in Taplejung district (65% of total district area) of Mechi zone, located between latitudes 27.69°N and longitudes 87.92°E. It is under Category VI of IUCN Protected Areas (Box 5.3 and 5.4). The area represents high mountain physiographic regions with 41% of its area covered by rocks and 23% by snow and glaciers. Remaining 36% is covered by forest (16%), shrubland (10%), grassland (9%), agricultural land (0.5%) and lakes and landslide (0.1%) (KCAMC 2013).

The KCA provides a pristine habitat for many species such as Snow leopard *(Uncia uncia)*, Red

© MoFSC

Snow leopard–the flagship species of KL Nepal

Box 5.3: Category VI: Protected area with sustainable use of natural resources

Category VI protected areas conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the areas in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area (Dudley 2008).

panda *(Ailurus fulgens)* and Musk deer *(Moschus chrysogaster)* as well as for many threatened and endangered plant species, including Lauth salla *(Taxus wallichiana)* and Kutki *(Neopicrorhiza scrophulariiflora)*. The KCA is one of the most isolated and least densely populated protected areas of Nepal and contains tracts of pristine forests, alpine meadows and high altitude wetlands.

Papung VDC provides connectivity between KCA and Makalu Barun National Park. Some other VDCs in the western part of Taplejung district (not included within the boundary of KL Nepal) also cover Rhododendron Conservation Area (IUCN 2010). There are a few other conservation areas initiated locally by District Forest Offices in Jhapa and Ilam. Furthermore, three districts of KL Nepal, Ilam, Panchthar and Taplejung fall under the Sacred Himalayan Landscape (SHL) Programme which extends from Langtang National Park in central Nepal through the Kangchenjunga region in Sikkim and Darjeeling in India to Toorsa Strict Nature Reserve in western Bhutan covering an area of 30,021 km^2. In Nepal, MoFSC is leading the SHL initiative in partnership with WWF, ICIMOD, The Mountain Institute (TMI) and IUCN, and has developed a Strategic Plan for 2006-2016 (MoFSC 2006).

5.2.4 Cultural services

These are non-material benefits obtained from ecosystems. Wetlands and sacred forests of KL Nepal provide different services such as spiritual, religious, recreational, aesthetic and inspirational. Therefore, wetlands and sacred forests are described under this category.

Wetlands and Ramsar site

Lakes *(pokharis)*, rivers, marshes, swamps, etc. are important features of the landscape. Wetlands are indispensible parts of the ecosystems as they perform ecological functions and provide many ecological services (Bhandari 2006). Wetlands are the interface of nature and culture. KL Nepal harbours many important

Box 5.4: Summary features of Kangchenjunga Conservation Area

Biodiversity Features

Biome:	Mixed mountain systems
Vegetation:	Represented by subtropical vegetation in the lower mid-hills to alpine grasslands in high hills and mountains forest types include Rhododendron forests upto treeline; *Larix griffithiana*–Juniperus forest–a characteristic east Himalayan vegetation type–found in the two main river valleys of this area between 3,000m–3,700m; Coniferous forest of *Abies spectabilis* and *Tsuga dumosa* between 2,800m–3,500m; Mixed broadleaved forest of *Quercus* species, *Castanopsis* species, *Magnolia campbellii, Acer campbellii* and *Osmanthus suavia* between 1,200m–2,800m; Sal-Schima mixed forest at 1,200m. 810 species of flowering plants. Largest families are Asteraceae (56 species), Fabaceae (51 species), Orchidaceae (48 species), Rosaceae (45 species), Ericaceae (42 species) and Poaceae (40 species). Largest genera are *Rhododendron* (23 species), *Rubus* (14 species), *Pedicularis* (10 species) and *Primula* (10 species). Important flora constitutes *Taxus wallichiana, Tetracentron sinense* and Rhododendron species

Socioeconomic Features

Community Structure and Ethnic Groups:	It includes four VDCs of Lelep, Tapethok, Olangchung Gola and Yamphudin. About 5,000 people of about 11 ethnic communities live in the area. As the original settlers of the Upper Tamur Valley, the Limbus are the dominant ethnic group in the lower region. The Sherpa/Lama people live in the higher altitude where they arrived from Tibet more than four hundred years ago. These Sherpas have a distinct culture and tradition from those in the other district. Also, Rais, Chhetris, Brahmins and others live in KCA.
Natural Heritage:	The KCA in the eastern Himalaya comprises some of the most stunning scenery in all of Nepal. Not only does this region host the third highest peak in the world (Mt. Kangchenjunga), but it is also a global hotspot for plant biodiversity. Twenty three species of Rhododendrons have been identified in the area. In this eastern Himalayan setting, glacial streams cut through high ridges creating remote and steep valleys where traditional farming practices are a way of life. Tucked within these hidden valleys, one can encounter rich forests that support more than 250 species of birds and endangered wildlife.
Cultural Significance:	The region has a mosaic of ethnic groups. The religious sites (temples and monasteries) in the area attest to Kangchenjunga's rich cultural heritage. Monasteries, chhortens, temples, prayer-walls are the icons of the conservation area's cultural heritage.
Livelihood Strategies:	Local people combine agriculture, pastoralism and trade to support their livelihood.

Conservation Management

IUCN Category:	IV - Habitat/Species Management Area (Box 5.3)
Management Authority:	Department of National Parks and Wildlife Conservation
Park Headquarters:	Lelep
Conservation History:	Recognizing its rich natural and cultural resources, GoN declared the core area of 1,650 km^2 in the Kangchenjunga region of Nepal a 'Gift to the Earth' on April 29, 1997. This action was in support of WWF's Living Planet Campaign and was also a commitment from GoN to conserve the area's natural and cultural heritage. This was followed by the KCA being conferred as a Conservation Area status on July 21, 1997, fulfilling the criteria that it contains sites of significant religious, cultural, archaeological or historic value; contains unique landform or geomorphic features; comprises sites of unique genetic diversity and habitat essential for the preservation and enhancement of rare or endangered species. Subsequently, the boundary was extended to 2,305 km^2 on September 14, 1998, to cover four VDCs in order to promote community-based conservation. The KCA, on September 22, 2006, was handed over to the Kangchenjunga Conservation Area Management Council (KCAMC) making it the first ever protected area managed by the community.
Conservation Challenges:	Regional efforts need to be concentrated to effectively safeguard typical eastern Himalayan vegetation of *Lithocarpus* and *Larix* forests. Knowledge base of the traditional grazing patterns of yak and sheep herds will be essential. Importance of integrating biodiversity conservation with socio-economic development should be explored.
Transboundary Features:	The conservation area with unique mountain ecosystems is envisioned as a tri-national peace park with TAR of China to the north and Sikkim (India) in the east.

Source: http://www.icimod.org/hkhconservationportal/PA.aspx?ID=1

wetlands of varying sizes supporting biodiversity and reviving culture. The Mai Pokhari in Ilam district is the only Ramsar Site in Kangchenjunga Landscape. Mai Pokhari, with catchment of 12ha, is located 13 km away from the district headquarters, Ilam in Mai Pokhari VDC. It was declared a Ramsar Site during the 10th Conference of Parties to the Ramsar Convention (COP 10) at Changwon, the Republic of Korea, on 28 October 2008. It is located at an altitude of 2,100m (WWF 2007).

Mai Pokhari has nine corners where nine goddesses came and lived in the past. It is a major habitat for some important animal species like tree frog *(Polypedates maculatus)* and Himalayan newt *(Tylototriton verrucosus)* commonly known as *Thakthake* and is a habitat for more than 350 species of birds. Mai Pokhari holds cultural and religious significance for Buddhist and Hindu pilgrims. Some other important wetlands in Ilam are Hans Pokhari, Mudke Pokhari, Kal Pokhari, Dhunge Pokhari, Santapur and Gorkhe Dhap.

Another important cultural and religious wetland of KL Nepal is Timbung Pokhari which lies at the border of Taplejung and Panchthar districts, sharing most of the areas of Kalikhola VDC of Taplejung. It was named after Limbu language. Apart from this, Nagumma Pokhari, Nuppu, Nura Pokhari, Samdu Pokhari, Kali Tin, Lama, Cheudi, Jaljale, Iwa, Chahare Pokhari, Sema Pokhari, Gayheche Pokhari and Sinjema Pokhari are other high altitude wetlands in Taplejung district (WWF 2008). Culture, religion and tradition have important role in the conservation of these wetlands. The need for identification and conservation of faunal and floral diversity and their habitat has been insisted as Timbung Pokhari has supported such diversity (WWF 2008). Except for Mai Pokhari, Timbung Pokhari and Sinjema Pokhari, no comprehensive information is available for other wetlands of KL Nepal.

Sacred forests

Forest Act 1993 defines religious forests as "a National Forest handed over to a religious body, group or community for its development, conservation and utilization" (MoFSC 1993). The District Forest Offices have provisions to hand over potential religious (sacred) forests to the user groups according to the Forest Act 1993 and Forest Regulations 1995. Any religious body, group or community desiring to develop, conserve and utilize the National Forest of any religious place or its surroundings should submit an application to the District Forest Officer mentioning the area and boundaries of such forest, the functions to be carried out in such forest and other details as prescribed. Under these provisions, some forests are reported to be religious in Panchthar (16ha) and Ilam (156ha).

Kichakbadh area of Prithivinagar VDC is a potential area identified as religious forest in Jhapa district (DFO Jhapa 2013). If local user group demands for the management of religious forests, DFO could hand over this forest to the user group following District Forest Office's Management Plan. DFO has also the provision of plantation of religious plants in such areas. Timber of such forests could be collected and used only for religious purpose from such forests.

Panchthar district also has some potential religious forests. The Jor Pokhari Mahadevsthan forest has been handed over to the user group to manage it as a religious forest. Likewise, the forest in Pauwa Bhanjyang, where the residence of Mahaguru Falgunanda is located, has also been handed over to the user group (DFO Panchthar 2007).

Ilam district also has a few religious forests: Mai Pokhari, Pathivara, Sinha Bahini, Gajur Mukhi and Seti Devi. The forest around Mai Pokhari was handed over to the user group as a religious forest in 2002–2003. Although no religious forest has been formally registered and handed over in Taplejung district, some potential forests exist which can be handed over to the user groups for management.

Apart from its religious significance, religious forests or sacred groves contribute to the conservation of indigenous culture that could play an important role in the identification of reference ecosystems for restoration purpose (Uprety et al. 2012). Dedicated to ancestral spirits or deities, such sites may be kept intact by local people for centuries (Bhagwat and Rutte 2006). Such areas cover a wide variety of habitats; they are often located in biodiversity-rich regions and serve as refuge for many species (Mgumia and Oba 2003, Bhagwat and Rutte 2006).

Religious forests are not given due consideration for the management and conservation of biodiversity and cultural diversity. Hence, there is a need to conduct an in-depth study of religious/sacred forests of KL Nepal.

Chapter

6 Resource Management System

Community forest user group members monitoring Jalthal forest in Jhapa district

6.1 Forest management

Forest management system observed in KL Nepal is almost common in all the districts. Although much of the data presented in the previous chapters revealed the utilization of forest resources primarily from community–managed and private forests, government data reveals that major proportion of forest resources of KL Nepal are still under the management of the government. The leasehold forestry programme was initiated in Panchthar district from 2002/03 with the aim of providing forest to households below poverty line for reducing their poverty mainly through increased utilization of forest products and animal husbandry. Besides, a limited proportion of the forest in KL Nepal is also managed as private and religious forests (Table 6.1and 6.2). With the initiation of DNPWC and KCAP, 73,327ha forest and rangeland within KCA has been handed over to the communities as 26 Conservation Community Forests (CCFs) and 676ha forest in Ghunsa is managed as sacred forest (KCAMC 2013).

Among the KL districts, the largest total forest area is recorded in Taplejung followed by Ilam, Panchthar and Jhapa districts. However, in relation to the total area of the districts, largest proportion of forest land can be observed in Panchthar (47.30%) followed by Ilam (47.26%), Taplejung (30.72%) and Jhapa (8.25%). Although Taplejung has large forest coverage, this district has the least number of community forests; whereas the

largest portion of forest in Ilam has been handed over to the communities. Similarly, over 63% of the total forest of Jhapa district has been already handed over to the communities. Moreover, the largest area under private and religious forests are recorded from Jhapa and Ilam respectively (Table 6.1). More specifically, only about 29,573ha of forests within 85 VDCs and 7 municipalities of KL Nepal have been handed over to the communities. These forests constitute about 11% of the total forest areas of KL Nepal districts (Table 6.2).

As per the guidelines prepared under the existing legislative framework, different community–based management modalities are being practised in KL Nepal districts. These are community forest, leasehold forest and community initiated conservation community forest. In all modalities, forests are handed over to the local community–based forest institutions (FUGs). In addition, forestry operations and other development activities in the government managed forest are carried out through DFO as per the approved District Forest Management Plan. Similarly, the protected/watershed management and development activities in the conservation area/ watershed area are carried out as per approved plans. These plans spell out strategy and implementation procedure at the field level. Table 6.3 provides a synopsis of forest conservation and management plans being implemented in KL Nepal.

6.1.1 Local institutions in biodiversity conservation and management

Community involvement in conservation initiatives is evident in KL Nepal. In addition to the DFO, several other GOs, NGOs, CBOs and clubs are actively involved in biodiversity conservation in the region. Monitoring of illegal harvest and trade of forest resources, conducting anti-poaching operations, conducting biodiversity conservation and awareness raising campaigns, regulating grazing, constructing and maintaining trail and pavement, cleaning and paving, restoration of forests through community forest user groups, preventing landslides, etc. are some of the common activities undertaken by these organizations.

Transfer of technology and skills along with cultural exchange is prevalent among the residents of these districts and the people from the state of Sikkim and Darjeeling in India (Chettri et al. 2008b). Community Forest User Groups (CFUGs) and the District Forest Offices in different districts have established nurseries of NTFPs. However, technical knowhow in processing raw materials into marketable products is limited. Some non-governmental organizations have been working on production and processing of MAPs.

6.1.2 Forest restoration

In recent years, several CFUGs in KL Nepal have started to establish nurseries of forest tree, fodder species and important NTFP/MAP species. Seedlings are distributed to the local communities for plantation in community forests and private lands. Such practice has resulted in the improvement of forest quality of the region both in terms of species richness as well as canopy coverage. In addition, detailed resource inventories are also conducted in different areas of KL Nepal. Assessments were conducted in the KCA region at regular intervals to identify and document high value NTFPs (*viz. Daphne bholua, Daphne papyracea, Edgeworthia gardneri, Juniperus indica, Juniperus communis, Nardostachys grandiflora,Neopicrorhiza scrophulariiflora, Saussurea tridactyla, Swertia chirayita,* etc.), to demonstrate effective management and sustainable use of wild-collected plants and to contribute significantly to the local livelihoods of the region (Shrestha 2003).

These assessments have provided comprehensive information to local user groups for effective management of NTFPs. Consequently, communities have been benefiting by the sustainable use of these valuable resources which has also improved local economy and forest quality in the region (KCA 2013). In addition to afforestation campaigns conducted mainly via community, leasehold and private forestry, the imposed prohibitions followed by proper monitoring by CFUGs, CBOs and the government agencies have controlled, to some extent, illegal harvesting and trade of NTFPs, tree logging, forest encroachment, overgrazing and forest fire in the region. Such efforts, to some extent, have collectively resulted in the restoration of the previously degraded forest ecosystems.

Agroforestry

Successful agroforestry practices in KL Nepal have led to the maintenance of greenery and stabilization of the ecosystems and the economy. Agroforestry innovations in the form of large cardamom plantations with moisture-loving trees, broom grass cultivation and tea cultivation, which are the characteristic of the landscape, have supplemented the income of the local communities. Cultivation of MAPs and their use as cash crops are recent phenomenon (Chettri and Sharma 2006).

Furthermore, agroforestry significantly contributes to animal husbandry and organic manure availability for the local agroecosystems. Major species recorded in these agroforestry systems include: fodder (*Arundinaria* species, *Dendrocalamus* species, *Ficus nemoralis* and *Saurauria napaulensis*); timber (*Alnus nepalensis, Castanopsis indica* and *Michelia champaca*); and firewood (*Alnus nepalensis, Macaranga pustulata* and *Schima wallichii*). Planting

Table 6.1: Distribution of forests under different forest categories in KL Nepal districts

Forest category		Districts				Total
		Taplejung	Panchthar	Ilam	Jhapa	
Government-managed forest (ha)		112,262	44,577	31,004	4,689	**192,533**
Community forest	Area (ha)	4,472	12,699	49,120	8,550	**74,841**
	No.	79	157	218	32	**486**
Private forest	Area (ha)	6	1	1	318	**326**
	No.	7	1	2	333	**343**
Leasehold forest	Area (ha)	0	731	0	0	**731**
	No.	NA	213	NA	NA	**213**
Religious forest area (ha)		0	16	156	0	**172**
Total forest area (ha)		**116,740**	**58,025**	**80,281**	**13,557**	**268,603**
% of total area of the district		**30.72**	**47.30**	**47.26**	**8.25**	**32.15**

Source: MoFSC (2013), DFO Taplejung (2013)

Table 6.2: Distribution of community forests in VDCs/municipalities within KL Nepal

Districts	Community Forest	
	Area (ha)	CFUGs
Taplejung	1,716	25
Panchthar	4,473	41
Ilam	15,576	105
Jhapa	7,809	28
Total	**29,574**	**199**

Source: DoF (2013)

Table 6.3: Forest conservation and management plans under implementation in KL Nepal districts

SN	Type of the plan	Level	No of plan	Duration of the plan	Status	Remarks
1.	District Forest Management Plan	District	4	5 years	Approved by DoF	Taplejung, Panchthar, Ilam and Jhapa
2.	Kangchenjunga Conservation Area Management Plan	Conservation Area	1	4 years	Approved by MoFSC	KCA (4 VDCs) in Taplejung (2014–2017)
3.	Community Forest Operational Plan	FUG	486	5 years	Approved by DFO	Taplejung, Panchthar, Ilam and Jhapa
4.	Conservation Community Forest Operational Plan	FUG	26	5 years	Approved by KCAMC	Taplejung (within KCA)
5.	Leasehold Forest Operational Plan	FUG	197	5 years	Approved by DFO	Panchthar
6.	Management Plan of Mai Pokhari, Ramsar Site	Wetland	1	5 years	Approved by MoFSC	Mai Pokhari area (3 VDCs) in Ilam

broom grass on steep terraces and marginal lands is an age-old practice particularly in Ilam and Panchthar districts. Majority of the farmers practise agroforestry on their farmland, private forestland and community forests, which have also reduced pressure on the government managed forests.

6.1.3 Forest utilization and management issues

Several initiatives have been undertaken by the government agencies (mainly the District Forest Offices) individually or in coordination with local stakeholders for the conservation and sustainable management of forest resources of KL Nepal (DFO Panchthar, Ilam and Jhapa 2008, DFO Taplejung 2013). However, such initiatives are not sufficient in reducing the pressure on forest resources due to several factors. In all KL Nepal districts, issues related with the utilization and management of forest resources are almost similar, which can be broadly categorized as: i) slash and burn agriculture in high elevation (above 3,000m) forests; ii) forest encroachment to convert forest areas into agricultural land; iii) overgrazing on alpine meadows; iv) extensive illegal tree logging for household cooking, heating and construction; v) illegal and overharvesting of NTFPs; vi) invasive species; vii) forest fire; and viii) poaching and retaliatory killings of wildlife. Explanations and reasons for degradation are a mixture of unclear ownership or tenure rights, lack of policy interventions, low agricultural productivity of existing land, lack of linkages to cash crop markets, and external market demands for traditional medicines (Parker and Thapa 2011, Oli et al. 2013). However, there has been some attempts in Nepal at the policy level to promote sustainable harvest of forest resources, but implementation has been far from satisfactory (Oli et al. 2013).

6.1.4 Transboundary forest conservation and management issues

Rich forest species of economic importance and the existence of porous border make KL Nepal a very critical transboundary area for conservation and management of the landscape. Some of the major transboundary issues related to agroforestry and forestry include illegal trade of medicinal plants/products and timber, cross-border movement of livestock, wildlife poaching, and uncertain markets due to heavy reliance on the international market.

Many local institutions are working in the area for conservation but with limited success. In order to address these cross-border conservation issues through transboundary cooperation, a few meetings are organized at local as well as national government levels with the bordering countries (KCA 2013). The objectives of such meetings are: i) to explore and address gaps in effective law enforcement in controlling wildlife crime in the border region; ii) sharing of experiences and lessons learned at all levels; iii) maintenance of biological corridors and connectivity; iv) declaration of bi-national peace park in the potential areas; and v) initiation of collaborative research and monitoring on the flagship species, etc. (KCA 2013). However, issues of illegal hunting and trade of wildlife, overharvesting and illegal trade of NTFPs/MAPs, illegal tree logging, timber trade and firewood still remain unresolved in the region.

6.1.5 Illegal transborder trade: An issue of biodiversity conservation and management

From the time of operation of traditional salt-grain trade (with Tibet and India) to present, transborder trade also involved illegal trade of wildlife (Wang and Li 1998) and their products, timber, NTFPs and several valuable medicinal plants. It has been reported that Illegal trade across the Sino-Nepal and Sino-India border is currently active and the trend is found to have increased particularly after 1950s (Oli 2003, NCDC 2005, 2010, Paudel 2010). Due to the porous border between Nepal and India and lack of monitoring in remote areas along the border between Nepal and Tibet, accompanied with the scarcity of trained human resources and lack of infrastructure with the government agencies for proper monitoring, the trend of illegal trade of wildlife and its product seems increasing in the region (WWF 2006).

Except a few discrete cases, there is no factual information and data with the concerned government agencies on the volume of illegal transborder trade, trade channels, trade centres and trade routes in this region (NCDC 2010a, Katuwal et al. 2013). As reported in the field, illegal trade is run by middlemen/brokers (in either side of the border) through channels that operate clandestinely with hidden support and is difficult to identify. Therefore, there is an urgent need of cooperation and proper coordination among the relevant stakeholders in the region while enhancing their capacity for monitoring and control of such trades. More importantly, there is a need of transboundary (bi/and tri-national) cooperation and coordination at the national and local levels for effective controlling illegal transborder trade of biodiversity components.

6.2 Rangeland management

The mountain communities of KL Nepal are heavily dependent on natural resources of the surrounding environment. Local institutions have strict regulations for natural resource management, including pastureland management and grass-cutting. Pasturelands belong to the government, but its use and management is controlled by local user groups (Box 6.1).

Only the local inhabitants have free access to these pastures and users from outside have to pay fee (Müller-Böker and Kollmair 2000). A healthy population of blue sheep above Khampachen (Brown1994) indicates that the local management of pastures is sustainable as well as supporting wildlife.

Box 6.1: Communal management of rangeland resources: A case of Ghunsa village

The 'grass-cutting day', which regulates the supply of winter fodder, is one of the most interesting and effective ways of grassland management in Ghunsa village (Brown 1994). To avoid individual exploitation of a crucial common resource, the village representatives fix the day for starting grass cutting. After 3–4 days, all the grass is harvested. All members of the community have the opportunity to collect sufficient hay. The grass-cutting regulation also includes private land. This helps to mitigate economic disparities and prevents the theft of grass from private lands. The ability to adapt to the system to a new setting was proven when Tibetan refugees settled in Phale in 1959. They were accepted as equal partners in this system. There are also locally developed rules and regulations concerning the forests, especially the heavily used forests in the neighbourhood of settlements. The term *Rani Ban* designates forests that are traditionally preserved for both religious and secular reasons. Timber for the construction of schools, *gompas*, bridges and other community needs is taken from the forests. Various local institutions establish governance over a particular resource defined by a user group, demarcating a boundary and establishing and enforcing a functioning set of user rights and restrictions. In the past, these local institutions could effectively resist external state control because of the remoteness of the area. However, the KCAP tries to enhance and modify these traditional rules and regulations by implementing a management plan through Conservation Area Management Committees.

Source: Müller-Böker and Kollmair (2000)

6.2.1 Major rangeland management regimes: From past to present

Land ownership and tenancy rights followed the *kipat* system until the *Birta Unmulan* Act of 1965 and the Pastureland Nationalisation Act of 1975 (also see section 6.7.6). The *de jure* right of *kipatiyas* or other locals to pastures were then vested in the government. However, in some remote mountain areas, a *de facto kipat* system is still prevalent (Khatri 2004). Before 1975 (2031 BS), all the rangelands called *kharkas* were used to be managed under the *kipat* system and after the *kharka* Nationalization Act 2031, people lost all the legal rights over the rangelands. The Act has nationalized all the rangelands by providing compensation. However, Provision 2 *Kha* of the Act states that the rangeland can be provided to the organized body or community for specific purpose leading to conservation prospect. According to section (5) of this Act, local VDCs are authorized for the protection and care of such land under the supervision of the District Revenue Office (Oli 2003, Khatri 2004). In the upper reaches of the area, despite several Acts, *de facto* use rights of many areas still remain with the traditional settlers. At the lower elevations and even in areas of *Lekali Kharkas* where community forestry is expanding, there is no claim and counter-claim except in rare cases. But in majority of the community forestry areas, the CFUG executive members are from the members of traditional *kipataya/jimmawal* clans. In the open areas and grazing sites within the CF boundary, animal grazing tax called *kharchari* is levied by the committee, which has still been largely misappropriated and considered as a tax of their land by the executive body (Oli 2003).

The current rental arrangements for pastureland are, therefore, variable depending on the types and number of animals. Sometimes, a flat rate is levied depending on the size and condition of *kharka*–larger the size of the grazing land, higher is the taxation. Payments are made both in cash and kind. Herders are either rented a fixed price or prefixed animal number(s) is given at the end of the term. If animal population increases in the herd, more money is charged to the herders (Oli 2003).

The same *Lekali Kharka* of Taplejung district is rented twice to different grazers in a year: for cattle, buffalo, sheep and goat grazing; and separately for yak. For cattle and buffalo grazing, the same *Lekali Kharka* is rented for a period of one year, but the animals are grazed only for six months after which they are moved downwards for wintering. For the rest of the winter period, the same land is rented to yak herders with different arrangements. This rental arrangement still exists between 2,000m to 3,500m. Above this altitude, *kharchari* used to be collected by the traditional *kipatiyas/jimmawalas* until 1993. However, in recent years, transhumance rearing has declined and tax collection as *kharchari* has also declined from alpine meadows (Oli 2003).

While these developments were taking place within Nepal, an agreement for prohibiting transborder use of pastureland was reached between the governments of China and Nepal in 1978. In the Kangchenjunga transboundary region, this arrangement impacted mainly in Taplejung district (Yamphudin, Lelep, Olangchung Gola and Papung VDCs) and part of Chyangthapu and

Pastureland in the high altitude region of KL Nepal

Phalaicha VDCs of Panchthar district (Oli 2003). This prohibition on pasturing animals on Tibetan side forced to open more highland grazing sites in Nepal. As a result, the inaccessible remote fragile high altitude areas were opened and made more accessible for domestic animal grazing, and were subjected to further degradation due to grazing and browsing. Grazing sites between 2,000m to 4,000m which were already overstocked received more grazing pressure from Nepalese and Sikkimese sides.

6.2.2 Transborder cooperation in pasture management

With the prohibition to pastureland by the Chinese and increase of protected areas in the Indian part of KL, yaks from there were brought to *Lekali kharka* in Nepal, where grazing sites were already overstocked, for wintering. Majority of people living either side of the Nepal-India border is from the same clan. Members of the same clan or family owns lands on both sides of the border, and also have rights over the use of natural resources, including the rangelands. If the use of pasture resource is regulated on the one side, they use resources from the other side. For example, after the delineation of Singhalila National Park in Darjeeling district, adjacent to Ilam and Panchthar districts of Nepal, animal grazing was restricted within the protected area. Consequently the people who were using the pasture of that area made grazing arrangements on the Nepalese side.

Along the Nepalese border, all the forest and pasturelands, other than within the PA system, are administered under the Forest Act 1993, in which community forestry is an important component. Law enforcement in Singhalila protected area is reported to be stringent while there is no effective presence of forest administration in the remote areas of Nepalese side. In addition, community forestry management in transborder area suffers from lack of local capacity, market incentive on the other side of the border and willingness of user groups to cope with transboundary competition for the illegal harvest of forest products (Oli 2003).

This is a divergence from the traditional sharing of transboundary resources. Although the process has reported to benefit biodiversity conservation towards the Indian side, it has been adversely impacting rangeland biodiversity in Nepal. Therefore, this development has severely impacted on traditional transboundary resource management regime (Oli 2003).

6.2.3 Transboundary movement of people and their impact on pastureland

During 1950s, a large number of Tibetan refugees started to come to settle in parts of Ilam, Taplejung, Panchthar and Sikkim and Darjeeling districts of the transborder area. More importantly, they also brought with them the Tibetan culture and knowledge base of rearing yaks and collecting herbs and medicinal plants. Earlier settlers invested on the new comers for settlement along the transborder areas for yak rearing, collection of herbs and medicinal plants, which eventually exerted extra pressure on pastureland (Oli 2003). In order to ensure continued flow of yak products for their businesses, wealthy people from urban centres hired middlemen who were in charge of rearing herds across transborder areas. Similarly, it is reported that some people from either side provided incentives to traditional mobile hunters to hunt barking deer, wild boar and red panda in such areas (Box 6.2).

Box 6.2: Multidimensional impacts of Tibetan immigrants on rangeland biodiversity

Once the Tibetan refugees settled in different villages and urban centres of India and Nepal. This brought multifaceted changes in the traditional pattern of resource use and management, including rangelands. It is reported that in addition to the Tibetan refugees of Taplejung district, those from different urban centres have made investment for yak herds and *kharkas* in the region and hired some Nepali herders for their management. Herds are grazed in Taplejung and Panchthar districts. However, yak products are supplied to the investors residing in different urban centres. As a result, the yak population has increased over the years in the region.

Furthermore, the settlers in Taplejung along with the local people opened up more areas clearing valuable rhododendron forests for expanding pastureland. This has reduced breeding and nesting grounds for many valuable highland avifaunas. The impact of this is observed to be many-fold. Since animals from Nepalese side are already grazing, additional animals from Darjeeling and Sikkim side exerted extra pressure on the Nepalese pasturelands. Yaks are heavy grazers and can graze in the difficult terrain, riversides and cliffs. High intensity grazing has reported to reduce palatable pasture species. Unwanted bush species have increasingly colonized. Transborder trade of NTFPs and forest products also takes place along the border.

6.2.4 Overgrazing in the rangelands

The danger of overgrazing and associated soil erosion has been recognized for many years in Nepal. With the increase in livestock numbers, high elevation grasslands and forest areas in Nepal are deteriorating. Overgrazing by domestic livestock and increased competition for forage may directly threaten the region's Blue sheep (*Pseudois nayaur*), ghoral (*Nemorhaedus goral*) and serow (*Capricornis sumatraensis*) population. However, local people, by tradition, have the right to graze their animals on pastures and in forests of the Kangchenjunga area (Rastogi et al. 1997). Over the years, the number and size of flocks of sheep has decreased. Unlike on the Nepal side, the Indian side of Singhalila range is under the strict protected area network since 2000. As a result, huge flocks of animals were sold and transferred towards Nepal side. This has further added the pressure on pastures of KL Nepal.

6.3 Wildlife management

Wildlife management is an integrated practice that draws on diverse disciplines ranging from biology to security. The main focus of wildlife management is the protection of wildlife species within their habitats and carrying capacity. Managing wildlife in KL Nepal with a large number of nationally and globally threatened species such as Snow leopard, Red panda, Musk deer, etc. is a challenge particularly due to an increasing pressure of human activities. One of the major challenges of the landscape is poaching and trading of wildlife species and/or their body parts (Paudel 2010). Limited research and data, inadequate environmental awareness of local communities, ineffective implementation of programmes and initiatives are other important issues of KL Nepal.

Some of the ongoing conservation initiatives include KCA, SHL, Mai Pokhari Ramsar site and IBAs, Red Panda Network (RPN) and community forests in KL Nepal. However, the only protected area in KL Nepal is the KCA, which is directly addressing wildlife management issues through various programmes and activities. One of the recent successful activities include collaring Snow leopard with GPS tracker for wildlife monitoring (WWF 2013). Data transmitted by the collar will allow researchers to track the Snow leopard's movement, habitat use and preferences, home range and other important parameters needed for effective management of the species. Similarly, RPN has been conducting baseline survey/research on Red panda and community-based monitoring of the species in Panchthar, Ilam and Taplejung districts. Training local villagers as forest guardians has been undertaken to create stewardship. Other government or non-government initiatives have not become effective as per their goals and objectives. Therefore, major gap in wildlife management in KL Nepal in general is the ineffectiveness of the initiatives. Identifying important animal-plant areas (Section 5.1.6) and activating IBAs (Section 5.1.4) and other initiatives with proper and adequate plans, programmes and activities will complement the ongoing effort of KCA, RPN and also adjoining Koshi Tappu Wildlife Reserve (outside KL Nepal).

6.3.1 Human-wildlife conflict

Human-wildlife conflict is a serious problem in KL Nepal. Crop depredation by wildlife is reported from all over KL Nepal districts. Major wildlife species involved in crop depredation include Asian elephant, Barking deer, Himalayan bear and livestock predators include Snow leopard and Common leopards. Emerging problem due to seasonal migratory herd of elephants in Jhapa district has become even more serious, which needs to be addressed with short and long-term strategies and effective implementation plans.

Wild elephants have covered 52 VDCs as migratory routes in KL Nepal and 19 of them are severely impacted by elephants. The severely impacted VDCs include Bahundangi, Budhabare, Chulachuli, Satashidham, Charali, Jalthal, Sanischare, Khudunabari, Surunga, Ratuwamai, Shantinagar, Anarmani, Haripur, Kusaha, Sripur, Prakashpur, Purbi Pipra, Chatara and Bhardaha. All migratory elephants come to Nepal from India through West Bengal and the main entry point is Bahundangi of Jhapa district. Forty four human casualties occurred with death of 19 people and serious injury of 25 people from January 2008 to December 2013. People have lost property worth over Rs. 6 million in Bahundangi from 102 damages during 2013. Official records of the Jhapa district DFO show that during 2010–2012 elephants killed or injured 21 people, damaged 210 houses and other property worth Rs 8 million. This conflict is increasing because the number of elephants visiting Jhapa has been increasing in recent years (Ram 2014). Action programmes for the reduction of human-elephant conflict in Jhapa is inadequate although DFO of Jhapa district has been implementing some programmes with the support of the World Bank.

6.3.2 Major causes of human-elephant conflict

Conflict arises from the conversion of forests into settlements, agriculture and infrastructure such as highways and dams leading to fragmentation, shrinkage and degradation of elephant habitats, and loss of traditional routes for elephant's movement. As a consequence, shortage of natural food arises and the elephants feed on agricultural crops such as maize, rice, wheat, sugar cane, banana, etc. Elephants thus enter into human settlements in search of food and water, and often come into direct conflict with humans by destroying crops, livestock or property and

An Asian elephant in Jhapa district

Solar fencing constructed to reduce human-wildlife conflict

sometimes even killing people. In retaliation, elephants also get injured/killed by the local communities.

6.3.3 Problem mitigation

In order to mitigate human-elephant problem, both short and long-term programmes, including research, awareness and education, effective patrolling, solar fencing, wider partnership, transboundary cooperation and coordination among human-elephant conflict affected communities, government and non-government organizations, and CBOs should be strengthened. Moreover, innovative local methods such as community insurance, compensation/relief, keeping and diverting elephants away from farm lands (e.g., burning chilli and shifting cultivation from rice-maize to non-palatable cash crops like cinnamon, ginger, tea, etc.) should be explored and models of community-based conflict mitigation programmes should be developed. Similarly, long-term methods for conflict mitigation such as land use planning and generating benefits from wildlife through community-based conservation should also be initiated. Such programmes are sustainable only when all the stakeholders work together (Ram 2014).

6.4 Agrobiodiversity management

Agrobiodiversity management has both socio-cultural and natural dimension. Selection and continuation of crops and livestock are defined largely by socio-economic, cultural and agro-climatic factors. Over the years, with the introduction of new varieties of crops, especially in the case of major crops like paddy, wheat, maize and potato, indigenous landraces are threatened. Landraces are more threatened in the areas with access to market and extension services such as the areas close to district headquarters and roadheads. Some minor crops such as fox-tail millet and *Perilla frutescens* are threatened to be lost. However, some crop species, especially fruits and vegetables which were not traditionally cultivated, have also been introduced in the region. For example, kiwi and coffee have been introduced in the recent past.

Over the years, the type and number of livestock raised have also declined. The flock of sheep has declined largely both in number and size. Gradual shift to stall feeding from grazing has also affected livestock diversity. People, however, have maintained some landraces for their favoured characteristics. No concerted efforts are in place to conserve and manage agrobiodiversity. Measures like the promotion of seed banks and the conservation of landraces have not been practised yet. Government agencies, particularly the District Agriculture Development Office and District Livestock Services Office at the district level and the Nepal Agriculture Research Council at the national level, are the lead agencies for the management of agrobiodiversity. In addition to these government agencies, NGOs and CBOs also play important role in conserving and managing agrobiodiversity.

Agrobiodiversity–an example of maize diversity in KL Nepal

6.5 Wetland management

Mai Pokhari has a specific management plan, which was prepared as a mandatory requirement for Ramsar

sites (DFO Ilam 2012). The plan has not addressed the cultural values which rarely become the objective of wetland management. Wetland culture can play a vital role in publicizing the importance of culture in the management of wetlands Bhandari (2006). The management plan, therefore, should take culture as an important tool to raise public awareness about wetland conservation and management, particularly in relation to the CBD and Ramsar Convention.

In Mai Pokhari, there are several management issues, which need to be addressed to safeguard its importance. These issues include introduced exotic species, especially the Japanese pine (*Cryptomeria japonica*), introduction of exotic fish, water seepage and decreasing water level, plantation of exotic flowering plants in botanical garden, collection of forest product, wildlife poaching, chemical fertilizer and pesticide use for agriculture, poor conservation and ecotourism awareness, infrastructure like the motorable road too close to the pond and garbage pollution, gravelled road, dust and vehicular noise (DFO Ilam 2012).

Timbung Pokhari located at the border of Taplejung and Panchthar districts

6.6 *Churia* management

The *Churia*, also known as the Siwaliks or Churia hills or foothills, rise abruptly reaching an elevational range of 700–1,500m. The Churia is wider in the West and Far-West Nepal than in the Eastern Nepal (Chaudhary 1998). Forest Resource Assessment Report on Churia Forests of Nepal shows that KL districts (Ilam and Jhapa) account for 3% (58,347 ha) of total Churia area (1,898,263 ha) in Nepal (DFRS 2014). Jhapa district has 19,207 (1%) and Ilam has 39,140 ha (2%) land area under Churia. The Churia range extends upto Bahundangi, Khudunabari, Shantinagar and Surunga VDCs in Jhapa district and Erautar, Jirmale, Laxmipur and Shantipur VDCs in Ilam district within KL Nepal.

Important biodiversity goods and services provided by Churia forests are under severe threats due to land use change. The forests are losing their ground

A view of the Churia forest in Jhapa district

and the indigenous animals like King cobra, stork, the world's largest flying bird, Python and Pygmy hog are threatened because of habitat loss. During the Rana era, hardwood timber of sal (*Shorea robusta*) forests of Churia was exported to India. Today, Churia is being indiscriminately mined for soil, sand, stones and boulders, thereby risking the plains of Nepal and India prone to disastrous floods (Rai and Dutta 2010, Shrestha 2012). When the Churia loses its forests opening up huge gashes on its slopes by quarries, monsoon rains can wash down the fragile mountain. An evidence of this possible grim scenario comes from Jhapa district where a bridge over the Ratuwa Khola has been recently buried by the sediment washed down from the Churia hills (Shrestha 2012).

Due to its sensitive geography, importance in terms of biodiversity and the severity of ongoing activities, the GoN has given special consideration on Churia management and development since the fourth periodic plan period (1970–1975). The Churia Area Programme Strategy (2008) has given due consideration to manage Churia in more integrated ways (MoFSC 2008) (also see Chapter VII). Recently, the GoN has formed the Rashtrapati Churia-Tarai-Madhesh Conservation Development Committee for integrated and holistic conservation of Churia area.

6.7 Institutional arrangements and stakeholders

6.7.1 Government institutions

The Ministry of Forests and Soil Conservation (MoFSC), the national focal point to implement CBD, is the lead agency with an overall responsibility of landscape management for biodiversity conservation and contributing to livelihoods. The Ministry is responsible to approve and implement plans and programmes through the five Regional Directorates and five departments–Department of Forests (DoF), Department of National Parks and

Wildlife Conservation (DNPWC), Department of Soil Conservation and Watershed Management (DSCWM), Department of Forest Research and Survey (DFRS) and the Department of Plant Resources (DPR). In MoFSC, a high level national committee consisting of concerned stakeholders is functioning at the central level to steer the implementation of landscape level programme as a whole. At the regional level in KL Nepal, the committee composed of multistakeholder body, which is chaired by the Regional Director, is also responsible to monitor the programmes.

The DoF is the oldest and largest of the five departments. DoF is mandated for the sustainable management, utilization, protection and development of forest resources outside protected areas. Likewise, the DNPWC is responsible to conserve and manage the biological diversity with an emphasis on wildlife and protected areas. The DSCWM is responsible for conserving and managing watersheds. The DPR and DFRS are responsible for research and development of plant resources, and contribute to the sustainable management of the forest resources through improved technologies and updated forest resource information respectively. The DSCWM has District Soil Conservation Offices in all KL Nepal districts, whereas the DPR has District Plant Resources Office in Ilam district only.

The district level government line agencies play major role in the implementation of landscape level programmes. At the district level, District Forestry Sector Coordination Committee (DFSCC) is responsible to facilitate and coordinate the execution of the landscape related programmes. The committee is chaired by the DDC chairperson/LDO and the DFO works as the member secretary. District line agencies also mobilize different partners from the communities, NGOs, CBOs, private sectors and other agencies.

6.7.2 Kangchenjunga Conservation Area Project and Kangchenjunga Conservation Area Management Council

The primary goal of the KCAP is to conserve biodiversity of KCA through the integration of natural resource conservation with sustainable community development (Amatya et al. 1995). The project aims to achieve this by strengthening local community capacity to improve their socio-economic conditions. The GoN has handed over KCA management to Kangchenjunga Conservation Area Management Council (KCAMC) in September 2006. Since then, KCAMC is the highest decision-making body of KCA and has roles and responsibilities for the management of natural resources, biodiversity conservation and community development activities.

The KCA is managed through participatory conservation approach. In addition to the conservation activities, KCAMC is implementing development activities and climate change adaptation practices through different donor agencies. The KCAMC formation has been a major milestone for institutionalizing participatory conservation approach in Nepal. The DNPWC provides legal, technical and financial support to the KCAMC. WWF Nepal also provides technical and financial support to the council for biodiversity conservation and sustainable community development programmes in the KCA.

6.7.3 Formal community organizations

Community-based Natural Resource Management (CBNRM) institutions such as community forestry user groups (CFUGs), leasehold forestry user groups , water user groups, etc. are identified as most effective institutions with regard to conservation, development and use of natural resources in the HKH (Gilmour and Fisher 1991, Sharma et al. 2010). At the district level, the common community level formal organizations are CFUGs, LFUGs, conservation area user groups and cooperatives. These organizations are involved in plan preparation and implementation of the programmes as mandated by the existing legislations. In addition, the institutionalization of CFUGs and LFUGs has largely supported sustainable natural resource management and biodiversity conservation together with community development activities. Altogether, 486 CFUGs and 196 LFUGs function in KL Nepal districts (DoF 2013).

6.7.4 Community-based organizations

Active participation and mobilization of CBOs is the critical factor in promoting conservation measures in rural communities. A large number of NGOs, civil society organizations, private sector and CBOs (such as mother groups, eco clubs, youth clubs and anti- poaching groups) are involved in natural resource management, biodiversity conservation and community development activities in KL Nepal. These institutions are involved in various collective actions such as forest management, spring water conservation, saving/ credit, conflict resolution, forest fire control, community sanitation, seed exchange, grazing regulation and NTFPs farming in private as well as community forests. These activities have supported biodiversity conservation, environmental education and creation of awareness, addressing gender and social inclusion issues, forest management for pro-poor income generation activities and restoration of degraded lands. In general, CBOs are actively involved in network development and monitoring of illegal harvest and trade, anti-poaching operations,

forest restoration and community development activities.

6.7.5 Major non-governmental organizations

Local and national NGOs are playing important role in forestry, wildlife protection, agriculture development, tourism promotion and awareness creation in KL districts. In addition to its accountability to respective clients (GoN/donors), the NGOs are primarily accountable to the Social Welfare Council, District Development Committee and District Administrative Office.

6.7.6 Traditional systems and institutions

Traditional and non formal institutions also play important role in local level resource governance. The culturally diverse communities of KL Nepal have been managing their natural resources in their own traditional systems, among which traditional institutions such as *kiduk* (among the Sherpas) and *kipat* (among the Limbus) are most notable. Mother groups or women groups, traditionally existing or formed by different development agencies, also play an important role in resource governance. In some places, women groups have taken over the responsibility of managing community forests as well (e.g., Pauwa Bhanjyang of Ranitar VDC, Panchthar).

Role of women group in resource governance has become more important against the general milieu of increasing absentee population of males owing to foreign employment. Some of these institutions are formally registered with the government agencies and have egalitarian system of functioning whereas other institutions like Subba system are more hierarchical and hereditary. As local institutions have strong legitimacy within socio-cultural-legal set up, their involvement in conservation and development initiatives would facilitate overall implementation of the programme effectively.

The *Kipat* system

The *kipat* is a customary system of communal land ownership through which a group of families hold land titles. It represents a communal form of land tenure inherited by the same communities from their ancestors as a source of livelihood (Regmi 1978). The *kipat* system went through a long history of political changes from 1774 to 1950. The process of land ownership and tenancy rights followed this system until the *Birta Unmulan* Act of 1965 and the Pastureland Nationalization Act of 1975. The *de jure* right of *kipatiyas* or other locals to pastures were then vested in the government. In Panchthar and Taplejung districts, a *de facto kipat* system is still prevalent in terms of using forest products and regulating pastures.

This system sometimes creates conflict with the current general system of land ownership. *Kipat* symbolically and legally mark the point of intersection between local and national system of land management. Some legal cases are underway as a result of such conflicts. As a system of land tenure with specific rights and regulations attached to it, *kipat* is sometimes locus to considerable competition over contemporary claims to resources. It is considered as rights to the land and also ethnic identity. In Taplejung and Panchthar, *kipat* system is often considered as a hurdle to resource management by the government officials and NGOs since they cannot initiate conservation programmes in such lands.

6.7.7 Shifting cultivation

One of the traditional land management systems practised by the people in the higher elevation of KL Nepal is shifting cultivation or slash and burn agriculture locally called *khoriya* or *bhasme*. In many VDCs like Tapethok, Lelep and Yamphudin shifting cultivation was the main livelihood strategy in the past. However, land use pattern and livelihood strategies have changed in recent times. It is a short duration practice and a kind of agroforestry system typically adopted on steep slopes that are unsuitable for permanent cultivation, and often inaccessible for livestock grazing. Local people clear secondary forests for crop production while leaving parcels to regenerate naturally via fallows for medium to long duration (Aryal et al. 2010). The main stages of the cycle include clearing and preparing suitable land (February–March), cropping (mid March–mid May) followed by fallow management.

Typical shifting cultivation involves sowing maize as a main crop which is done with the help of a dibbling stick. Intercrops such as radish, beans, soybean, and amaranth are grown together with maize (Aryal et al. 2010). Some people grow barley and wheat after harvesting maize. Over the years, Chiraito (*Swertia chirayita*) cultivation in increasing. With the increase of demand and price of Chiraito, its cultivation is also increasing rapidly.

Fallow management is an integrated part of shifting cultivation system and is essential to improve soil fertility and structure, control soil erosion and decrease invasion of weeds after cultivation. In the KCA villages, the length of the fallow phase depends upon the family's land holding size and food security. Poorer households leave their land fallow for around eight years, whereas richer families have fallow land of 12–15 years (Aryal et al. 2010).

Issues of shifting cultivation

Land related Acts of Nepal do not recognize shifting cultivation as a land use system, and farmers cannot

register land for this purpose. However, Aryal et al. (2010) reports that shifting cultivation is being practised and the practice is sustainable since the fallow cycles are long enough to restore soil properties and vegetation, and provides several benefits to faunal and floral diversity. However, it is considered a serious threat to biodiversity by other researchers (e.g., Ikeda 2004, Parker and Thapa 2011). The time span between cropping patterns has declined significantly resulting in decreased agricultural productivity and increasing incursion into forests and wildlife habitats (Rastogi et al. 1997, Parker and Thapa 2011). Nevertheless, shifting cultivation is a result of ambiguous land ownership rights/weak tenure, poor soil condition, lack of arable land and lack of alternative sources of livelihood in the higher altitudes.

6.8 Community perception on environmental issues and climate change

6.8.1 Culture and conservation

Local communities rely on natural resources for livelihoods establishing a close link between biodiversity and cultural diversity (Chaudhary et al. 2007). Resource use by local people is based on a deep knowledge of ecological systems, processes and the services they provide (Gadgil et al. 1993). This knowledge is valued from the conservation perspective and is increasingly taken into account in the management and conservation initiatives (Berkes 2013, Uprety et al. 2012). More and more scientists are finding value in collaborating with local population and growing political awareness and activism by indigenous peoples have led to increased recognition of their knowledge and ideas (Huntington 2011). Therefore, it is important to understand communities' perception in conservation and development initiatives.

An assessment of community perception on biodiversity, cultural values, environmental issues and climate change was carried out in Ilam, Panchthar and Taplejung districts. Local people are often regarded as the guardian of their cultural landscape. The changes that occur in their surrounding impact directly on the cultural practices. Therefore, they are very sensitive towards such changes. Since KL Nepal is culturally a diverse landscape, biodiversity plays an important role in peoples' cultural identity. Various plants and animal species are culturally important (also see Chapter 5). Likewise, many wetlands and forests are sacred.

KL Nepal is a multi-lingual and multi-religious region. Religion is deeply rooted and binds people together to perform community activities that preserve their cultural identity and resources. Indigenous people are making efforts to preserve their traditional norms, values and practices. These factors play a key role in socio-economic development, cultural identity and biodiversity conservation.

6.8.2 Climate change and community resilience

There has been a high level of awareness among the communities of Taplejung district about climate change mainly due to the activities of the KCAMC. A study around Olangchung Gola has revealed this fact. Awareness programmes and Local Adaptation Plan of Action (LAPA) from the GoN on potential effects of climate change alone are inadequate However, there has been some gaps in other districts; for example, the people from CFUGs of Pauwa Bhanjang, Ranitar VDC of Panchthar district, were less aware about climate change. Awareness is the first step towards community resilience on climate change.

Sustainable Conservation Approaches in Priority Ecosystems (SCAPES) programme has been launched in four VDCs of KCA (Tapethok, Yamphudin, Lelep and Olangchung Gola), three other VDCs outside KCA (Kalikhola, Surumkhim, Angkhop) in Taplejung and Phalaicha VDC of Panchthar by KCAMC with the help of USAID, WWF and Care Nepal (Care Nepal 2010). The main objective of this programme was to analyze the impacts of climate change on community and prepare adaptation plan for community resilience. Some non-governmental organizations have conducted the assessment of community awareness on climate change and community resilience. However, there are no such regular programmes by the governmental organizations. The SCAPES programme has implemented capacity building and awareness activities in different VDCs (Care Nepal 2010). Likewise, ECDF has formed eco clubs under the coordination of environmental education teacher to facilitate the impacts of climate change and the plans for mitigation measures (ECDF 2009).

Reforestation, afforestation and agroforestry programmes are being implemented in all KL Nepal districts. The community forestry programme has contributed considerably in enhancing community resilience to climate change. The CFUGs have also initiated climate change resilience provisions in community forest operational plans. As a result, use of renewable energy is widespread. Resource mapping activities, identification and prioritization of potential risk and hazard sites, preparation of seasonal crop calendar, growing awareness in the communities, use of indigenous skill, knowledge and technology, provision of developing 'adaptation

fund' to support the most vulnerable communities etc. are helping community to adapt with the adverse effects of climate change in KL Nepal.

6.8.3 Peoples' observation on climate change

Local people have observed many evidences and identified issues related to climate change. Their perception on climate change is somehow similar in many aspects (Chaudhary and Bawa 2011, Macchi et al. 2011). The findings from primary information collected through key informants interview in Taplejung and Panchthar districts and the synthesis from the literature (ECDF 2009, Care Nepal 2010, NCDC 2010c) has revealed the following community perceptions on climate change:

- Local communities mentioned that they have experienced a gradual increase in temperature in recent years. In their experience, the amount of rainfall has decreased in monsoon season and dry season has prolonged. There are irregularities in rainfall patterns in the districts and also more evidences of landslides and soil erosion. The amount of water in water sources including wetlands has been decreased.
- Local people have observed increased evidence of the emergence of new pests and diseases in crops such as large cardamom, maize, wheat, millet and potatoes, and also increased the infestation of mosquitoes in residential areas. Although crop sowing season has not been shifted, harvesting time of crops such as barley, wheat and maize has shortened. There has been a change in snowing time, less snowfall and snow cover in recent years. The period of fog coverage has been shortened and lesser fog coverage or even absence of fog covered days is observed. Compared to the past, livestock can span more time in upper rangelands. An elderly person mentioned that he sees some new species of birds in different localities.
- Livelihood of local communities has been altered in several ways because of climate change and assosiated issues. Farmlands are less productive due to prolonged dry season and unpredictable rainfall. The seedlings of large cardamom are withering-up due to prolonged dry season, which has resulted in the loss of net profit to local farmers. The invasion of new weeds and extinction of indigenous grass (e.g., *Banso*) has resulted in the need of more investment in animal husbandry. There are also evidences of new epidemic diseases in villages causing more sicknesses. Likewise, increased new pests and diseases in fruits, vegetables, crops, and production and cash crops have resulted in increase investment in production but the quality of the production has been decreased and food insecurity has been an emerging issue. Recently, conflicts at local level, mostly due to drying-up of water sources have also emerged.

A woman collecting wild vegetable in Jhapa district

Mai Pokhari, a Ramsar site, located in Ilam district

Chapter

7 Policy and Enabling Environment

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A Red panda habitat with bamboo thickets in KL Nepal

7.1 Existing policies and legislations

Several policies and Acts formulated in different sectors such as forest resources, biodiversity, protected areas, water resources, wetland, agriculture and general development create enabling environment for the development and implementation of transboundary level conservation and development initiatives. On the other hand, there are instances of poor integration and harmonization of laws relating to natural resources, landscape development and environment. Some of the existing policies/Acts are inconsistent, overlapping or contradictory, and constricted by sectoral biases. The major policies and Acts of Nepal that have direct bearing on the transboundary initiatives and the relevant provisions under the major policies and Acts are listed in Table 7.1. Similarly, the Regulations and Directives/Guidelines related to the forestry sector that have implications to KL Nepal are listed in Annexes IX and X.

Table 7.1: Existing policies and legislations having direct implications for KL Nepal

Policy & Legislation	Relevant provisions
Interim Constitution of Nepal 2007	• Right of every person to live in a clean environment affirmed as a fundamental right • Protection of forest, vegetation and biodiversity, its sustainable use and equitable distribution of benefits • Identification and protection of traditional knowledge, skills and practices
Sector-specific Policies and Plans	
Master Plan for Forestry Sector1989	• Contributing to the growth of local and national economies by managing forest resources and forest-based industries • Creating opportunities for income generation and employment; meeting peoples' basic needs for firewood, timber, fodder and other forest products on a sustained basis • Promoting peoples' participation in forestry development, development of legal framework and strengthening organizational structure
Revised Forest Policy 2000	• Prioritization of biodiversity conservation while ensuring both sustainable livelihoods and equitable benefit sharing • Management of biodiversity with landscape level planning approach
Nepal Biodiversity Strategy 2002	• Adoption of landscape planning approach to protect and manage biodiversity • Aiming to conserve forests, soil, water and biological diversity, while at the same time meeting basic needs of people who are dependent on these resources
Leasehold Forest Policy 2002	• Handing over forests to the community living below poverty line
Herbs and Non Timber Forest Products Development Policy 2006	• Contribution to economy through protection and promotion of NTFPs
Sacred Himalayan Landscape (SHL) Nepal Strategic Plan 2006–2016	• Long-term sustainable management of biodiversity and water resources. • Promotion of traditional knowledge and cultural values. • Sustainable livelihoods in the transboundary landscape of the Eastern Himalayan region of Nepal
National Bio-safety Framework 2007	• Protection of biodiversity, human health, and the environment from adverse effects of research and development activities of modern biotechnology
Churia Area Programme Strategy 2008	• Creation of an enabling environment for all stakeholders to contribute to the conservation and livelihood of resource dependent people in an equitable manner
Forestry Sector Gender and Social Inclusion Strategy 2008	• Enhancing gender and equity, good governance and gender sensitive institutional development; gender budgeting, planning and monitoring; and equitable access to benefit sharing and decision-making processes
Forest Fire Management Strategy 2010	• Consideration of four pillars for forest fire management as: (i) policy, legal and institutional development and improvement; (ii) education, awareness raising, capacity strengthening and technology development; (iii) participatory fire management and research; and (iv) coordination and collaboration, networking and infrastructure development, and international cooperation.
Rangeland Policy 2012	• Maintaining ecological balance through conservation, promotion and sustainable use of rangeland biodiversity • Conducting scientific study to generate data on rangeland biodiversity
National Wetland Policy 2012	• Conservation of wetland biodiversity and environment by rehabilitation and effective management of wetland areas • Contribution to the well-being of wetland dependent communities through the sustainable and wise use management of wetland-based resources • Identification and utilization of traditional knowledge and skills of wetland dependent communities, and equitable distribution of benefits
Forest Encroachment Control Strategy 2012	• Aiming to achieve the national policy of maintaining 40% of the total area under forests
Forestry Sector Protection Plan 2013	• Control of different types of forest offences to achive the long-term vision of the forestry sector
Nepal National Biodiversity Strategy and Action Plan 2014-2020	• Preparation of a 35-year vision of biodiversity conservation for sound and resilient ecosystems and national prosperity
Forestry Policy 2015	• Provide guidance to all other policies of forestry sector • Conserve, promote and ulitize forest, vegetation, wildlife, protected areas, watershed and biodiversity for employment generation, livelihood improvement and maintaining ecosystem balance.

Sector-related Policies/Plans	
Agriculture Perspective Plan 1995	• Envisioning to increase agricultural productivity through the delivery of agriculture inputs and services
Water Resources Strategy 2002	• Protection and development of water resources through integrated water resource management
National Agriculture Policy 2004	• Improvement of degraded forests and natural water bodies for biodiversity conservation, as well as utilization and development of agroforestry system
National Water Plan Nepal 2005	• Contribution in a balanced way to the overall national goals of economic development, poverty alleviation, food security, public health and safety, decent standard of living for the people through water resource development and protection.
National Agrobiodiversity Policy 2007	• Emphasis on sustainable development and maintenance of ecological balance by protecting agrobiodiversity to benefit from protection and utilization of genetic resources for food security and poverty reduction
Tourism Policy 2009	• Promotion of Nepal in global scenario as an attractive, secured destination by conserving and promoting natural, cultural and biological resources
Climate Change Policy 2011	• Improvemet of livelihoods by mitigating and adapting to the adverse impacts of climate change
National Land Use Policy 2012	• Identification and protection of environmental sensitive areas; conservation and promotion of biodiversity, sustainable forest and watershed management
Irrigation Policy 2013	• Promoting conjunctive use of ground and surface water based irrigation systems along with new/non-conventional irrigation systems for food security and economic prosperity
General Policies/Plans	
Sustainable Development Agenda for Nepal 2003	• Sustainable use of natural resources, identification of high biological diversity needing protection • Environmental conservation to be an integral component of poverty alleviation and sustainable economic growth • Emphasis on the need for more effective management of forests, ecosystem and biodiversity for sustainable development
The Periodic National Plans of Nepal (11th, 12th and 13th)	• The 11th Plan (2008–2010) has emphasized on the access to forest resources of the poor, downtrodden and socially excluded groups; and laid the objective of the forestry sector as the maintenance of balanced environment through sustainable management of forest, plants, watersheds, biodiversity and protected areas as well as enhancing forest supply and promotion of forest based enterprises for employment generation • The 12th Plan Approach Paper (2010–2013) had the objectives of promoting forest ecosystem services through scientific and participatory management and creating employment and income generating opportunities through forest based enterprise development • The 13th Plan Approach Paper (2013/14–2015/16) supports the economic development through conservation, sustainable management, and appropriate use of forests, flora and fauna as well as biodiversity
Environment-friendly Local Governance Framework 2013	• Mainstreaming environment, climate change, disaster management in the local level planning process; encouraging coordination and collaboration in environment and development
Regulatory Frameworks—Sector-specific Acts	
National Parks and Wildlife Conservation Act 1973	• The legal foundation for the conservation and management of natural areas and wild species and empower the government to create different types of protected areas
Soil and Watershed Conservation Act 1982	• Provision of legislative measures concerning soil and water conservation to properly manage the catchment of Nepal
Forest Act 1993	• Provision for the management of community forests, leasehold forests, government managed forests, protected forests, religious forests under the category of national forests and private forests in the country
Regulatory Frameworks—Sector-related Acts	
Aquatic Animals Protection Act 1961	• Recognition of the value of wetlands and aquatic animals • Prohibition on the use of unsafe pesticides for catching aquatic life
Pasture Land Nationalization Act 1974	• Bestowing of rights over all pastureland in the country on the government and provision of compensation for such transfer of rights

Tourism Act 1978	•	The legal foundation for promoting tourism activities in the country; provision of environmental code of conduct for mountaineering activities
Seed Act 1988	•	Promotion and regulation of production and distribution of quality seed in order to increase the yields of agricultural crops
Electricity Act 1992	•	Prohibition of blocking, diverting or placing hazardous or explosive materials in rivers, streams or any water source
Water Resources Act 1992	•	Prioritization of different uses of water
	•	Development of mechanism for issuing license for different uses and compensation mechanism
Environment Protection Act 1996	•	The Act obliges proponents to prepare an initial environmental examination (IEE) and/or environmental impact assessment (EIA) report in relation to prescribed plans, programmes or projects which may cause changes in existing environmental conditions by physical and/or development activities or change in land use
Nepal Tourism Board Act 1997	•	Development of tourism business while conserving and promoting natural and cultural heritage and environment of the country
Livestock Health and Livestock Services Act 1998	•	Provision requiring government to establish temporary or permanent quarantine check posts in any area of Nepal
Local Self-Governance Act 1999	•	Empowerment of VDCs to prepare and implement programmes related to forests, vegetation, biodiversity, soil conservation and environmental conservation in the village development area
Plant Protection Act 2007	•	Prevention of the introduction, establishment, prevalence and spread of pests while importing and exporting plants and plant products, promoting trade in plants and plant products
General Acts		
Land (Survey and Measurement) Act 1963	•	Stipulation that land can be registered on the basis of an unofficial deed if it has been in the uninterrupted possession of an individual for 15 years
New Civil Code 1964	•	Prohibition of cultivation on any land which has been used since time immemorial for grazing or watering cattle, or for roads, streets, graveyards or other public uses
Land Act 1964	•	Aiming to divert "inactive" capital and labour from land to other economic sectors, bring about an equitable distribution of cultivable land, improving the standard of living of "actual tillers" who depend on land for their livelihood, and maximization of agricultural production
Land Administration Act 1967	•	Prohibition of cultivation on any land which has been used since time immemorial as a road, highway, grazing land, waterhole, public resting hut, cemetery or graveyard, and any other land area or "servitude land" which has been used for public purpose
Public Roads Act 1974	•	Empowering the government to acquire any land for construction, development and improvement of public roads, in accordance with the prevailing law related to land acquisition
Land Acquisition Act 1977	•	Authorizing the government to acquire any land, and as much land as it determines to be necessary, for public purposes, and required to pay compensation as decided by a committee
Nepal Treaties Act 1991	•	Provision that the treaties are to prevail over national legislation to the extent of the inconsistency if conflicting with the law in force
	•	When a treaty to which the government is a signatory, but which has not been ratified, acceded to, approved or accepted by parliament, creates additional obligations that require the enactment of legislation, the government must enact laws for its execution in a timely fashion
	•	Requirement that the law be enacted for the execution of the treaties

Source: Belbase and Thapa (2007), MoFSC (2014) www.lawcommission.gov.np; www.mofsc.gov.np

7.2 Nepal's commitment to major international conventions, treaties and agreements

Government of Nepal has committed itself to various international conventions, treaties and agreements for conservation and development. As a signatory, Nepal is bound to uphold the provisions by enacting national legislations to bring them into effect. The conventions, treaties and agreements to which Nepal is a party are listed in Annex XI.

7.3 Bilateral agreements within the region

There are two agreements in the field of biodiversity conservation between Nepal and China, and between Nepal and India (DNPWC 2010). These two bilateral cooperation initiatives provide basis for regional landscape 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, GoN, and the State Forestry Administration, People's Republic of China (PRC), signed on 3 June 2010, mentions commitment to implement the obligations of multilateral agreements and conventions to protect the environment and conserve biodiversity. Similarly, a resolution was signed between the Department of National Parks and Wildlife Conservation, Government of Nepal, and National Tiger Conservation Authority, Ministry of Environment and Forests, Government of India, on 29 July 2010, on transboundary conservation, as an outcome of the Fourth Nepal-India Consultative Meeting.

7.4 Enabling policy frameworks for gender inclusive conservation and development

The government's commitment to address the issues of gender and social inclusion has been reflected in the national development plans, policies, and strategies developed since 2002. There is enabling policy framework in order to promote gender and social inclusive conservation and development practices in the Nepalese natural resource management sector. For example, Nepal Forest Sector Gender Strategy Framework 2008 recognizes the need to consider gender issues and perspectives while designing and implementing any programme related to forestry (MoFSC 2008).

In addition, the community forestry strategy and community- based conservation strategies stress the need to include women and socio-economically marginalized groups in forest management, conservation programme and local development processes, and ensure they benefit from the conservation and development programme. For example, the Community Forestry Development Guideline, 2008 clearly recognizes the need for inclusion of women, Indigenous Peoples (IPs) and socially excluded groups in the selection of executive committee of CFUGs, their proportionate representation in the committee and participation in income generation activities. Besides, the guideline states the need to include women in key positions (either chairperson or secretary) (DoF 2008) and spend at least 35% of the total annual income of a CFUG for livelihoods improvement targeting poor women, Dalits, and IPs.

Likewise, conservation policies in Nepal tend to be supportive to engage local communities in natural resource management and community development. For example, the Kangchenjunga Conservation Area Management Regulation 2008 transfers roles of and responsibilities for conservation, development and use of natural resources from the state authority to the community institutions such as Conservation Area Management Council and VDC level User Committees (UC). The regulation requires the council to design and implement special programme targeting women, poor, Dalits, and Indigenous Peoples (MoFSC 2008). Similarly, the Buffer Zone Management Guideline, 1999 calls for inclusion of women in the User Committee (MoFSC 1999).

The National Biodiversity Strategy and Action Plan (2014-2020) has identified issues and challenges in addressing gender and social inclusion as: (i) gender equality and social inclusion policies are not well implemented; (ii) institutional structure capacity is weak; (iii) gender and social inclusion criteria are not included in monitoring and evaluation or in budgeting programmes; (iii) inadequacy of gender disaggregated data; and (v) inadequate conservation education and awareness (MoFSC 2014). These policy provisions in the Nepalese forestry sector with regard to consideration of women's strengths and knowledge in conservation, development and management of natural resources and local development is an important avenue for the KLCDI to experiment and promote gender sensitive conservation linked development interventions.

7.5 Inconsistencies in the statutory regime, contemporary plans and policies

The inconsistencies and gaps in the existing policies, strategies and legislations with regard to landscape conservation and development are discussed in the following sections.

I. Conflict in existing laws: The contradictions across the various legislative instruments have created a number of conflicts in claiming the rights over resources. Legal frameworks such as Forest Act, National Parks and Wildlife Conservation Act, Local Self-Governance Act contradict with each other in relation to legal provisions to sell specified natural resources and products. Likewise, they also contradict in provisions related to extraction and selling of sand, stones, and boulder from the

rivers and adjoining forest areas. Land (Survey and Measurement) Act and LSG Act also contradict to each other in terms of forest land ownership issues.

II. Policy and legislation gaps: Although most of the policies are very supportive to landscape conservation and development, the policies have not specifically addressed the issues related to the landscape level. Forest Policy, Agriculture Policy, Land Reform Policy, and other sector policies related to landscape conservation and development do not align with each other in some aspects. The existing forest policy and other conservation policies are silent on pastureland, corridor and connectivity in landscape level biodiversity conservation. Livelihood development is one of the crucial issues that has not been addressed in most of the sectoral and cross sectoral policies.

There is no explicit government policy, strategy, process that necessitates including river-affected downstream people in the conservation and management of watershed in upstream area of Churia hills. Thus, there is a need of comprehensive legal and policy framework for facilitating integrated landscape conservation and development.

III Poor integration and harmonization of policies and laws: Despite of the policy instruments in the management of collaborative forest, rangeland, wetland, and wildlife farming, these policies have not been translated into comprehensive legislation for effective implementation of the programme. Also, the Forest Act 1993 and Revised Forest Policy 2000 have different and contradictory provisions with regard to forest management strategies, particularly for the Tarai and the inner Tarai. The implementation of the Land Use Policy 2012 also requires amendment of the existing Acts and regulations with land use rights and land management. Forestry regulations are yet to be developed to regulate the flow of environmental costs and benefits of forest management.. The existing legal framework does not provide basis for payment to ecosystem services (PES).

IV. Lack of legislation to support functioning of multi-stakeholder approach: As there are several stakeholders responsible in the landscape conservation and development process, multi-stakeholders' approach is crucial factor for landscape conservation and development. Lack of legal support has hampered effective functioning of the multi-stakeholder approach. A comprehensive policy for multi-stakeholder approach would help in addressing such confusions and institutionalization of multi-stakeholder approaches

V. Gaps in the implementation of policies and legislations: Some of the contemporary policies and strategies have addressed the issues related to conservation and development but the degree of implementation is weak. For example, the climate change policy states that 80% of the climate change budget will be diverted to local components. But National Planning Commission reports that only 11% of climate budget was being shared with local components (MoE 2011, THT 5/2/2014).

Many of the policy provisions are not supported by appropriate institutional frameworks and budgetary mechanisms for effective implementation. Even the provisions stipulated in the legislations are not effectively implemented. There is a low level of awareness on policy provisions among major stakeholders. Timely assessment of relevancy and updating of legal frameworks including regulations, these directives and guidelines would enhance the effectiveness in implementation.

VI. Gaps in the implementation of international commitments: Nepal is a party to several international conventions and treaties related to natural resources, environment, wetland and biodiversity that are directly related to landscape conservation and development. However, the laws required for the fulfilment of the obligations set by these conventions have not been adequately developed. For example, ABS and CITES Bill is yet to be enacted to fulfil the obligations set by the international conventions. There should be synergy among various treaties/conventions related to the Multilateral Environmental Agreements (MEAs) for smooth implementation, and it calls for a need to generate a set of coherent guidelines to bring synergy among all the relevant MEAs.

Chapter

8 Key Issues, Gaps and Priorities

A degraded Rhododendron forest in KL Nepal

8.1 Thematic areas, issues and gaps

This section highlights key issues and gaps based on the analysis presented in the previous chapters. The major issues and gaps are listed according to the following thematic areas:

1. Socio-economy and livelihoods;
2. Biodiversity and ecosystem services;
3. Resource governance and access to genetic resources and benefit sharing;
4. Long-term socio-ecological and environmental monitoring; and
5. Enabling environment, knowledge management and regional cooperation.

Table 8.1: Thematic areas, issues and gaps in KL Nepal

Thematic areas	Issue(s)	Gap(s)
Socio-economy and livelihoods	• Weak economic and social conditions	• Inadequate resource assessment and value chain analysis of high value forest products and cash crops • Inadequate information and linkages with market and technology for local products • Inadequate alternative livelihood options • Inadequate exploration of traditional technologies
	• Emerging problems in cash crop production	• Disease infestation in large cardamom and tea
	• Sustainable tourism	• Lack of community-based tourism plan and programmes • Inadequate physical infrastructure and human resources for tourism • Lack of benefit flow from tourism to local communities
	• Gender equity and social inclusion	• Inadequate participation of women in decision-making process
	• Energy and water management	• Limited use of alternative energy • Depleting water source
	• Out-migration	• Shortage of human resource
Biodiversity and ecosystem services	• Forest degradation and habitat loss	• Inadequate scientific information on population dynamics, ecology and conservation status of threatened fauna and flora • Limited understanding on the impact of slash and burn practice and habitat loss
	• Unsustainable harvesting of plant resources, including MAPs	• Lack of information on sustainable harvesting of economically important plant species • Limited understanding on potential contribution of local and indigenous communities in conservation
	• Poaching and illegal trade of wildlife and its body parts	• Poor implementation of conservation action plan of endangered species • Inadequate monitoring of flagship species
	• Assessment of ecosystem services	• Lack of status and value of ecosystem goods and services in relation to beneficiaries
	• Inadequate inventory of biodiversity (sacred groves, wetlands, grasslands, agrobiodiversity)	• Inadequate information on biodiversity components, patterns and processes • Lack of biodiversity database
Resource governance and access to genetic resources and benefit sharing	• Growing pressure on rangeland biodiversity	• Lack of carrying capacity assessment, productivity of rangelands and stock analysis • Inconsistency in management regimes of bordering countries
	• Increasing human-wildlife conflict (including livestock and crop depredation)	• Lack of coordination, cooperation and capacity enhancement among stakeholders • Conflict due to land use rights • Inadequate transboundary cooperation and coordination in livestock management • Transboundary movement of people and their impact • Inadequate human resources and infrastructure for resource management
	• Corridor and connectivity	• Inadequate institutional interaction between researcher, technician, farmer, public and private sectors
	• *Churia* management	• Lack of integrated management plan for *Churia* • Ineffective planning and implementation of programmes in *Churia*
	• Mai Pokhari Ramsar site management	• Inadequate planning and programme implementation
	• Access to genetic resource and benefit sharing	• Absence of AGRBS bill • Lack of Plant Biodiversity Register (PBR) protocol • Ineffective efforts to resolve conflicting property rights • Inadequate data on the trade volume, channels, centres and routes • Lack of clarity of jurisdiction of resource ownership and utilization

Long-term socio-ecological and environmental monitoring	• Baseline socio-ecological data with indicators	• Inadequate and inconsistent socio-ecological data
	• Ground level environmental monitoring	• Data deficiency on lower groups of fauna and flora • Inadequate information on carbon sequestration and pollution • Lack of comparable and consistent data on land use, climate change, biodiversity (particularly lower groups of fauna and flora), tourism, cryosphere, etc.
	• Pollution	• Lack of pollution data on national and transboundary countries
	• Invasive alien species (IAS)	• Inadequate data
	• Land use land cover change, including Churia region	• Inadequate understanding of land use and land cover changes
	• Assessment of ice, snow, glaciers and watershed	• Data gap on cryosphere • Lack of monitoring of flood and landslide affected areas
	• Assessment of actual and potential impact of climate change	• Lack of assessment of vulnerability/resilience of local biodiversity
	• Awareness programmes on effects of climate change	• Inadequate initiation on LAPA (Local Adaptation Plan of Action) on climate change
	• Meteorological stations and its functioning	• Inadequate long-term climate data from high altitude regions
Enabling environment, knowledge management and regional cooperation	• Transboundary regional cooperation and coordination in natural resource management	• Inadequate institutional interaction • Inadequate harmonization of transboundary landscape management practice and policy
	• Policy on landscape planning and management	• Inadequate comprehensive policy and regulations
	• Sectoral and cross-sectoral policies and regulations	• Weak implementation of policies and legislations • Inadequate multi-stakeholders' landscape development and coordination mechanism
	• Illegal transboundary trade	• Weak institutional capacity and law enforcement to implement landscape conservation plans/programmes
	• Knowledge management	• Inadequate institutional mechanism for knowledge management

8.2 Conservation and development priorities

This section identifies conservation and development priorities based on the issues and gaps. Conservation and development priorities have been clustered according to the main thematic areas.

Development in this context should be understood as initiatives and interventions that are manageable at local level, based on management of ecosystem goods and services which contribute to attaining healthy ecosystem, livelihoods, and human well-being on a sustained manner.

8.2.1 Socio-economy and livelihoods

Several factors influence the socio-economic environment of the landscape. Poor economic and social conditions resulting from inadequate resource assessment and value chain analysis of high value forest products and cash crops, inadequate alternative livelihood options, lack of development of sustainable tourism and limited use of alternative energy are some of the issues in KL Nepal. Out-migration has resulted in lack of human resources which is also posing extra burden on women for household activities. Therefore, micro level analysis of agriculture, food sufficiency, wage, livestock development, trade, and tourism development is essential to know. Cultural/religious issues are sensitive and are also important to be considered.

Specifically, the socio-economy and livelihoods priorities identified include:

- Dissemination of information and technological advances at the farmers' level for enhancing agriculture productivity and diversification of livelihood options;
- Sustainable tourism;
- Green economy and employment: (value addition and market promotion of local and high value

products such as broom grass, large cardamom, round chilli (akabare type), dairy products, ginger, 'argeli', 'chiraito');
- Assessment of traditional knowledge systems;
- Research and development on diseases (crops and livestocks); and
- Promotion of alternative/renewable energy technologies

8.2.2 Biodiversity and ecosystem services

Forest degradation and habitat loss, unsustainable harvesting of NTFPs, poaching and illegal trade of wildlife, invasive alien species, and loss of forests, wetland and grassland habitats, and cultural and religious sites are posing serious threats to biodiversity and ecosystem services of KL Nepal. Sustainable management and conservation efforts need reliable information base at all levels of biodiversity. Ecosystem services are vital for the human well-being. However, the absence of assessment of available ecosystem goods and services does not support for sustainable planning. To address these issues, the following priority programmes are suggested:

- Preparation of comprehensive biodiversity assessment and conservation plan at all levels;
- Preparation of comprehensive conservation action plan of endangered priority species;
- Comprehensive documentation and action plan for agrobiodiversity including establishment of community based seed bank at regional level in Nepal;
- Comprehensive inventory and management of wetlands and sacred forests;
- Assessment and valuation of ecosystem services
- Monitoring and regulation of environmental pollutions; and
- Sustainable management plan for NTFPs/MAPs

8.2.3 Resource governance and access to genetic resources and benefit sharing

In resource management and use, the access and benefit sharing agendas are emerging which now have become a mandatory in research and conservation and development activities. Human-wildlife conflict is a serious issue in KL Nepal. Similarly, crop and livestock depredation by wildlife in Ilam, Panchthar, and Taplejung and human-wildlife conflict in Jhapa district has resulted into serious conflict. The dual system of resources management (the Kipat) in some parts of Ilam, Panchthar, and Taplejung, and over-grazing in high altitude rangelands are also issues. The Churia has been over exploited in terms of land use and land cover chage as well as natural resources. Social and gender inclusion issues are also vital factors of socio-economic development and livelihoods. These issues can be addressed by strengthening institutional and capacity enhancement of the management authorities. The following priority activities are proposed under this thematic area.

- Assessment of traditional/local resource governance systems;
- Strengthening capacity of stakeholders;
- Gender equity and social inclusion;
- Assessment of carrying capacity, productivity and stock analysis of rangelands;
- Effective planning and implementation of programmes in Churia and Mai Pokhari;
- Community based forest management and other forest restoration programmes;
- Strengthening transboundary coordination and cooperation among the KL member countries for resource management; and
- Monitoring along the transborder areas

8.2.4 Long-term socio-ecological and environmental monitoring

Lack of socio-ecological data, rapidly changing land use patterns, data gap on cryosphere, emerging problems of solid waste management and other pollutions, and climate change related issues need to addressed in KL Nepal. Systematic long term socio-ecological and environmental monitoring is necessary to achieve the goal of sustainable conservation and development. Similarly, comprehensive information on land use and land cover determines sustainable planning of the landscape. The programmes implemented in other parts of Nepal for climate change adaptation have not been implemented in KL Nepal districts. Therefore, the priorities should be given in following areas.

- Development of comprehensive biodiversity and environmental monitoring plan
- Development of socio-economic monitoring
- Sustainable monitoring of tourism
- Cryosphere
- Scientific and indigenous knowledge on climate change and knowledge management
- Transboundary environmental monitoring
- Detail land use and land cover assessment and planning including socio-political dimension
- Assessment of vulnerability/resilience of natural hazards, biodiversity, and society to climate change
- Extension of LAPA to KL Nepal districts

8.2.5 Enabling environment, knowledge management and regional cooperation

Although majority of the policy frameworks of Nepal are

enabling for landscape conservation and development, there are some policy and institutional development related issues that should be addressed to make policy and enabling environment more conducive for landscape level conservation and development programmes. Regional cooperation among the countries is equally important to address trandboundary issues such as illegal trade, wildlife movement, transboundary grazing, etc. Specific priority should be given to:

- Assessment of landscape conservation and development policies among partner 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; and
- Development of knowledge management centre

Bamboo resource–one of the major sources of livelihoods in KL Nepal

A stupa located near Sandakpur, Ilam district

Chapter

9 Approaches and Way Forward

A landscape as seen from Phidim Bazar, Panchthar district

Based on the assessment and analysis of physical, socio-economic, biological, resource governance and enabling environment of KL Nepal, the vision, strategic goal and outcomes have been envisaged for its conservation and development (see Figure 9.1).

I. Economic and social well-being of indigenous and local communities, especially disadvantaged groups and women in the landscape are improved

The KL region is challenging in terms of socio-economic status, including poverty, health, education, infrastructure and transboundary conditions that influence the region as a whole. The region's economic growth has been dependent on natural resources, its governance and culture. Natural environment is a major basis for socio-economic progress and resource conservation. In addition, communities in KL Nepal are engaged in regional trade across the border (with China and India). But, the political changes in China during 1960s have brought changes in economic activity too. Currently, the region's economic and social well-being is related largely to sustainable crop and livestock productivity, niche forest products (both timber and non-timber), tourism and hydropower development.

Human well-being needs multiple constituents for social and economic well-being. Conservation and sustainable development of ecosystems provide basic material for a good life, such as secure and adequate livelihoods, enough food at all times, shelter, clothing, and access to goods as well as access to natural and other resources (MEA 2005). The MEA examines how

changes in ecosystem services influence human well-being (MEA 2003).

Natural environment can provide significant opportunities for maintaining conservation and culture, and enhance employment opportunities, raise living standard of local communities; however, conservation and development are not always in harmony. A major outcome of the initiative will be improving sustainable economic and social well-being of the indigenous and local communities of the landscape. There is increasing community-wide recognition of indigenous knowledge and its role in conservation of natural resources and biodiversity.

This outcome comprises two major strategies: (i) income generation through value addition of cash crops, livestock, and fish production enhanced; and (ii) livelihood of local, indigenous and marginalized communities including women improved and diversified.

II. Ecosystem structure and functions are conserved

Ecosystem services are essential for human well-being and sustainable development. Natural habitats, both within and outside protected areas are able to retain ecosystem structures that keep functioning and providing ecosystem services sustainably. Protected areas (National Parks, Conservation Areas), in particular, play a key role in buffering natural system and climate change including species conservation and habitat management.

Over the past 50 years, humans have changed ecosystems globally more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber, and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth (MEA 2005).

The vision of Strategic Plan for Biodiversity 2011–2020 and the Aichi Targets have been to value, conserve, restore and wisely use biodiversity by 2050, maintaining ecosystem functions and services, sustaining a healthy planet and delivering benefits essential for all people in the face of growing pressure, including from climate change. The Mission of Aichi Biodiversity Targets, among others, has been to take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services.

Knowledge gaps in ecosystem structure and functions, in particular for KL Nepal, suggest that we need to develop strategies to maintain and improve ecosystems. This outcome comprises strategies such as: (i) management and valuation of ecosystems, including agrobiodiversity within protected area system (PAs) and outside PAs, biological corridors and connectivity; and (ii) adaptation to and mitigation of impacts of climate change and management of potential environmental pollution, risks and hazards on ecosystems.

III. Participatory resource governance and equitable access to natural resources and benefit sharing are improved

Local governance, in many instances, leads to failures in managing the global commons. Problems like over-exploitation of resources grow worse, and environmental problems intensify at global, regional and national levels. However, communities have realized that they can manage their local resources through developing networks among communities, to better manage the global commons.

Improved resource governance, the protection, restoration, and enhancement of natural resources, and management of high altitude forests tend to have multiple and synergistic benefits. Development of mechanism toward sustainable management of biological resources, with access to genetic resources and benefit sharing with indigenous peoples' and local communities need to be effectively mainstreamed. Sharing good solutions and discarding poor ones eventually improves approaches to a variety of social and environmental problems, ranging from poverty to human-wildlife conflict, and access to genetic resources and benefit sharing (MEA 2003). As more knowledge is collected from successes and failures, provision of many services improves and where, there are, mutually beneficial opportunities for coordination within the country and across transboundary countries.

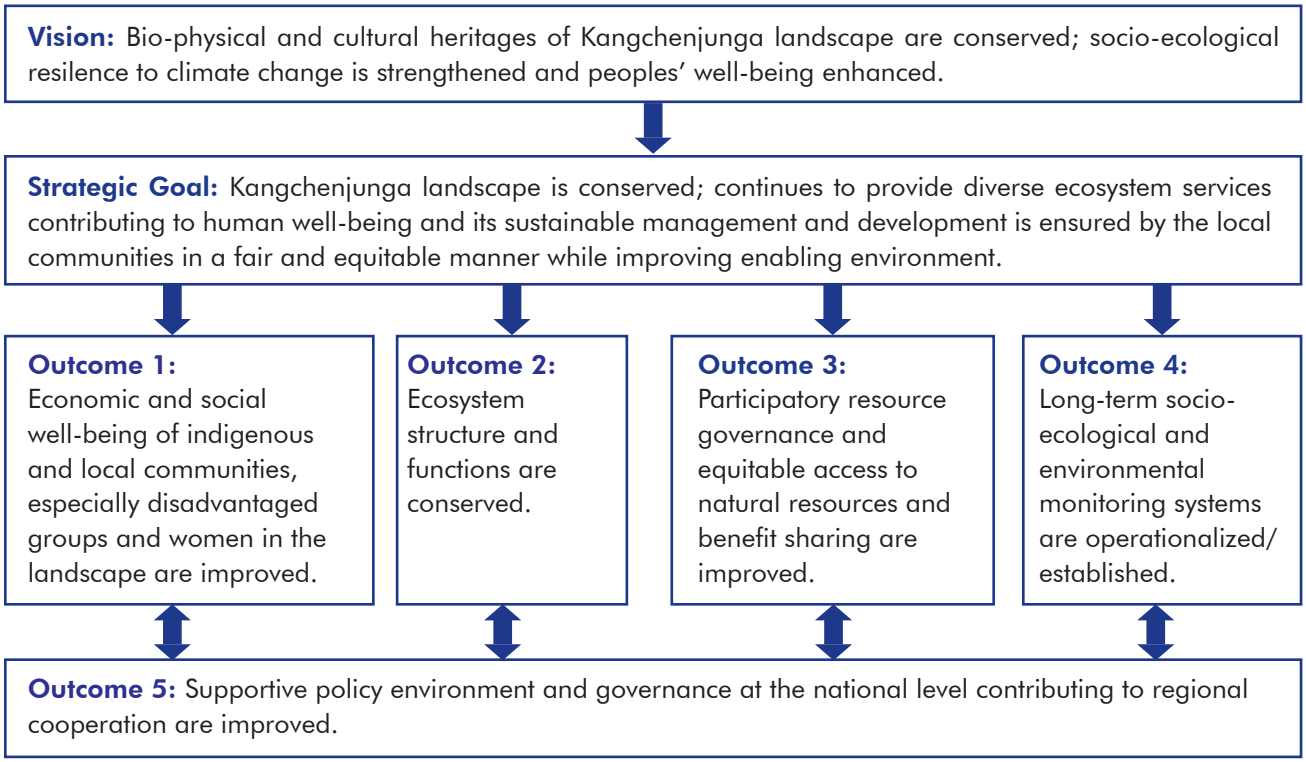
The 13th Plan of Nepal has also given an emphasis for maintaining good governance in the forestry sector (GoN/NPC 2013). The GoN also recognizes the contribution of private sector in the process of development to more effective management of these basic life-support systems.

The outcome comprises following strategies: (i) development of mechanisms for ABS through participatory resource governance and mainstreaming GESI in conservation and development; and (ii) strengthening capacity of stakeholders.

IV. Long-term socio-ecological and environmental monitoring systems at national and regional levels are operationalized/established

Although all countries have considerable information on the production of crops, timber and water resources, relatively little is known about the actual socio-economic and environmental conditions.

Figure 9.1: Vision, strategic goal and outcomes envisaged for KL Nepal



Given the lack of monitoring process and scientific data about ecosystems, traditional ecological knowledge may well make valuable contributions to the development of modern management strategies at the landscape level. Indigenous institutions of ecosystem management (mainly social and judicial institutions and religious beliefs, norms, and practices) have also largely disappeared (MEA 2005). It has been realized recently that there is need to integrate indigenous ecological knowledge into ecosystem assessments and into developing resource management plans (Agrawal 1995) for resilience of ecosystem. Ecosystem resilience is capacity to adapt to changes and disturbances while maintaining the same basic function, structure and interactions, especially in a changing environment.

Monitoring and indicator-based assessments need to be developed and implemented in KL Nepal to address whether actions or policies are effectively implemented; whether they achieved their intended results; and whether new factors have arisen, in which the entire process is evaluated and structured.

The strategies to achieve this outcome include: (i) strengthening/establishing long-term monitoring of socio-ecological and environmental processes at national and tranboundary levels; and (ii) strengthening knowledge management, information sharing and dissemination mechanism.

V. Supportive policy environment and governance at the national level contributing to regional cooperation improved

Nepal has committed to the conservation and development related agreements before the international community by signing or becoming a party to a number of Multilateral Environmental Agreements (MEAs). The MEAs provide important opportunities as well as bring obligations to the country. MEAs can also help improve environmental governance within the country and improve and harmonize relevant policies and legislations, both at national and regional perspectives. More importantly, however, they can help enhance national capacity for setting conservation agenda and its implementation.

The Government of Nepal and other governments in the region have made considerable efforts and achieved successes in the implementation of some of its international commitments, including those related to the CBD (1992), Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973), Convention on Wetlands of International Importance - Ramsar Convention (1971), World Heritage Convention (1972), and International Treaty on Plant Genetic Resources for Food and Agriculture (2001). The country has also been participating in the Global Tiger Forum

and Global Tiger Initiatives. There are, however, some gaps in implementation of international conventions. For example, Nepal is yet to ratify the Cartagena Protocol on Biosafety (2001), and Nagoya Protocol on Access to Genetic Resources and Benefit Sharing (2010). Effective management of ecosystems/natural resources at KL Nepal will require actions at all scales, in the country and across the transborder countries- India and Bhutan. The 13th Plan (GoN/NPC 2013) calls for creating a supportive environment for the conservation and development of the forestry and other natural resources management sectors.

The strategies for supportive environment and governance at the national level contributing to regional cooperation are: (i) formulation and assessment of policies/strategies/legal frameworks for landscape level conservation and development at national level; and (ii) strengthening transboundary cooperation among partner countries.

Way Forward

Conservation and development of KL Nepal requires a holistic approach to conserve, use, enhance and manage physical, biological and cultural resources of the landscape. A strong mechanism to establish coordination among the governmental, non-governmental, civil society organizations, private sector and other stakeholders for effective and sustainable management of KL Nepal is needed. A few important approaches are essential to be considered as way forward.

(i) Landscape in transition

People of Kangchenjunga landscape have historically and culturally established close linkages with neighbouring countries, such as India and China, as well as Bhutan. In the past, a large part of population directly or indirectly were dependent on the transborder trade with China and India. Political cessation of trade with TAR of China since 1960s brought significant socio-economic and environmental impacts as well as transhumance practice, although a part of trade across TAR still continues informally.

People of KL Nepal still hold close linkages in terms of socio-economic, cultural and linguistic aspects with India and Bhutan; since Nepali language is a *lingua-franca* of the Kangchenjunga landscape.

Various types of development activities that include intensification of tea cultivation, commercialization of large cardamom as agroforestry, increasing tourism, establishment of small and medium enterprises particularly dairy and paper industries have brought changes in the landscape. Further, extension of road network (north-south as well as east-west), migration of rural population to urban areas as well as temporary out-migration have shown transition of the landscape. Road network has also intensified harvesting of NTFPs, including high value MAPs leading to unsustainable harvesting of selected plant resources as well as illegal wildlife hunting.

Shortage of water resources for drinking and irrigation purposes, and several micro-hydropower dam construction in Kabeli and Mai Rivers have been observed. Climate change has led to the shrinkage of glaciers. KL Nepal, therefore, is experiencing evidences of transition and its sustainability requires conservation and development trade-off.

(ii) Conservation and development trade-off

The landscape is extremely diverse in terms of bio-physical and cultural aspects, thereby posing challenges for conservation targets.

Climate change accompanied by land use and land cover changes particularly along the wide altitudinal/climatic range that prevail in the landscape tend to manifest at different scales.

The resources and their linkage with human needs at spatial scale and aspirations of people is still at a very low level of understanding. While analysing conservation and development imperatives for the landscape, the key issue would be to effectively implement development programmes in the service of conservation. In this context, the important challenges related to conservation and development are to address on-going processes and mainstreaming plans into national programmes.

Bringing sustainable conservation and development during the verge of transition of KL Nepal landscape requires trade offs, in particular among land use and land cover changes, agricultural pattern, indigenous knowledge and practices, strengthening customary institutions, erosion of traditional genetic resources, convergence and synergy in strategic approach, adoption of conservation alternatives incorporating climate change adaptation and mitigation dimensions, and developing a functional network of institutions.

(iii) Knowledge management

Bio-physical and cultural heritage of the landscape is very heterogeneous. It has been essential to understand that sustainable conservation and development strategies of the landscape need to be based on the scientifically sound decision system that integrates data generated through standard assessment, and analysis and monitoring

protocols (GBPIHED 2012) as well as from diverse sectors of social, economic, cultural and environmental conditions.

Knowledge status of natural resources (including ecosystem services, biodiversity, land use and water) are far from complete for the region requiring adequate inventory to be conducted. Long-term socio-ecological and environmental monitoring programme would greatly help in addressing information data gaps and support landscape level conservation and development planning to help policy and decision makers, and planners.

(iv) Emerging opportunities

The feasibility assessment of KL Nepal and casual observation (field visits) tell us that some current trends present challenges for the future. Wherever the challenges exist, there are opportunities too. Key emerging opportunities include:

a. **Generating scientific knowledge on climate change**: The current knowledge for the prediction of climate change impacts on peoples' livelihood, biodiversity, including species of narrow range, cryosphere, water resources, etc. is inadequate. Long-term environmental monitoring need to be established at different spatial scales across landscape through scientific research.
b. **Facilitating tranboundary knowledge and data sharing:** There is a weak transboundary link with programmes/projects that requires regional approach to successfully implement and monitor programmes across the national boundary. Kangchenjunga is a transboundary landscape programme shared by Bhutan, India and Nepal. Effective coordination in generating and sharing data is required to implement conservation and monitoring plans.
c. **Transboundary environmental monitoring:** Transboundary issues are varied; and most obvious cross-border issues include illegal hunting and trade, transhumance, movement of wildlife across the border, tourism, pollution, etc. Landscape approach has been felt important to environmental monitoring, in particular at the transboundary scale (Sharma et al. 2007).
d. **Tourism promotion:** Tourism based on nature and culture is becoming increasingly popular among the three neighbouring countries–Bhutan, India and Nepal. KL Nepal with unexplored natural environment and cultural heritage has great potential to benefit from tourism. Ecotourism incomes should be used to support the conservation of bio-cultural diversity and enhance the socio-economic status of local communities through social equity, as adopted in the case of Annapurna Conservation Area, Nepal (Chaudhary 2009). The tourism sector may develop as the major industry in future. Demands for home stay in the villages and variety of hotels, lodges and restaurants are likely to increase. Potentials also exist for developing opportunities such as mountaineering, rafting, wildlife viewing, bird watching, etc. International, regional and domestic visitors are likely to increase once the services and facilities are developed in KL region.
e. **Ecosystem services: Upstream-downstream linkage:** The river basins include the Mai-Kankai and Kabeli, and a part of Tamur river basin in KL Nepal. The Nepalese parts of the river basins are also linked with India. The field assessment has revealed that the local communities along the border areas in Bhutan, India and Nepal are heavily interdependent for ecosystem services, biological resources, cultural relationship, employment and trade over centuries.

Jamunkhadi wetland located in Jhapa district

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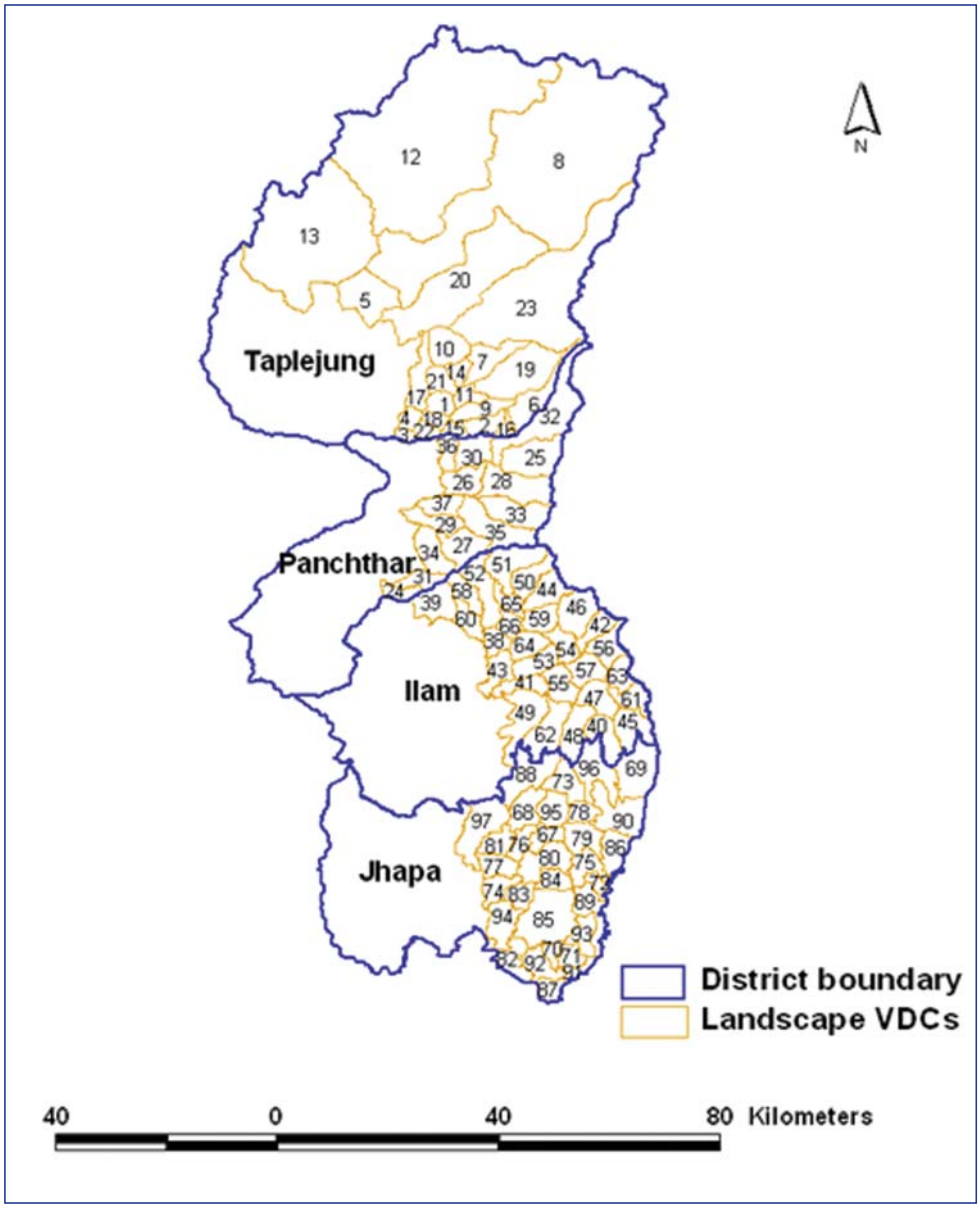
Annexes

ANNEX I: KANGCHENJUNGA LANDSCAPE NEPAL VDCs AND MUNICIPALITIES



District	VDC	VDC ID	Area (km²)
Taplejung	Ambegudin	1	16.48
Taplejung	Angkhop	2	20.84
Taplejung	Chaksibote	3	6.76
Taplejung	Dumrise	4	11.81
Taplejung	Ikhabu	5	61.22
Taplejung	Kalikhola	6	42.15
Taplejung	Khebang	7	37.49
Taplejung	Lelep	8	805.15
Taplejung	Limbudin	9	25.12
Taplejung	Mamangkhe	10	37.03
Taplejung	Mehele	11	14.28
Taplejung	Olangchung Gola	12	698.75
Taplejung	Papung	13	365.01
Taplejung	Pedang	14	13.12
Taplejung	Sablakhu	15	9.80
Taplejung	Sadewa	16	8.35
Taplejung	Sikaicha	17	33.58
Taplejung	Sinam	18	10.07
Taplejung	Surumkhim	19	84.61
Taplejung	Tapethok	20	218.99
Taplejung	Tellok	21	18.74
Taplejung	Thumbedin	22	10.97
Taplejung	Yamphudin	23	312.59
Panchthar	Chilingdin	24	14.19
Panchthar	Chyangthapu	25	56.84
Panchthar	Ektin	26	31.27
Panchthar	Lungrupa	27	38.72
Panchthar	Memeng	28	58.46
Panchthar	Nagin	29	25.91
Panchthar	Oyam	30	29.90
Panchthar	Pauwasartap	31	19.62
Panchthar	Phalaicha	32	84.62
Panchthar	Prangbung	33	46.31
Panchthar	Ranitar	34	35.02
Panchthar	Sidin	35	58.54
Panchthar	Tharpu	36	17.30
Panchthar	Yangnam	37	22.52
Ilam	Barbote	38	16.65
Ilam	Chamaita	39	35.13
Ilam	Erautar	40	32.19
Ilam	Godak	41	21.82
Ilam	Gorkhe	42	22.13
Ilam	Ilam municipality	43	26.61
Ilam	Jamuna	44	30.70
Ilam	Jirmale	45	37.67
Ilam	Jogmai	46	40.70
Ilam	Kanyam	47	29.72
Ilam	Kolbung	48	37.09
Ilam	Laxmipur	49	56.24
Ilam	Mabu	50	29.18
Ilam	Maimajhuwa	51	46.62
Ilam	Maipokhari	52	41.24
Ilam	Namsaling	53	27.62
Ilam	Nayabajar	54	21.73
Ilam	Paanchakanya	55	28.36
Ilam	Pashupati Nagar	56	28.39
Ilam	Phikkal	57	27.44
Ilam	Puwa Maimajhuwa	58	21.26
Ilam	Pyang	59	23.65
Ilam	Sakhejung	60	20.52
Ilam	Samalbung	61	23.97
Ilam	Shantipur	62	47.43
Ilam	Shree Antu	63	21.08
Ilam	Soyang	64	24.51
Ilam	Sulubung	65	14.52
Ilam	Sumbek	66	15.24
Jhapa	Anarmani	67	18.39
Jhapa	Arjundhara	68	31.12
Jhapa	Bahundangi	69	57.26
Jhapa	Balubadi	70	10.85
Jhapa	Baniyani	71	15.16
Jhapa	Bhadrapur municipality	72	10.56
Jhapa	Budhabare	73	31.19
Jhapa	Chakchaki	74	21.89
Jhapa	Chandragadhi	75	25.55
Jhapa	Charpani	76	17.41
Jhapa	Dangibari	77	22.98
Jhapa	Dhaijan	78	16.49
Jhapa	Duwagadhi	79	31.33
Jhapa	Garamani	80	42.12
Jhapa	Ghailadubba	81	21.66
Jhapa	Gherabari	82	30.60
Jhapa	Goldhap	83	17.99
Jhapa	Haldibari	84	18.52
Jhapa	Jalthal	85	80.33
Jhapa	Jyamirgadhi	86	30.99
Jhapa	Kechana	87	15.89
Jhapa	Khudunabari	88	51.04
Jhapa	Maheshpur	89	36.02
Jhapa	Mechinagar municipality	90	55.69
Jhapa	Pathamari	91	11.34
Jhapa	Pathariya	92	25.35
Jhapa	Prithvinagar	93	23.22
Jhapa	Rajgadh	94	35.11
Jhapa	Sanischare	95	27.23
Jhapa	Shantinagar	96	48.24
Jhapa	Surunga	97	57.10

ANNEX II: SOCIO-ECONOMIC FEATURES OF KANGCHENJUNGA LANDSCAPE NEPAL VDCs AND MUNICIPALITIES BASED

SN	VDC/Municipality	Total HH	Average HH size	Population			Population density	Sex ratio	Average annual growth rate	Absentee Population				Poverty percentage
				Male	Female	Total				HH	Male	Female	Total	
Taplejung														
1.	Ambegudin	625	4.77	1,442	1,537	2,979	180.73	93.82	-0.13	182	203	15	218	26.50
2.	Angkhop	451	5.20	1,122	1,224	2,346	112.55	91.67	-0.76	134	167	29	196	28.63
3.	Chaksibote	191	4.75	425	483	908	134.34	87.99	-1.75	61	70	12	82	28.75
4.	Dummrise	324	4.81	729	830	1,559	132.05	87.83	-2.13	138	186	18	204	28.75
5.	Ekhabu	396	5.13	971	1,061	2,032	33.19	91.52	-1.34	75	85	5	90	23.35
6.	Kalikhola	118	5.33	303	326	629	14.92	92.94	-1.38	27	32	0	32	28.63
7.	Khebang	526	5.12	1,283	1,408	2,691	71.77	91.12	-1.15	153	182	2	184	24.87
8.	Lelep	511	4.32	1,122	1,083	2,205	2.74	103.60	-0.49	116	110	47	157	24.87
9.	Limbudin	356	5.15	841	991	1,832	72.94	84.86	-1.98	130	162	3	165	26.93
10.	Mamangkhe	240	4.73	519	616	1,135	30.65	84.25	-1.70	65	74	4	78	24.87
11.	Mehele	463	5.09	1,148	1,209	2,357	165.07	94.95	-0.03	132	152	6	158	26.50
12.	Olangchung Gola	62	3.85	127	112	239	0.34	113.39	-1.25	7	9	6	15	23.35
13.	Papung	316	5.13	794	827	1,621	4.44	96.01	0.32	74	92	19	111	29.30
14.	Pedang	344	4.94	815	886	1,701	129.67	91.99	-0.77	105	117	3	120	26.50
15.	Sablakhu	432	4.94	997	1,136	2,133	217.59	87.76	-1.47	134	161	16	177	26.93
16.	Sadewa	211	4.97	515	533	1,048	125.53	96.62	-0.86	48	57	2	59	28.63
17.	Sikaicha	417	5.40	1,066	1,184	2,250	67.01	90.03	-1.01	139	167	22	189	26.50
18.	Sinam	461	4.54	977	1,116	2,093	207.84	87.54	-0.53	119	137	8	145	26.93
19.	Surumkhim	339	5.17	851	903	1,754	20.73	94.24	-0.82	68	73	8	81	24.87
20.	Tapethok	322	4.53	719	741	1,460	6.67	97.03	-0.55	69	75	4	79	23.35
21.	Tellok	449	4.96	1,013	1,214	2,227	118.81	83.44	-0.52	139	168	9	177	26.50
22.	Thumbedin	454	4.99	1,076	1,191	2,267	206.61	90.34	-1.41	153	177	13	190	26.93
23.	Yamphudin	165	4.42	367	363	730	2.34	101.10	-0.92	41	46	3	49	24.87
	Sub-total	**8,173**	**4.92**	**19,222**	**20,974**	**40,196**	**14.04**	**91.65**	**-0.94**	**2,309**	**2,702**	**254**	**2,956**	

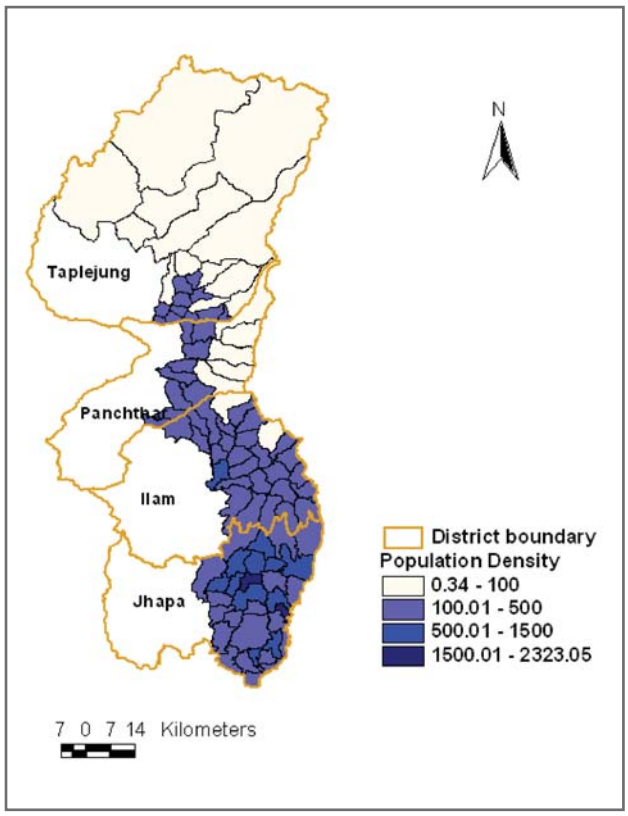
Panchthar														
24.	Chilingdin	799	4.57	1,706	1,944	3,650	257.28	87.76	-0.68	252	294	31	325	10.05
25.	Chyangthapu	494	4.60	1,073	1,199	2,272	39.97	89.49	-1.46	182	229	36	265	9.97
26.	Ekteen	1,190	4.43	2,461	2,810	5,271	168.57	87.58	-0.49	171	210	18	228	9.98
27.	Lungrupa	1,090	4.97	2,552	2,860	5,412	139.77	89.23	-0.20	333	385	37	422	10.45
28.	Memeng	984	4.73	2,247	2,407	4,654	79.61	93.35	-1.15	294	378	26	404	10.59
29.	Nagin	1,388	4.84	3,114	3,598	6,712	259.05	86.55	0.07	507	596	24	620	10.96
30.	Oyam	766	5.08	1,876	2,015	3,891	130.13	93.10	-0.61	249	289	24	313	9.97
31.	Pauwa Sartap	939	4.62	1,961	2,377	4,338	221.05	82.50	0.04	380	464	31	495	10.05
32.	Phalaicha	652	5.00	1,587	1,674	3,261	38.54	94.80	-0.83	186	235	21	256	9.97
33.	Prangbung	893	4.92	2,097	2,293	4,390	94.80	91.45	-0.43	305	383	82	465	10.59
34.	Ranitar	1,500	4.71	3,345	3,720	7,065	201.75	89.92	-0.32	494	577	38	615	6.51
35.	Sidin	885	5.18	2,150	2,438	4,588	78.37	88.19	-0.23	330	383	28	411	9.98
36.	Tharpu	1,036	4.55	2,212	2,504	4,716	272.66	88.34	-0.55	389	460	37	497	7.25
37.	Yangnam	1,232	4.69	2,608	3,167	5,775	256.41	82.35	0.50	424	475	37	512	10.69
	Sub-total	**13,848**	**4.77**	**30,989**	**35,006**	**65,995**	**122.39**	**88.52**	**-0.39**	**4,496**	**5,358**	**470**	**5,828**	
Ilam														
38.	Barbote	1,414	4.54	3,227	3,197	6,424	385.85	100.94	0.95	278	268	62	330	4.34
39.	Chamaita	1,230	4.79	2,830	3,061	5,891	167.67	92.45	-0.51	344	393	50	443	5.94
40.	Erautar	956	4.53	2,118	2,216	4,334	134.62	95.58	0.02	221	225	46	271	6.54
41.	Godak	1,137	4.38	2,451	2,527	4,978	228.11	96.99	0.82	315	368	105	473	4.97
42.	Gorkhe	1,122	4.31	2,391	2,450	4,841	218.76	97.59	-0.70	315	368	105	473	3.50
43.	Ilam Muncipality	4,732	3.94	8,946	9,687	18,633	700.11	92.35	1.48	889	958	162	1120	11.25
44.	Jamuna	777	4.12	1,523	1,677	3,200	104.24	90.82	-1.19	336	409	68	477	5.82
45.	Jirmale	1,069	4.41	2,376	2,342	4,718	125.26	101.45	0.00	247	260	62	322	6.54
46.	Jogmai	726	4.71	1,758	1,664	3,422	84.08	105.65	3.89	123	134	28	162	7.50
47.	Kanyam	1,715	4.25	3,596	3,694	7,290	245.29	97.35	0.14	317	341	47	388	2.89
48.	Kolbung	1,134	4.34	2,423	2,502	4,925	132.78	96.84	0.22	209	213	36	249	5.42
49.	Laxmipur	2,035	4.52	4,455	4,748	9,203	163.63	93.83	0.20	486	539	53	592	8.25
50.	Mabu	734	4.29	1,495	1,654	3,149	107.90	90.39	-0.64	293	388	56	444	5.49
51.	Maimajhuwa	758	4.58	1,745	1,724	3,469	74.41	101.22	-0.58	287	351	47	398	5.49
52.	Maipokhari	931	4.67	2,113	2,235	4,348	105.43	94.54	-0.22	301	354	50	404	6.20
53.	Namsaling	1,299	4.43	2,778	2,974	5,752	208.22	93.41	-0.51	269	305	22	327	5.36

54.	Naya Bazar	1,090	4.35	2,355	2,388	4,743	218.32	98.62	-0.06	227	271	33	304	7.50
55.	Paanchakanya	1,911	4.44	4,127	4,359	8,486	299.27	94.68	0.41	362	376	57	433	4.97
56.	Pasupati Nagar	1,,980	4.18	4,042	4,229	8,271	291.30	95.58	0.43	384	412	113	525	1.90
57.	Phikkal	2691	4.19	5,568	5,696	11,264	410.43	97.75	1.20	480	478	125	603	3.07
58.	Puwa Maimajuwa	634	4.62	1,386	1,541	2,927	137.65	89.94	-0.31	187	207	20	227	5.97
59.	Pyang	604	4.56	1,331	1,424	2,755	116.50	93.47	-0.45	153	197	38	235	8.44
60.	Sakhejung	932	4.34	1,917	2,128	4,045	197.08	90.08	0.70	226	234	38	272	4.24
61.	Samalbung	1,099	4.23	2,341	2,311	4,652	194.05	101.30	-0.27	222	249	50	299	5.15
62.	Shantipur	1,192	4.33	2,472	2,686	5,158	108.75	92.03	0.07	332	365	36	401	7.36
63.	Shree Antu	1,086	4.26	2,276	2,350	4,626	219.46	96.85	0.39	154	181	57	238	4.24
64.	Soyang	1,064	4.59	2,404	2,485	4,889	199.44	96.74	-0.51	248	277	32	309	7.70
65.	Sulubung	799	4.49	1,721	1,863	3,584	246.80	92.38	0.33	198	230	8	238	5.82
66.	Sumbek	591	4.34	1,233	1,330	2,563	168.17	92.71	0.00	143	163	10	173	5.82
	Sub-total	**37,442**	**4.34**	**79,398**	**83,142**	**162,540**	**191.35**	**95.50**	**0.29**	**8,546**	**9,514**	**1,616**	**11,130**	
Jhapa														
67.	Anarmani	10,235	4.17	20,892	21,820	42,712	2,323.05	95.75	5.39	2,223	2,407	534	2,941	1.56
68.	Arjundhara	4,560	4.41	9,466	10,637	20,103	645.89	88.99	2.43	1,551	1,740	299	2,039	4.77
69.	Bahundangi	5,479	4.35	11,105	12,717	23,822	416.00	87.32	0.40	2,233	2,643	530	3,173	4.75
70.	Balubadi	1,246	4.44	2,632	2,903	5,535	510.24	90.66	4.17	428	496	52	548	12.46
71.	Baniyani	1,444	4.47	3,043	3,415	6,458	426.09	89.11	22.21	476	583	75	658	11.99
72.	Bhadrapur Municip.	4,248	4.28	8,880	9,284	18,164	1,720.81	95.65	0.01	747	822	223	1,045	13.52
73.	Budhabare	5,270	4.35	10,938	11,998	22,936	735.36	91.17	1.62	1,733	1,926	345	2,271	2.97
74.	Chakchaki	2,196	4.65	4,716	5,486	10,202	465.95	85.96	0.54	835	1,014	85	1,099	14.46
75.	Chandragadhi	4,514	4.20	9,013	9,936	18,949	741.67	90.71	1.80	952	1,082	225	1,307	6.76
76.	Charpane	4,158	4.20	8,498	8,964	17,462	1,003.26	94.80	4.89	964	1,092	215	1,307	2.56
77.	Dangibari	1,758	4.41	3,581	4,180	7,761	337.67	85.67	0.39	725	894	98	992	8.91
78.	Dhaijan	2,204	4.46	4,544	5,276	9,820	595.60	86.13	1.89	1,518	1,853	298	2,151	4.56
79.	Duwagadhi	2,591	4.13	4,994	5,703	10,697	341.46	87.57	2.34	790	906	168	1,074	3.74
80.	Garamani	4,725	4.59	10,358	11,346	21,704	515.31	91.29	1.72	1,482	1,688	349	2,037	6.64
81.	Ghailadubba	2,969	4.27	5,924	6,747	12,671	584.89	87.80	1.33	1,075	1,172	225	1,397	7.35
82.	Gherabari	1,480	4.71	3,312	3,666	6,978	228.04	90.34	1.10	313	375	25	400	30.13
83.	Goldhap	1,701	4.50	3,509	4,141	7,650	425.17	84.74	0.22	776	973	178	1,151	12.46
84.	Haldibari	1,792	4.42	3,721	4,199	7,920	427.72	88.62	0.54	508	563	72	635	10.81

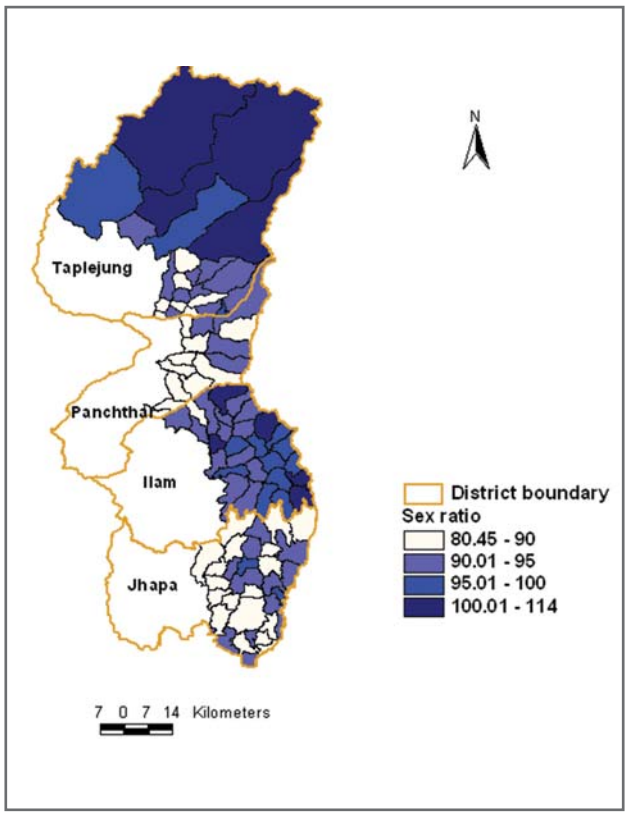
85.	Jalthal	2,922	4.57	6,090	7,273	13,363	166.35	83.73	0.18	1,389	1,720	182	1,902	11.70
86.	Jyamirgadhi	2,076	4.75	4,765	5,088	9,853	317.90	93.65	1.53	532	635	91	726	14.13
87.	Kechana	1,284	4.64	2,850	3,107	5,957	374.97	91.73	1.11	308	395	11	406	26.96
88.	Khudunabari	3,457	4.35	7,011	8,020	15,031	294.49	87.42	0.06	1,293	1,454	232	1,686	5.91
89.	Maheshpur	2,853	4.60	6,251	6,885	13,136	364.66	90.79	0.29	863	998	198	1,196	13.33
90.	Mechinagar Municipalty	13,181	4.37	27,588	29,957	57,545	1,033.35	92.09	1.73	3,629	4,059	992	5,051	22.24
91.	Pathamari	955	4.56	2,049	2,309	4,358	384.28	88.74	6.11	266	374	20	394	26.96
92.	Pathariya	2,333	4.39	4,821	5,431	10,252	404.48	88.77	0.29	662	822	66	888	11.70
93.	Prithivinagar	3,655	4.18	6,814	8,470	15,284	658.16	80.45	5.47	1,973	2,364	488	2,852	4.33
94.	Rajgadh	3,444	4.56	7,413	8,277	15,690	446.93	89.56	0.22	1,113	1,327	129	1,456	18.77
95.	Sanischare	5,606	4.47	11,948	13,123	25,071	920.67	91.05	2.35	2,636	3,022	578	3,600	4.34
96.	Shantinagar	4,228	4.41	8,704	9,945	18,649	386.60	87.52	0.70	1,637	1,848	302	2,150	6.94
97.	Surunga	6,457	4.25	12,612	14,858	27,470	481.05	84.88	2.71	2,561	2,927	476	3,403	5.92
	Sub-total	**115,021**	**4.37**	**238,042**	**265,161**	**503,203**	**536.11**	**89.77**	**1.85**	**38,191**	**44,174**	**7,761**	**51,935**	
	Grand Total	**174,484**	**4.42**	**367,651**	**404,283**	**771,934**	**148.73**	**90.94**	**1.10**	**53,542**	**61,748**	**10,101**	**71,849**	

Source: CBS (2012b, 2013)

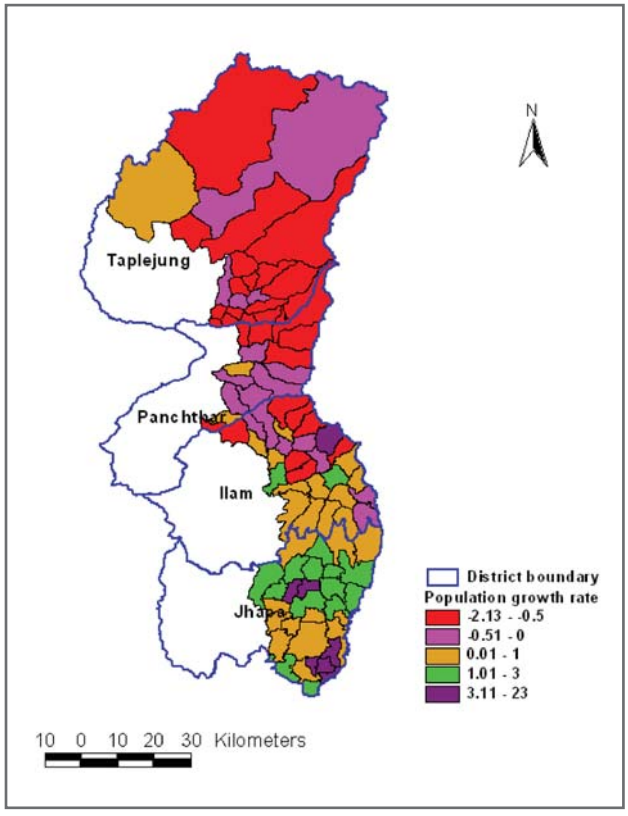
ANNEX III: DEMOGRAPHIC FEATURES OF KANGCHENJUNGA LANDSCAPE NEPAL DISTRICTS



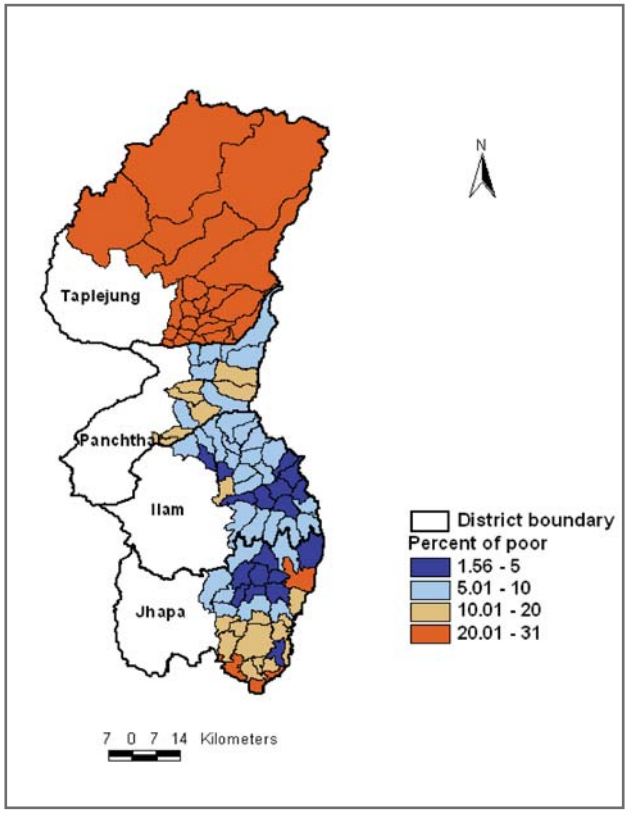
Population density in KL Nepal



Sex ratio in KL Nepal



Population growth rate in KL Nepal



Distribution of poverty in KL Nepal

ANNEX IV: FOREST TYPES IN KANGCHENJUNGA LANDSCAPE NEPAL

SN	Forest types	Associated species	Elevation (m)	Location
1.	Sal forest	*Shorea robusta, Lagerstroemia parviflora, Terminalia belirica, T. chebula*	62–700	Jalthal–Bahundangi forest (Jhapa)
2.	Tropical deciduous riverain forest	*Bombax ceiba, Adina cordifolia, Mallotus philippinensis, Cycas pectinata, Dillenia pentagyna*	80–600	Jhapa –Lower Ilam
3.	Tropical evergreen forest	*Duabanga sonneratioides, Toona ciliata, Pandanus furcatus*	100–300	Jhapa
5.	Subtropical evergreen forest	*Schima wallichii, Castanopsis tribuloides, Macaranga pustulata*	1,100–1,700	Tapethok–Hellok; Yamphudin–Mamankhe (Taplejung)
6.	Khair-Sisoo forest	*Acacia catechu, Dalbergia sisoo, Colebrookea oppositifolia, Pogostemon benghalensis*	200–1,200	Jhapa – Lower Ilam
7.	*Schima-Castanopsis* forest	*Schima wallichii, Castanopsis indica, Castanopsis tribuloides, Michelia champaca, Macaranga pustulata*	600–2,000	Lower part of Ilam, Panchthar, Taplejung
8.	*Quercus incana-Quercus lanuginosa* forest	*Quercus incana, Quercus lanuginosa, Rhododendron arboreum, Lyonia ovalifolia*	1,200–2,600	Mid hills of Ilam, Panchthar and Taplejung
9.	Lower temperate mixed broad-leaved forest	*Machillus odoratissima, Lindera* species, *Litsea* species, *Castanopsis* species	1,500–2,200	Dabale Deurali, Chintapu (Ilam); Mamankhe–Yamhudin (Taplejung)
10.	Alnus woods (*Alnus nepalensis* forest)	*Alnus nepalensis, Betula alnoides, Populus ciliata, Prinsepia utilis*	1,500–3,000	Mid hills of Ilam, Panchthar, and Taplejung
11.	*Castanopsis tribuloides- C. hystrix* forest	*Castanopsis hystrix, C. tribuloides, Eurya acuminata, Quercus* species	1,800–2,200	Hangetham, Jamuna (Ilam)
12.	*Quercus lamellosa* forest	*Quercus lamellosa, Q. semecarpifolia, Castanopsis tribuloides, Ilex dipyrena*	2,000–2,600	Gairibas khola, Jamuna (Ilam)
13.	*Quercus semecarpifolia* forest	*Quercus semecarpifolia, Abies spectabilis, Betula utilis, Lithocarpus pachyphylla*	2,200–3,000	Hangetham, Jamuna - Gairibas, Ramite, Jogmai (Ilam) ; Amjelassa–Thangyang (Taplejung)
14.	*Lithocarpus pachyphylla* forest	*Lithocarpus pachyphylla, Quercus semecarpifolia, Q. lamellosa, Litsea* species, *Lyonia ovalifolia, Viburnum erubescens*	2,300–2,500	Goruaale, Chhintapu Maimajhuwa, Dobate, Mabu, Hangetham Jamuna (Ilam), Amje Khola (Taplejung)
15.	Rhododendron forest	*Rhododendron arboreum, Eurya accuminata, Daphniphyllum himalense, Acer* species, *Lyonia ovalifolia*	2,300–2,800	Goruaale, Dhupi, Chhintapu CF Maimajhuwa, Mabu, Gorkhepani (Ilam), Memeng (Panchthar)
16.	*Betula utilis* forest	*Rhododendron arboreum, R. campanulatum, R. hodgsonii, R. lindleyi, Betula utilis*	3,000–3,800	Tarsing, Sidin (Panchthar); Ghuna–Selele (Taplejung)
17.	Upper temperate mixed broad leaved forest	*Quercus semecarpifolia, Q. lamellosa, Litsea* species, *Lindera* species, *Rhododendron arboreum, Vaccinium nummularia*	2,400–3,300	Hangetham Jamuna, Chandane, Mabu Manedhunga (Ilam)
18.	*Abies spectabilis* forest	*Abies spectabilis, Tsuga dumosa, Acer* species, *R. barbatum, Sorbus cuspidata, Daphne bholua*	3,000–4,000	Lampokhari, Pasibhanjyang (Ilam), Prangbung, Falaincha (Panchthar); Pholay - Ghunsa–Chairam (Taplejung)
19.	*Tsuga dumosa* forest	*Tsuga dumosa, Quercus semecarpifolia, Acer acuminatum, Rhododendron arboreum*	2,500–3,500	Upper temperate to Lower Subalpine zone of Ilam, Panchthar, Taplejung
20.	Larix forest (*Larix griffithiana* forest)	*Larix griffithiana, Abies spectabilis, Tsuga dumosa, Betula utilis*	3,200–3,900	Ghunsa–Khambachen (Taplejung)
21.	Juniper forest	*Juniperus indica, J. recurva*	3,700–4,050	Chaira–Yalung (Taplejung)
22.	Moist alpine scrub	*Rhododendron lepidotum, R. anthopogon, R. setosum, Iris clarkei, Potentilla fructicosa, Primula* species, *Juniperus recurva*	3,000–4,000	Bikhepani, Phalaut (Ilam), Memeng, Dund, Pahare Meghu, Ghumne-Falaincha (Panchthar)
23.	Dry alpine scrub	*Rhododendron lepidotum, R. barbatum, Rosa sericea, Spirea arcuata, Berberis* species, *Potentilla* species	3,000–4,500	Toriphule, Chyangthapu (Panchthar). Kambachen–Lhonak (Taplejung)

Source: Stainton (1972), Shrestha and Ghimire (1996), Kunwar et al. (2008), Field study (2013 and 2014)

ANNEX V: FAUNA OF KANGCHENJUNGA LANDSCAPE NEPAL

MAMMALS
(27 Families, 70 Genera, 102 Species; 15 Species protected by NPWC Act 1973; 39 Species in CITES List)

Ailuridae (1 genus, 1 species): *Ailurus fulgens*

Bovidae (3 genera, 4 species): *Hemitragus jemlahicus, Naemorhedus goral, Naemorhedus sumatraensis, Pseudois nayaur*

Canidae (2 genera, 4 species): *Canis aureus, Canis lupus, Vulpes bengalensis, Vulpes vulpes*

Cercopithecidae (2 genera, 3 species): *Macaca assamensis, Macaca mulatta, Semnopithecus schistaceus*

Cervidae (2 genera, 2 species): *Axis axis, Muntiacus muntjak*

Elephantidae (1 genus, 1 species): *Elephas maximus*

Felidae (6 genera, 7 species): *Cuon alpines, Felis chaus, Felis temminckii, Panthera pardus, Pardofelis nebulosa, Prionailurus bengalensis, Uncia uncia*

Herpestidae (1 genus, 3 species): *Herpestes edwardsi, Herpestes javanicus, Herpestes urva*

Hystricidae (1 genus, 2 species): *Hystrix brachyura, Hystrix indica*

Leporidae (1 genus, 1 species): *Lepus nigricollis*

Manidae (1 genus 1 species): *Manis pentadactyla*

Megadermatidae (2 genera, 3 species): *Eptesicus nilssoni, Eptesicus serotinus, Megaderma lyra*

Moschidae (1 genus, 3 species): *Moschus chrysogaster, Moschus fuscus, Moschus leucogaster*

Muridae (6 genera, 12 species): *Bandicota maxima, Dacnomys millardi, Mus booduga, Mus cookie, Mus musculus, Mus platythrix, Mus terricolor, Rattus andamanensis, Rattus nitidus, Rattus rattus, Tatera indica, Vandeleuria oleracea*

Mustelidae (7 genera, 11 species): *Aonyx cinerea, Lutra lutra, Lutrogale perspicillata, Martes flavigula, Martes foina, Mellivora capensis, Melogale personata, Mustela altaica, Mustela kathiah, Mustela sibirica, Mustela strigidora*

Ochctonidae (1 genus, 2 species): *Ochotona macrotis, Ochotona roylei*

Pteromyidae (1 genus, 1 species): *Petaurista petaurista*

Pteropodidae (3 genera,3 species): *Cynopterus sphinx, Pteropus giganteus, Rousettus leschenaulti*

Rhinolophidae (2 genera, 6 species): *Myotis siligorensis, Rhinolophus affinis, Rhinolophus lepidus, Rhinolophus pearsonii, Rhinolophus pusillus, Rhinolophus sinicus*

Sciuridae (5 genera, 5 species): *Callosciurus pygerythrus, Dremomys lokriah, Funambulus pennantii, Ratufa bicolor, Tamiops macclellandii*

Soricidae (4 genera, 8 species): *Chimarrogale himalayica, Nectogale elegans, Soriculus baileyi, Soriculus caudatus, Soriculus leucops, Soriculus nigrescens, Suncus murinus, Suncus stoliczkanus*

Suidae (1 genus, 1 species): *Sus scrofa*

Talpidae (1 genus, 1 species): *Talpa micrura*

Tupaiidae (1 genus, 1 species): *Tupaia glis*

Ursidae (1 genus, 1 species): *Ursus thibetanus*

Vespertilionidae (8 genera, 10 species): *Barbastelle leucomelas, Hipposideros armiger, Kerivoula hardwickii, Nyctallus montanus, Pipistrellus babu, Pipistrellus coromandra, Plecotus auritus, Scotophilus heathii, Scotophilus kuhlii, Taphozous longimanus*

Viverridae (5 genera, 5 species): *Paguma larvata, Paradoxurus hermaphrodites, Prionodon pardicolor, Viverra zibetha, Viverricula indica*

Source: BPP (1995), Sherpa (1994), Yonzon (1996), KCA (2005), Bhuju et al. (2007), Jnawali et al. (2011)

BIRDS
(42 Families, 176 Genera, 354 Species; 2 Species protected by NPWC Act 1973; 1 Endemic species; 41 Species in CITES List)

Accipitridae (13 genera, 27 species): *Accipiter badius, Accipiter gentilis, Accipiter nisus, Accipiter trivirgatus, Accipiter virgatus, Aegypius monachus, Aquila chrysaetos, Aquila clanga, Aquila heliaca, Aquila nipalensis, Butastur teesa, Buteo buteo, Buteo hemilasius, Buteo rufinus, Circus cyaneus, Gypaetus barbatus, Gyps bengalensis, Gyps fulvus, Gyps himalayensis, Gyps tenuirostris, Hieraaetus pennatus, Ictinaetus malayensis, Milvus migrans, Pernis ptilorhyncus, Sarcogyps calvus, Spilornis cheela, Spizaetus nipalensis*

Aegithalidae (1 genus, 2 species): *Aegithalos concinnus, Aegithalos iouschistos*

Alcedinidae (1 genus, 1 species): *Alcedo atthis*

Anatidae (4 genera, 4 species): *Aythya ferina, Anser indicus, Anas penelope, Tadorna ferruginea*

Apodidae (4 genera, 5 species): *Apus affinis, Apus pacificus, Collocalia brevirostris, Hirundapus caudacutus, Tachymarptis melba*

Ardeadae (4 genera, 4 species): *Ardea cinerea, Bubulcus ibis, Butorides striatus, Egretta garzetta*

Bucerotidae (1 genus, 1 species): *Buceros bicornis*

Caprimulgidae (1 genus, 2 species): *Caprimulgus indicus, Caprimulgus macrurus*

Certhidae (2 genera, 4 species): *Certhia discolor, Certhia familiaris, Certhia nipalensis, Troglodytes troglodytes*

Cerylidae (2 genera, 2 species): *Ceryle rudis, Megaceryle lugubris*

Charadridae (1 genus, 1 species): *Ibidorhyncha struthersii*

Ciconidae (3 genera, 3 species): *Anastomus osciatu, Ciconia episcopus, Leptoptilos javanicus*

Cinclidae (1 genus, 2 species): *Cinclus cinclus, Cinclus pallasii*

Cisticolidae (1 genus, 1 species): *Prinia criniger*

Columbidae (3 genera, 7 species): *Columba hodgsonii, Columba leuconota, Columba livia, Streptopelia chinensis, Streptopelia decaocto, Streptopelia orientalis, Treron sphenura*

Coracidae (1 genus, 1 species): *Coracias benghalensis*

Corvidae (14 genera, 28 species): *Aegithina tiphia, Cissa chinensis, Coracina macei, Coracina melaschistos, Corvus corax, Corvus macrorhynchos, Corvus splendens, Dendrocitta formosae, Dicrurus aeneus, Dicrurus hottentottus, Dicrurus leucophaeus, Dicrurus macrocercus, Garrulus glandarius, Nucifraga caryocatactes, Oriolus oriolus, Oriolus tenuirostris, Oriolus traillii, Oriolus xanthornus, Pericrocotus brevirostris, Pericrocotus ethologus, Pericrocotus flammeus, Pseudopodoces humilis, Pyrrhocorax graculus, Pyrrhocorax pyrrhocorax, Rhipidura albicollis, Rhipidura hypoxantha, Urocissa erythrorhyncha, Urocissa flavirostris*

Cuculidae (7 genera, 12 species): *Cacomantis passerines, Cacomantis sonneratii, Chrysococcyx maculates, Cuculus canorus, Cuculus micropterus, Cuculus poliocephalus, Cuculus saturates, Eudynamys scolopacea, Hierococcyx sparverioides, Hierococcyx varius, Phaenicophaeus tristis, Surniculus lugubris*

Dacelonidae (1 genus, 1 species): *Halcyon smyrnensis*

Falconidae (1 genus, 6 species): *Falco cherrug, Falco naumanni, Falco peregrines, Falco severus, Falco subbuteo, Falco tinnunculus*

Fringillidae (10 genera, 23 species): *Carduelis flavirostris, Carduelis spinoides, Carpodacus erythrinus, Carpodacus nipalensis, Carpodacus pulcherrimus, Carpodacus puniceus, Carpodacus rodopeplus, Carpodacus rubicilla, Carpodacus rubicilloides, Carpodacus subhimachala, Carpodacus thura, Emberiza cia, Emberiza pusilla, Haematospiza sipahi, Leucosticte brandti, Leucosticte nemoricola, Loxia curvirostra, Melophus lathami, Mycerobas affinis, Mycerobas carnipes, Propyrrhula subhimachala, Pyrrhoplectes epauletta, Pyrrhula erythrosephala*

Halcyonidae (1 genus, 1 species): *Halcyon coromanda*

Hirundidae (3 genera, 7 species): *Delichon dasypus, Delichon nipalensis, Delichon urbica, Hirundo daurica,*

Hirundo rupestris, Hirundo rustica, Riparia riparia

Irenidae (2 genus, 2 species): *Chloropsis hardwickii, Irena puella*

Indicatoridae (1genus, 1 species): *Indicator xanthonotus*

Lanidae (1 genus, 2 species): *Lanius schach, Lanius tephronotus*

Megalaimidae (1 genus, 3 species): *Megalaima asiatica, Megalaima franklinii, Megalaima virens*

Muscicapidae (21 genera, 56 species): *Brachypteryx montana, Chaimarrornis leucocephalus, Copsychus saularis, Culicicapa ceylonensis, Cyornis unicolor, Enicurus immaculatus, Enicurus maculates, Enicurus schistaceus, Enicurus scouleri, Eumyias thalassina, Ficedula monileger, Ficedula parva, Ficedula strophiata, Ficedula superciliaris, Ficedula tricolor, Ficedula westermanni, Grandala coelicolor, Luscinia brunnea, Luscinia pectoralis, Monticola cinclorhynchus, Monticola rutiventris, Monticola solitaries, Muscicapa dauurica, Muscicapa ferruginea, Muscicapa ruticauda, Muscicapa sibirica, Muscicapella hodgsoni, Myiomela leucura, Myophonus caeruleus, Niltava grandis, Niltava magrigoriae, Niltava sundara, Phoenicurus erythrogaster, Phoenicurus erythronota, Phoenicurus frontalis, Phoenicurus hodgsoni, Phoenicurus ochruros, Phoenicurus schisticeps, Rhyacornis fuliginosus, Saxicola caprata¸ Saxicola ferrea, Saxicola torquata, Tarsiger chrysaeus, Tarsiger cyanurus, Tarsiger hyperythrus, Tarsiger indicus, Turdus albocinctus, Turdus boulboul, Turdus rubrocanus, Turdus ruticollis, Turdus unicolor, Zoothera dauma, Zoothera dixoni, Zoothera molissima, Zoothera monticola., Zoothera wardii*

Paridae (3 genera, 9 species): *Melanochlora sultanea, Parus ater, Parus dichrous, Parus major, Parus monticolus, Parus rubidiventris, Parus spilonotus, Parus xanthogenys, Sylviparus modestus*

Passeridae (5 genera, 17 species): *Anthus hodgsoni, Anthus richardi, Anthus roseatus, Anthus rufulus, Anthus sylvanus, Montifringilla adamsi, Motacilla alba, Motacilla cinerea, Motacilla citreola, Motacilla flava, Passer domesticus, Passer montanus, Prunella collaris, Prunella himalayana, Prunella immaculata, Prunella ruberculoides, Prunella strophiata*

Phalacrocoracidae (1 genus, 1 species): *Phalacrocorax carbo*

Phasianidae (8 genera, 8 species): *Arborophila torqueola, Francolinus francolinus, Ithaginis cruentus, Lerwa lerwa, Lophophorus impejanus, Lophura leucomelana, Tetraogallus tibetanus, Tragopan satyra*

Picidae (6 genera, 8 species): *Blythipicus pyrrhotis, Dendrocopos darjellensis, Dendrocopos hyperythrus, Gecinulus grantia, Picumnus innominatus, Picus canus, Picus squamatus, Sasia ochracea*

Psittacidae (1 genus, 1 species): *Psittacula himalayana*

Pycnonotidae (2 genera, 5 species): *Hypsipetes leucocephalus, Hypsipetes mcclellandii, Pycnonotus cafer, Pycnonotus leucogenys, Pycnonotus striatus*

Scolopacidae (3 genera, 5 species): *Gallinago nemoricola, Gallinago solitaria, Scolopax rusticola, Tringa glareola, Tringa nebularia*

Sittidae (2 genera, 4 species): *Sitta castanea, Sitta frontalis, Sitta himalayensis, Tichodroma muraria*

Strigidae (7 genera, 8 species): *Asio falmmeus, Athene brama, Bubo nipalensis, Glaucidium brodiei, Glaucidium cuculoides, Otus bakkamoena, Otus spilocephalus, Strix aluco*

Sturnidae (3 genera, 3 species): *Acridotheres tristis, Gracula religiosa, Sturnus malabaricus*

Sylvidae (27 genera, 72 species): *Actinodura nipalensis, Aethopyga gouldiae, Aethopyga ignicauda, Aethopyga nipalensis, Aethopyga saturate, Aethopyga siparaja, Alcippe castaneceps, Alcippe chrysotis, Alcippe vinipectus, Calandrella brachydactyla, Cettia acanthizoides, Cettia brunnifrons, Cettia flavolivacea, Cettia fortipes, Cettia major, Conostoma oemodium, Cutia nipalensis, Dicaeum concolor, Dicaeum ignipectus, Dicaeum melanoxanthum, Garrulax affinis, Garrulax albogularis, Garrulax erythrocephalus, Garrulax leucolophus, Garrulax lineatus, Garrulax ocellatus, Garrulax squamatus, Garrulax striatus, Garrulax subunicolor, Heterophasia capistrata, Leiothrix lutea, Minla cyanouroptera, Minla ignotincta, Minla strigula, Myzornis pyrrhoura, Nectarinia asiatica, Orthotomus sutorius, Paradoxornis fulvifrons, Paradoxornis nipalensis, Paradoxornis oemodium, Paradoxornis unicolor, Phylloscopus affinis, Phylloscopus cantator, Phylloscopus chloronotus, Phylloscopus humei, Phylloscopus inornatus, Phylloscopus maculipennis, Phylloscopus magnirostris, Phylloscopus occipitalis, Phylloscopus pulcher, Phylloscopus reguloides, Phylloscopus trochiloides, Pnoepyga albiventer, Pnoepyga pusilla, Pomatorhinus*

erythrogenys, Pteruthius flaviscapis, Pteruthius rufiventer, Pteruthius xanthochlorus, Seicercus whistleri, Seicercus burkii, Seicercus castaniceps, Seicercus xanthoschistos, Spelaeronis caudatus, Stachyris nigriceps, Stachyris ruficeps, Tesia castaneocoronata, Tesia cyaniventer, Turdoides nipalensis, Xiphirhynchus superciliaris, Yuhina flavicollis, Yuhina gularis, Yuhina occipitalis

Upupidae (1 genus, 1 species): *Upupa epops*

Zosteropidae (1 genus, 1 species): *Zosterops palpebrosus*

Source: BPP (1995), Thapa and Karki (2004), Baral and Inskipp (2005), KCA (2005), Bhuju et al. (2007), Inskipp and Inskipp (2009), Basnet (2011), BCN and DNPWC (2011, 2012)

HERPETOFAUNA

(19 Families, 64 Genera, 98 Species; 2 Species protected by NPWC Act 1973; 2 Endemic species; 2 Species in CITES List)

Amphibia

Bufonidae (1 genus, 4 species): *Bufo himalayanus, Bufo melanostictus, Bufo microtympanum, Bufo stomaticus*

Gymnophiona (1 genus, 1 species): *Ichthyophis sikkimensis*

Megophryidae (2 genera, 3 species): *Megophrys parva, Megophrys robusta, Scutiger sikkimmensis*

Microhylidae (3 genera, 4 species): *Kaloula taprobanica, Microhyla ornata, Microhyla ornata, Uperodon globulosus*

Ranidae (10 genera, 19 species): *Amolops formosus, Amolops marmoratus, Amolops monticola, Chaparana sikimensis, Euphlyctis cyanophlyctis, Hoplobatracus crassus, Hoplobatracus tigerinus, Limnonectes nepalensis, Limnonectes pierrei, Limnonectes syhadrensis, Limnonectes teraiensis, Paa annandalii, Paa blanfordii, Paa liebigii, Paa rostandi, Rana humeralis, Rana nigrovittata, Rana tytleri, Sphaerotheca rolandae*

Rhacophoridae (3 genera, 5 species): *Philautus annandalii, Polypedates leucomystax, Polypedates maculatus, Polypedates taeniatus, Rhacophorus maximus*

Salamandridae (1 genus, 1 species): *Tylototriton verrucosus*

Reptilia: Turtles and Lizards

Agamidae (5 genera, 5 species): *Calotes versicolor, Japalura variegata, Laudakia tuberculata, Ophisaurus gracilis, Oriotiaris tricarinatus*

Bataguridae (1 genus, 1 species): *Cyclemys oldhamii*

Gekkonidae (3 genera, 8 species): *Cosymbotus platyurus, Cyrtopodion markuscombaii, Cyrtopodion martinstollii, Gekko gecko, Hemidactylus brookii, Hemidactylus flaviviridis, Hemidactylus frenatus, Hemidactylus garnotii*

Scincidae (4 genera, 5 species): *Asymblepharus sikimmensis, Lygosoma albopunctatum, Mabuya carinata, Sphenomorphus indicus, Sphenomorphus maculatus*

Testudinidae (1 genus, 1 species): *Indotestudo elongata*

Trionychidae (3 genera, 3 species): *Aspideretes gangeticus, Chitra indica, Lissemys punctata andersoni*

Varanidae (1 genus, 2 species): *Varanus bengalensis, Varanus flavescens*

Reptilia: Snakes

Boidae (1 genus, 1 species): *Python molurus*

Colubridae (15 genera, 24 species): *Amphiesma parallelum, Amphiesma platyceps, Amphiesma stolatum, Atretium schistosum, Boiga nuchalis, Boiga ochracea stoliczkae, Boiga trigonata, Chrysopelea ornata ornata, Dendrelaphis tristis, Elaphae cantoris, Elaphae hodgsonii, Elaphae porphyracea, Lycodon aulicus, Lycodon striatus striatus, Oligodon albocinctus, Psammodynastes pulverulentus, Pseudoxenodon macrops, Ptyas mucosa mucosa, Rhabdophis himalayanus, Sibynophis*

collaris, Trachischium fuscum, Trachischium tenuiceps, Xenochrophis piscator, Xenochrophis sanctijohannis

Elapidae (4 genera, 7 species): *Bungarus bungaroides, Bungarus caeruleus, Bungarus fasciatus, Hemibungarus macclellandii univirgatus, Naja kaouthia, Naja naja, Ophiophagus hannah*

Typhlopidae (2 genera, 2 species): *Rhamphotyphlops braminus, Typhlops jerdoni*

Viperidae (2 genera, 2 species): *Gloydius himalayanus, Ovophis monticola monticola*

Source: BPP (1995), Shah and Tiwari (2004), KCA (2005), Bhuju et al. (2007), Basnet (2011)

FISH FAUNA

(6 Families, 22 Genera, 44 Species)

Anguillidae (1 genus, 1 species): *Anguilla bengalensis*

Belonidae (1 genus, 1 species): *Xenentodon cancilla*

Chandidae (1 genus, 2 species): *Channa barca, Channa gachua*

Cyprinidae (14 genus, 32 species): *Barilius barila, Barilius barna, Barilius bendelisis, Barilius shacra, Barilius vagra, Botia almorhae, Botia dario, Botia histrionica, Botia lohachata, Crossocheilus latius, Garra annandalei, Garra gotyla, Garra nasuta, Labeo coeruleus, Labeo dero, Naziritor chelynoides, Neolissiochilus hexagonolepis, Noemacheilus beavani, Noemacheilus elongatus, Puntius sarana, Schizothoraichthys curvifrons, Schizothoraichthys labiatus, Schistura rupecula inglisi, Schistura multifasciatus, Schizothoraichthys progastus, Schizothorax molesworthii, Schizothorax nepalensis, Schizothorax richardsonii, Schizothorax semiplotus, Schizothorax sinuatus, Semiplotus semiplotus, Tor putitora*

Psilorhynchidae (1 genus, 1 species): *Psilorhynchoides pseudecheneis*

Sisoridae (4 genera, 7 species): *Bagarius bagarius, Glyptothorax indicus, Glyptosternum pectinopterus, Glyptothorax telchilta, Myersglanis blythi, Pseudecheneis crassicauda, Pseudecheneis sulcatus*

Source: Bhattarai et al. (2008), Shrestha et al. (2009) and Siwakoti et al. (2012).

ARTHROPODA (INSECTS)

(9 Orders, 234 Genera, 391 Species)

Collembola (7 genera, 7 species): *Desoria notabilis, Isotoma diverticula, Isotomiella minor, Lepidocyrtus* sp., *Lobella roseola, Odontella lamellifera, Pseudachorutella nakaoi*

Psocoptera (13 genera, 18 species): *Blaste* sp., *Caecilius coei, Caecilius himalayanus, Caecilius ilamensis, Caecilius martensis, Caecilius pictifrons, Caecilius roseus, Dypsocus fucosus, Fulleborniella persimilaris, Heterocaecilius nepalensis, Hinduipsocus coleoptratus, Myopsocus sanguensis, Peripsocus quercicola, Psococeratis nirvana, Scytopsocopsis hirtipenna, Seopsis nepalensis, Trichadenotecnum dobhanensis, Trichadenotecnum pokhariense*

Ephemeroptera (5 genera, 5 species): *Ecdyonurus apicatus, Epeorus bispinosus, Ephemerella serrata,, Iron psi, Teloganodes tritis*

Dermaptera (5 genera, 6 species): *Brachylabis* sp., *Cordax politus, Forticula schlagintweiti, Liparura punctata, Liparura simplex, Nannisolabis* sp.

Odonata (17 genera, 22 species): *Allophaea ochracea, Anisogomphus bivittatus, Anotogaster nipalensis, Calicnemis pulverulans, Cephalaeschna orbifrons, Ceriagrion coromandelianum, Chlorogomphus mortoni, Chlorogomphus preciosus, Crocothemis servilia, Diplacodes tribialis, Himalagrion exclamationis, Idionyx*

stevensi, Indolestes cyanea, Orthetrum glaucum, Orthetrum japonicum, Orthetrum sabina, Orthetrum triangulare, Pantala flavescens, Philoganginae montana, Rhinocypha cuneata, Rhinocypha quadrimaculata, Stylogomphus insiglisi

Hemiptera (24 genera, 31 species): *Acyrthosiphon pisum, Agnesiella distant, Agnesiella dubia, Agnesiella roxana, Agnesiella quadridens, Almunisna bulbosa, Amphiareus obscuriceps, Amphiareus Panchtharensis, Capitophorus* sp., *Chaetosiphon tetrarhodus, Chionapsis clematidis, Dikraneura denticulate, Eupteryx cristagalli, Eupteryx irminae, Eupteryx janeki, Greenidea formosana, Helopeltis theivora, Kerria lacca, Ledeira callosa, Lippomanus carayani, Lippomanus hirsutus, Neoquernaspis takagii, Neparla katus, Nephotettix nigropictus, Pentalonia nigrinervosa, Sannella otiosa, Tamuraspis malloti, Tetraphleps alticola, Thaia oryzivora, Toxoptera aurantii, Wagneriunia thecata*

Hymenoptera (2 genera, 4 species): *Apis dorsata, Apis florae, Apis indica, Vespa orientalis*

Coleoptera (70 genera, 121species): *Abaeletes perroti, Abraeomorphus atomarius, Abraeomorphus topali, Agathidium caelebs, Agathidium fallax, Agathidium glaciale, Agathidium ilamense, Agathidium indicum, Agathidium laticorne, Agathidium martensi, Agathidium microreticulatum, Agathidium nivale, Agathidium pseudoparia, Agathidium shermathangense, Agathidium singmaricum, Agathidium transversum, Agathidium unumvesciculatum, Agrosteomela indica, Aloconota spectabilis, Altica coerulea, Amara darjelingensis, Anapleus cyclonotus, Anastena cyanca, Aplosonyx chalybeus, Aspidolopha rugosa, Atheta aptera, Atheta disputanda, Atheta furtive, Atheta lewisiana, Atheta maiensis, Atheta martensi, Atheta nagaorum, Atheta pokhariensis, Atheta sculticeps, Atheta sordiduloides, Atheta sororcula, Atheta subamicula, Atheta subgranulithoracia, Basilepta femoratum, Basilepta nepalense, Basilepta variabile, Carabus pseudoharmandi, Chrysolina Vishnu, Cicindela dromicoides, Cicindela virgule, Clavicomus harmandi, Cneorane tibialis, Coccinella septempunctata, Colasposoma downesi, Cordalia vestita, Crypsis blairi, Crypsis rufomarginatus, Cryptocephalus exsulans, Cynorta yasudai, Dactylispa brevispinosa, Derispia bistrimaculata, Derispia confluens, Derispia notate, Derispia truncate, Derispiola blairi, Derispiola darjeelingiana, Diapromorpha dejeani, Edaphus brevipennis, Encephalus himalayiensis, Epicauta nepalensis, Epipedocera undulata, Eulomalus brevipes, Eulomalus pupulus, Falsotithassa pterolomoides, Gyrophaea limbuorum, Hespera nepalensis, Himalhopalia furcata, Hoplasoma sexmaculata, Hylaspes longicornis, Hypocyphtus besuchetiellus, Ipelates castaneicolor, Ipelates indicus, Leiochrodes assimilis, Leiochrodes lanceolatus, Leiochrodes sikkimensis, Leptusa ilamensis, Leptusa lophophororum, Leptusa martensi, Liopygus diopsipygus, Liroetis nepalensis, Litoglossa opaca, Lucanus atratus, Lucanus gracilis, Lucanus smithi, Mandarella itoi, Meloe aruanachale, Merista pulunini, Merista sexmaculata, Merista trifasciata, Myllaena tricolor, Neolucanus baladeva, Nirmala cincta, Nodina parvula, Nonarthra variabile, Onthophilus sculptilis, Oomorphoides* sp., *Oxypoda campestris, Oxypoda exilis, Oxypoda kashmirica, Oxypoda subconformis, Oxypoda subsericea, Paridea octomaculata, Paridea unifasciata, Pelioptera martensi, Pelioptera opaca, Perexosoma cuprescens, Periclitena vigrosi, Platycorynus pyrophorus, Prostomis edithae, Prostomis morsitans, Saprinus frontistrius, Sphenoraia rutilans, Spitiella auriculata, Stenaesthetus quadrisulcatus, Temnaspis septemmaculata, Tomoderus martensi*

Diptera (91 genera, 177 species): *Acanthoclinocera saigusa, Anopheles aitkeni, Anopheles balabacensis, Anopheles dirus, Anopheles karwari, Anopheles konchi, Anopheles lindesayi, Anopheles majidi, Anopheles nigerrimus, Anopheles philippinensis, Anopheles pseudojamesi, Anopheles ramsayi, Apsinota rufipes, Asarkina aegrota, Asarkina ericetorum, Atherigona ovatipennis, Baccha maculata, Baccha sp., Bengalia subnitida, Betasyrphus albipilus, Betasyrphus serarius, Bibio ablusus, Bibio affiniproximus, Bibio nigerrimus, Bibio scaurus, Bibio totonigra, Callantra nepalensis, Callicera nitens, Callicera sanguensis, Callomyia coei, Campiglossa brahma, Celyphus coei, Celyphus obtectus, Cephenius mucronatus, Cephenius sikkimensis, Cerodontha duplicate, Chelifera* sp., *Chelipoda bakra, Chelipoda keta, Chelipoda* sp., *Chrysotoxum baphyrus, Clinocera chilamche, Clinocera evae, Clinocera nadi, Clinocera pani, Clinocera* sp., *Conops claripennis, Conops coei, Conops sinensis, Culex fatigans, Cyrtosia amnicola, Dasyphora himalayensis, Decachaetophora aeneipes, Delia coei, Dichaetomyia heteromma, Dicranosepsis bicolor, Dicranosepsis pubipes, Dolichocephala flamingo, Drapetis coei, Drapetis kala, Drapetis kholsa, Drapetis litoralis, Drapetis sanguensis, Drapetis ukhalo, Drapetis uralo, Elfriedella flavipilosa, Emmesomyia kempi, Episyrphus balteatus, Eristalinus arvorum, Eristalinus brevifacies, Eristalinus cerealis, Eristalinus errans, Eristalinus multifarious, Eristalinus paria, Eristalinus quadristriatus, Eristalinus simplicipes, Eristalinus tarsalis, Eristalinus zonata, Ferdinandea longifacies, Haematobosca sanguinolenta, Harpagophalla raciproca, Heleodromia ausobskyi, Heleodromia hilo, Hemerodromia chita, Hemerodromia lomri, Hemerodromia pila, Hemerodromia serpa, Hemipenthes melanus, Hilara bhiga, Hilara gila, Hilara*

khola, Hybos aimai, Hybos bhainse, Hylemya detracta, Hylemya probilis, Hypenella bhura, Hypenella spumarius, Ischiodon scutellaris, Japanagromyza trispina, Lasiomma eriophthalmum, Lemurimyza admirabilis, Leptothelaira latistriata, Lycastris flavohirta, Melanagromyza metallica, Melanagromyza phaseoli, Melanostoma formmelanoides, Melanostoma oreintale, Melanostoma univittatum, Meliscaeva cinctellus, Metallea setiventris, Microdon bellus, Miltogramma nepalicum, Nepalisca dasyops, Nepalometopia brunneipennis, Oxyphyllomyia alticola, Paragus auratus, Paragus crenulatus, Paragus tibialis, Paragus yerburiensis, Paralimosina brevis, Parasarcophaga orchidea, Parasarcophaga sp., *Penthetria japonica, Penthetria mallochi, Pericoma coei, Phaonia kambaitiana, Phytoliriomyza australensis, Phytomyza nepalensis, Platensina zodiacalis, Platypeza nepalensis, Proclinopyga seticosa, Pseudovolucella hingstoni, Psychoda cinerea, Psychoda magna, Rhagoletis rumpomaculata, Rhinomorinia longifacies, Ringia binotata, Ringia laticincta, Saltella stigera, Sarcophaga albiceps, Sarcophaga doleschalii, Sarcophaga haemorrhoidalis, Sarcophaga khasiensis, Sarcophaga macroauriculata, Sarcophaga sericea, Senotainia himalayica, Senotainia nepalica, Sepsis albopunctata, Sepsis himalayensis, Sepsis lateralis, Sepsis thoracica, Sicodus* sp., *Simulium nepalense, Siphunculina hirtifrons, Spaniocelyphus nepalensis, Sphaerophoria fulvifacies, Sphaerophoria indiana, Sphaerophoria nitens, Sphaerophoria torvus, Stenoproctus nepalensis, Stilpon löew, Tachydromia brunette, Tachydromia kosi, Tachydromia sanguensis, Tachydromia shealsi, Tachydromia tapa, Tachydromia taplejungensis, Telmatoscopus arcuatus, Telmatoscopus nepalensis, Tephritis coei, Tephritis daedala, Tephritis interrupta, Tephritis spiloptera, Thecophora nepalensis, Trichoclinocera maewa, Trichopsychoda atra, Trixella nox*

Source: Thapa (1997, 1998)

ARTHROPODA (BUTTERFLY)

(9 Families, 120 Genera, 186 Species)

Papilionidae (9 genera, 16 species): *Atrophaneura (Byasa) dasarada, Belenois aurota, Colias erate, Graphium (Idaides) agamemnon, Graphium (Idaides) doson, Graphium (Paranticopisis) xenocles, Leptosia nina, Metaporia leocodice, Papilio (Aarcturus) krishna, Papilio (Achillides) paris, Papilio (Menelaides) helenus, Papilio (Mimbyasa) janaka, Papilio (Pachliopta) aristolochiae, Synchloe sherpae, Troides aeacus, Troides helena*

Pieridae (46 genera, 75 species): *Acytolepsis puspa, Albulina asiatica, Appias (Catophaga) lyncida, Appias libythea, Arhopala abseus, Arhopala perimuta, Arhopala rama, Caleta caleta, Caleta elna, Castalius rosimon, Catochrysops strabo, Catopsilia pyranthe, Celastrina argiolus, Cepora nadina, Cepora nerissa, Charana (Rachana) jalindra, Cheritra freja, Chilades laius, Chrysozephyrus birupa, Colias fieldii, Colias stoliczkana, Curetis acuta dentate, Curetis bulis, Delias (Anaemorpha) agostina, Delias (Cathaemia) eucharis, Delias (Anaemorpha) descombesi, Delias (Cathaemia) hyparete, Delias acalis, Delias belladonna, Delias pasithoe, Delias sanaca, Dercas verhuelli, Deudorix epijarbus, Flos areste, Gandaca harina, Hebomoia glaucippe, Heliophorus epicles, Ixias marianne, Ixias pyrene, Jamides alecto, Jamides celeno, Lade (Appias) indra, Lade (Appias) lalage, Logania distant, Loxura atymnus, Megisba malaya, Nacaduba hermus, Nacaduba kurava, Nacaduba pactolus, Orthomiella pontis, Pareronia avatar, Pieris brassicae, Pieris canidia, Pithecops corvus, Pithecops zalmora, Poritia hewitsoni, Prosotas (Petrelaea) dubiosa, Prosotas (Petrelaea) lutea, Prosotas (Petrelaea) nora, Rapala damona, Rapala dieneces, Rapala manea, Rapala nissa, Rapala rectivitta, Spalgis epeus, Spindasis lohita, Spindasis schistacea, Spindasis syama, Surendra quercetorum, Taraka hamada, Terias blanda, Terias brigitta, Terias hecabe, Virachola isocrates, Zeltus amasa, Zizeeria karsandra, Zizeeria otis*

Nemeobiidae (1 genus, 1 species): *Zemeros flegyas*

Acraeidae (1 genus, 1 species): *Acraea violae*

Nymphalidae (25 genera, 37 species): *Aglais cashmirensis, Apatura ambica, Argyreus hyperbius, Ariadne merione, Athyma jina, Athyma nefte, Cethosia biblis, Chilrena childreni, Cirrochroa aoris, Cirrochroa tyche, Doleschallia bisaltide, Euthalia garuda, Euthalia phemius, Herona marathus, Hypolimnas bolina, Kallima inachus, Kaniska canace, Lebadea martha, Limenitis (Sumalia) daraxa, Neptis cartica, Neptis clinia,*

Neptis hylas, Neptis magadha, Neptis miah, Neptis pseudovikasi, Neptis sappho, Phaedyma columella, Polyura arja, Precis hierta, Precis iphita, Precis lemonias, Precis orithya, Pseudergolis wedah, Sephisa chandra, Stibochiona nicea, Tanaecia julii, Vanessa indica

Amathusiidae (1 genus, 1 species): *Discophora sondaica*

Satyridae (11 genera, 20 species): *Aulocera swaha, Elymnias hypermnestra, Elymnias malelas, Lethe confusa, Lethe europa, Lethe rohria, Lethe verma, Melanitis leda, Melanitis zitenius, Mycalesis anaxias, Mycalesis perseus, Nemetis (Lethe) mekara, Neope pulahoides, Orsotioena medus, Raphicera moorei, Ypthima baldus, Ypthima hannyngtoni, Zophoessa jalaurida, Zophoessa maitrya, Zophoessa sidonis*

Danaidae (4 genera, 9 species): *Danaus chrysippus, Danaus genutia, Danaus sita, Euploea algea, Euploea sylvester, Parantica aglea, Parantica melaneus, Tirumala limniace, Tirumala septentrionis*

Hesperiidae (22 genera, 26 species): *Ancistroides nigrita, Arnetta atkinsoni, Borbo bevani, Celaenorrhinus putra, Chamunda chamunda, Coladenia indrani, Gerosis bhagava, Gerosis phisara, Halpe homolea, Halpe zema, Hosora chromus, Matapa druna, Notocrypta curvifascia, Ochus subvittatus, Parnara guttata, Pelopidas sinensis, Pseudocoladenia dan, Sarangesa dasahara, Scobura cephala, Spialia galba, Suada swerga, Tagiades litigiosa, Tagiades menaka, Tagiades parra, Telicota bambusae, Zographetus ogygia*

Source: Smith (1994), Thapa (1998) and Bhuju et al. (2007)

ANNEX VI: FLORA OF KANGCHENJUNGA LANDSCAPE NEPAL

Gymnosperms: 6 Families, 10 Genera, 15 Species; Angiosperms: Dicots (140 Families, 731 Genera, 1861 Species); Monocots (32 Families, 239 Genera, 587 Species). Total Number of Flowering Plants: 178 Families, 980 Genera and 2,463 Species

GYMNOSPERMAE (Gymnosperms)

Cupressaceae (incl. Taxodiaceae**; 1 genus, 4 species):** *Cryptomeria Japonica, Juniperus communis, J. indica, J. recurva, J. squamata*

Cycadaceae (1 genus, 1 species): *Cycas pectinata*

Ephedraceae (1 genus, 1 species): *Ephedra gerardiana*

Gnetaceae (1 genus, 1 species): *Gnetum montanum*

Pinaceae (4 genera, 6 species): *Abies densa, A. spectabilis, Larix griffithiana, Pinus roxburghii, P. wallichiana, Tsuga dumosa*

Taxaceae (1 genus, 1 species): *Taxus wallichiana*

ANGIOSPERMAE (Angiosperms)

DICOTYLEDONAE (Dicots)

Acanthaceae (18 genera, 42 species): *Barleria cristata, B. dichotoma, B. strigosa, Dicliptera bupleuroides, D. roxburghiana, Echinacanthus attenuatus, Eranthemum splendens, E. strictum, Hemigraphis latebrosa* var. *rupestris, Hygrophila polysperma, H. salicifolia, Hypoestes triflora, Justicia adhatoda, J. procumbens, J. quinqueangularis, J. tukuchensis, Lepidagathis incurva, Peristrophe bicalyculata, P. speciosa, Phaulopsis parviflora, Phlogacanthus pubinervis, P. thyrsiflorus, Pseuderanthemum pataliferum, Pteracanthus agrestis, P. urticifolius, Rungia himalayensis, R. parviflora, Strobilanthes agrestis, S. atropurpureus, S. attenuata, S. auriculatus, S. capitatus, S. coloratus, S. glutinosus, S. helicta, S. tamurensis, S. thomsonii, S. urophyllus* var. *sikkimensis, Thunbergia coccinea, T. fragrans, T. grandiflora*

Achariaceae (incl. Flacourtiaceae**; 1 genus, 1 species):** *Gynocardia odorata*

Actinidiaceae (incl. Saurauiaceae**; 2 genera, 3 species):** *Actinidia callosa, A. strigosa, Saurauia napaulensis*

Adoxaceae (incl. Caprifoliaceae**; 2 genera, 11 species):** *Sambucus adnata, S. canadensis, S. hookeri, Viburnum colebrookeanum, V. cordifolium, V. coriaceum, V. cotinifolium, V. cylindricum, V. erubescens, V. mullaha, V. nervosum*

Alismataceae (1 genus, 1 species): *Butomopsis latifolia*

Amaranthaceae (8 genera, 14 species): *Achyranthes aspera, A. bidentata, Alternanthera bettzickiana, A. sessilis, Amaranthus caudatus, A. spinosus, A. viridis, Celosia argentea* var. *cristata, Centrostachys aquatica, Cyathula capitata, C. prostrata, C. tomentosa, Deeringia amaranthoides, Iresine herbstii*

Anacardiaceae (6 genera, 12 species): *Cherospondias axillaris, Dobinea vulgaris, Mangifera indica, Rhus hookeri, R. insignis, R. javanica, R. parviflora, R. punjabensis, R. succedanea, R. wallichii, Semecarpus anacardium, Spondias pinnata*

Annonaceae (4 genera, 4 species): *Annona squamosa, Desmos chinensis, Miliusa velutina, Uvaria hamiltonii*

Apiaceae/Umbelliferae (17 genera, 27 species): *Acronema hookeri, Angelica cyclocarpa, A. harae, Bupleurum candoleii, B. dalhousieanum, B. hamiltonii, C. asiatica, Chaerophyllum villosum, Coriandrum sativum, Cortia depressa, C. staintonia, C. wallichiana, Cortiella lamondiana, Eryngium foetidum, Heracleum lallii, H. nepalense, H. wallichii, Oenanthe thomsonii, Pimpinella diversifolia, Pleurospermum dentatum, Sanicula elata, Selinum candollii, S. tenuifolium, S.wallichianum, Sinocarum pulchellum, Torilis japonica, Vicatia coniifolia*

Apocynaceae (incl. Asclepiadaceae**; 21 genera, 33 species):** *Alstonia neriifolia, A. scholaris, Asclepias curassavica, Calotropis gigantea, Catharanthus roseus, Ceropegia hookerii, C. macrantha, C. pubescens, Chonemorpha macrophylla, Gymnema tingens, Holarrhena pubescens, Hoya arnottiana, H. edeni, H. fusca, H. lanceolata, H. linearis, H. longifolia, H. serpens, Ichnocarpus frutescens, Marsdenia calesiana, M. lucida,*

M. roylei, M. tinctoria,Nerium indicum, Pentasachme wallichii, Periploca calophylla, Plumeria rubra, Rauvolfia serpentina, Tabernaemontana divaricata, Thevetia peruviana, Trachelospermum lucidum, Treutlera insignis, Wrightia arborea

Aquifoliaceae (1 genus, 8 species): *Ilex dipyrena, I. excelsa, I. fragilis, I. godajam, I. insignis, I. intricata, I. sikkimensis, I. umbellulata*

Araliaceae (incl. Apiaceae;**13 genera, 22 species):** *Acanthopanax cissifolius, Aralia alpina, A. cachemirica, A. gigantea, Brassaiopsis glomerulata, B. hainla, B. mitis, Gamblea ciliata, Hedera nepalensis, Heteropanax fragrans, Hydrocotyle himalaica, H. nepalensis, H. sibthorpioides, Macropanax dispermus, Merrilliopanax alpinus, Panax pseudo-ginseng* var. *pseudo-ginseng, P. pseudo-ginseng* var. *angustifolia, P. pseudo-ginseng* var. *bipinnatifidus, Pentapanax fragrans, P. leschenaultii, P. racemosus, Schefflera impressa, S. venulosa, Trevesia palmata*

Aristolochiaceae (2 genera, 3 species): *Aristolochia griffithii, A. roxburghiana, Asarum himalaicum*

Asteraceae/Compositae (62 genera, 138 species): *Acanthospermum hispidum, Adenostemma lavenia, Ageratina adenophora, Ageratum conyzoides, Ainsliaea aptera, A. latifolia, Anaphalis adanta, A. busua, A. cavei, A. contorta, A. margaritacea, A. nepalensis, A. triplinervis, Artemisia dubia, A. indica, A. japonica, A. vulgaris, Aster ageratoides, A. albescens, A. asteroides, A. falconeri, A. flaccidus, A. sikkimensis, A. stracheyi, A. tricephalus, Bidens pilosa, B. tripartita, Blainvillea latifolia, Blumea falcata, B. hieraciifolia, B. lacera, Blumeopsis flava, Caesulia axillaris, Carpesium abrotanoides, C. nepalense* var. *nepalense, C. nepalense* var. *lanatum, Centipeda minima, Chromolaena odorata, Chrysanthemum indicum, C. morifolium, Cicerbita cyanea, C. macrantha, C. macrorhiza* var. *saxatilis, Cirsium falconeri, C. nishiokae,C. verutum, C. wallichii, Conyza canadensis, C. japonica,C. leucantha, C. stricta* var. *pinnatifida, C. stricta* var. *stricta, C. sumatrensis, C. viscidula, Cosmos bipinnatus, Crassocephalum crepidioides, Cremanthodium nepalense, C. oblongatum, C. palmatum, C. reniforme, Cyathocline purpurea, Dahlia imperialis, Dichrocephala benthamii, D. integrifolia, Dubyaea hispida, Eclipta prostata, Elephantopus scaber, Emilia sonchifolia, Erigeron bellidioides, E. karvinskianus, E. sumatrensis, Galinsoga parviflora, Gazania rigens, Gerbera maxima* var. *glabrata, G. maxima* var. *maxima, G. piloselloides, Gnaphalium affine, G. leuto-album, Guizotia abyssinica, Gynura cusimbua, G. nepalensis, G. pseudo-china, Hieracium umbellatum, Inula eupatorioides, I. nervosa, Jurinea dolomiaea, Lactuca dolichophylla, L. graciliflora, L. rostrata, Laggera alata, Leibnitzia nepalensis, Leontopodium monocephalum, Mikania cordata* var. *indica, M. micrantha, Myriactis nepalensis, Parthenium hysterophorus, Saussurea crispa, S. deltoidea, S. gossypiphora, S. obvallata, S. taraxisifolia, S. topkegolensis, S. tridactyla, S. uniflora, Senecio acuminatus, S. alatus, S. brunneo-villosus, S. buimalia, S. cappa, S. chrysanthemoides* var. *chrysanthemoides, S. chrysanthemoides* var. *spectabilis, S. densiflorus* var. *densiflorus, S. densiflorus* var. *pubescens, S. diversifolius,S. graciliflorus, S. quinquelobus, S. scandens, S. topkegolensis, S. triligulatus, S. wallichii, Siegesbeckia orientalis, Solidago virga-aurea, Sonchus arvensis* var. *laevipes, S. wightianus, Soroseris hookeriana, Sphaeranthus indicus L., Spilanthes acmella, S. calva, S. iabadicensis, Synedrella nodiflora, Synotis alata, S. cappa, S. tetrantha, Tagetes erecta, T. patula, Taraxacum officinale, Tithonia diversifolia, Vernonia anthelmintica, V. cinerea* var. *cinerea, V. cinerea* var. *parviflora, V. subsessilis* var. *macrophylla, V. volkameriaefolia, Wedelia biflora, W. wallichii, Zinnia elegans*

Balanophoraceae (2 genera, 4 species): *Balanophora dioica, B. involucrata, B. polyandra, Rhopalocnemis phalloides*

Balsaminaceae (1 genus, 18 species): *Impatiens amplexicaulis, I. arguta, I. bicornuta, I. discolor, I. exilis, I. falcifer, I. graciliflora, I. insignis, I. jurpia, I. occultans, I. puberula, I. racemosa, I. radiata, I. spirifer, I. stenantha, I. sulcata, I. tripelata, I. urticifolia*

Begoniaceae (1 genus, 15 species): *Begonia adscendens, B. dioica, B. dolichoptera, B. flaviflora, B. gemmipara, B. hatacoa, B. josephii, B. leptoptera, B. megaptera, B. nepalensis, B. palmata* var. *gamblei, B. Panchtharensis, B. picta, B. roxburghii, B. sikkimensis*

Berberidaceae (3 genera, 19 species): *Berberis angulosa, B. aristata, B. asiatica, B. concinna, B. erythroclada, B. hookeri, B. insignis, B. lycium, B. mucrifolia, B. petiolaris, B. praecipua, B. thomsoniana, B. tsarica, B. umbellata, B. wallichiana, Mahonia acanthifolia, M. borealis, M. napaulensis, Sinopodophyllum hexandrum*

Betulaceae (incl. Corylaceae; **4 genera, 5 species):** *Alnus nepalensis, Betula alnoides, B. utilis, Carpinus viminea, Corylus ferox*

Bignoniaceae (1 genus, 1 species): *Oroxylum indicum*

Boraginaceae (incl. Cordiaceae**; 10 genera,**

12 species): *Chionocharis hookeri, Cynoglossum lanceolatum, C. wallichii, C. zeylanicum, Ehretia laevis, Eritrichium canum, Hackelia uncinata, Lasiocaryum diffusum, Maharanga emodi, Microula pustulosa, Onosma verruculosum, Trigonotis ovalifolia*

Brassicaceae/Cruciferae (12 genera, 20 species): *Brassica juncea, B. rapa, Braya alpina, B. oxycarpa, Capsella bursa-pastoris, Cardamine flexuosa, C. macrophylla, C. scutata, C. violacea, C. yunnanensis, Draba altaica, D. gracillima, D. oreades, Eutrema heterophyllum, Lepidium sativum, Lignariella hobsonii, Loxostemon pulchellus, Raphanus sativus, Rorippa nasturtium-aquaticum, Thlaspi cochlearoides*

Buxaceae (1 genus, 3 species): *Sarcococca coriacea, S. hookerana, S. wallichii*

Cactaceae (1 genus, 1 species): *Opuntia monocantha*

Calceolariaceae (incl. Scrophulariaceae**; 1 genus, 2 species):** *Calceolaria gracilis, C. maxicana*

Campanulaceae (7 genera, 23 species): *Campanula cana, C. colorata, C. pallida, Codonopsis affinis, C. bhutanica, C. inflata, C. thalictrifolia, C. viridis, Cyananthus hookeri, C. incanus, C. inflatus, C. lobatus, C. pendunculatus, C. spathulifolius, Lobelia alsinoides, L. erectiuscula, L. heyneana, L. pyramidalis, L. seguinii* var. *doniana, L. zeylanica, Peracarpa carnosa, Pratia nummularia, Wahlenbergia marginata*

Cannabaceae (incl. Ulmaceae**; 3 genera, 4 species):** *Cannabis sativa, Celtis tetrandra, Trema cannabina, T. orientalis*

Capparaceae (1 genus, 1 species): *Capparis multiflora*

Caprifoliaceae (incl. Dipsacaceae, Morinaceae, Valerianaceae; **8 genera, 20 species):** *Acanthocalyx nepalensis, Dipsacus inermis* var. *mitis, Leycesteria formosa, L. glaucophylla, L. gracilis, Lonicera acuminata, L. angustifolia, L. glabrata, L. lanceolata, L. macrantha, L. myrtilloides, L. myrtillus, L. obovata, L. webbiana, Morina longifolia, M. nepalensis, Nardostachys jatamansi, Triplostegia glandulifera, Valeriana hardwickii, V. jatamansi*

Caricaceae (1 genus, 1 species): *Carica papaya*

Carlemanniaceae (1 genus, 1 species): *Carlemannia griffithii*

Caryophyllaceae (8 genera, 23 species): *Arenaria glanduligera, A. globiflora, A. orbiculata, A. polytrichoides, Cerastium glomeratum, C. holosteoiodes* var. *hallisanense, Dianthus barbatus, D. chinensis, Drymaria cordata, D. villosa, Gypsophila cerastoides, Lychnis nigrescens, Sagina japonica, S. saginoides, Stellaria decumbens, S. himalayensis, S. media, S. monosperma, S. ovalifolia, S. patens, S. sikimensis, S. subumbellta, S. uliginosa*

Celastraceae (incl. Parnassiaceae**; 6 genera, 16 species):** *Cassine glauca, Celastrus hookeri, C. paniculatus subsp. multiflorus, C. stylosus, Euonymus amygdalifolius, E. frigidus* var. *frigidus, E. frigidus* var. *elongatus, E. grandiflorus, E. hamiltonianus, E. porphyreus, E. tingens, E. vagans, Maytenus rufa, Parnassia chinensis, P. nubicola, P. pusilla, Reissantia arborea*

Chenopodiaceae (1 genus, 1 species): *Chenopodium album*

Chloranthaceae (1 genus, 1 species): *Chloranthus officinalis*

Cleomaceae (incl. Capparaceae**; 1 genus, 2 species):** *Cleome gynandra, C. speciosa*

Combretaceae (2 genera, 9 species): *Combretum chinense, C. decandrum, C. flagrocarpum,C. roxburghii, C. wallichii, Terminalia alata, T. bellirica, T. chebula, T. myriocarpa*

Convolvulaceae (5 genera, 17 species): *Argyreia atropurpurea, A. hookeri, A. roxburghii, Cuscuta europaea, C. reflexa, Evolvulus alsinoides, Ipomoea aquatica, I. batatus, I. carnea subsp. fistulosa, I. congesta, I. pes-tigridis, I. purpurea, I. quamoclit, Porana grandiflora, P. paniculata, P. racemosa, P. stenoloba*

Coriariaceae (1 genus, 1 species): *Coriaria terminalis*

Cornaceae (incl. Alangiaceae**; 2 genera, 3 species):** *Alangium alpinum, A. chinense, Swida oblonga*

Crassulaceae (3 genera, 13 species): *Kalanchoe spathulata, Rhodiola bupleuroides, R. chrysanthemifolia subsp. chrysanthemifolia, R. chrysanthemifolia subsp. sacra, R. cretinii, R. fastigiatum, R. himalensis, R. tibetica, R. wallichiana, Sedum discolor, S. himalense, S. multicaule, S. oreades, S. triactina*

Cucurbitaceae (15 genera, 21 species): *Biswarea tonglensis, Bryonopsis laciniosa, Cucumis sativus, Cyclanthera pedata, Diplocyclos palmatus, Gomphogyne cissiformis, Gynostemma pentaphyllum, Herpetospermum pedunculosum, Melothria heterophylla, M. maderaspantana, M. perpusilla, Momordica charantia, Sechium edule, Solena heterophylla,*

Thladiantha calcarata, T. cordifolia, Trichosanthes cucumerina, T. himalensis, T. tricuspidata, T. wallichiana, Zehneria maysorensis

Daphniphyllaceae (1 genus, 1 species): *Daphniphyllum himalense*

Diapensiaceae (1 genus, 1 species): *Diapensia himalaica*

Dilleniaceae (1 genus, 2 species): *Dillenia indica, D. pentagyna*

Dipterocarpaceae (1 genus, 1 species): *Shorea robusta*

Droseraceae (1 genus, 1 species): *Drosera peltata* var. *lunata*

Ebenaceae (1 genus, 1 species): *Diospyros virginiana*

Elaeagnaceae (2 genera, 5 species): *Elaeagnus caudata, E. conferta, E. infundibularis, E. parvifolia, Hippophae tibetana*

Elaeocarpaceae (2 genera, 2 species): *Elaeocarpus sphaericus, Sloanea sterculiaceus*

Ericaceae (incl. Monotropaceae**; 9 genera, 52 species):** *Agapetes hookeri, A. incurvata, A. serpens, A. smithiana, Cassiope fastigiata, Enkianthus deflexus, Gaultheria fragrantissima, G. griffithiana, G. hookeri, G. nummularioides, G. pyroloides, G. semi-infera, G. trichophylla, Lyonia ovalifolia, L. villosa, Monotropa hypopitys, M. uniflora, Pieris formosa, Rhododendron anthopogon, R. arboreum* var. *arboreum, R. arboretum* var. *campbelliae, R. arboreum* var. *roseum, R. barbatum, R. camelliieflorum, R. campanulatum* var. *campanulatum, R. campanulatum* var. *wallichii, R. campylocarpum, R. ciliatum, R. cinnabarinum, R. dalhousiae, R. elaeagnoides, R. falconeri, R. fulgens, R. glaucophyllum, R. grande, R. griffithianum, R. hodgsonii, R. lanatum, R. lepidotum, R. lindleyi, R. nivale, R. pendulum, R. pumilum, R. setosum, R. thomsonii, R. triflorum, R. vaccinioides, R. wightii, Vaccinium dunalianum, V. gaultherifolium, V. glaucoalbum, V. nummularia, V. retusum, V. sikkimense, V. vacciniceum*

Euphorbiaceae (13 genera, 24 species): *Alchornea mollis, Baliospermum montanum, B. nepalense, Chamaesyce supina, Croton caudatus, Euphorbia heterophylla, E. hirta, E. pseudosikkimensis, E. pulcherrima, E. royleana, E. sikkimensis, E. stracheyi, E. wallichii, Jatropha curcas, Macaranga denticulata, M. indica, M. pustulata, Mallotus albus, M. philippinensis, Manihot esculenta, Mercurialis leiocarpa, Ostodes paniculata, Ricinus communis, Sapium insigne*

Fabaceae/Leguminosae (63 genera, 145 species): *Abrus pulchellus, Acacia catechu, A. intsia* var. *oxyphylla, A. pennata, Acrocarpus fraxinifolius, Aeschynomene aspera, A. indica, Albizia chinensis, A. gamblei, A. julibrrissin, A. lebbeck, A. lucida, A. myriophylla, A. odoratissima, A. procera, A. sherriffii, Alysicarpus rugosus, A. vaginalis, Apios carnea, Argyrolobium roseum, Astragalus donianus, A. sikkimensis, A. stipulatus, Atylosia elongata, A. mollis, Bauhinia purpurea, B. vahlii, B. variegata, Butea minor, Caesalpinia bonduc, C. cucucllata, C. decapetala, C. digyna, Cajanus cajan, C. elongatus, Campylotropis macrostyla, C. speciosa,Cassia fistula, C. mimosoides, C. occidentalis, C. sophera, C. tora, Chesneya nubigena, Cochlianthus gracilis, Codariocalyx motorius, Colutea multiflora, Crotalaria alata, C. albida, C. cytisoides, C. ferruginea, C. hirsuta, C. humifusa, C. mucronata, C. pallida, C. prostrata, C. retusa, C. sessiliflora, C. tetragona, Dalbergia latifolia, D. sissoo, D. stipulacea, Delonix regia, Dendrolobium triangulare, Derris acuminata, D. marginata, D. thyrsiflora, Desmodium concinnum* var.*conncinum, D. concinnum* var.*retusum, D. confertum, D. elegans, D. gangeticum, D. heteropcarpum, D. heterophyllum, D. khasianum, D. laxiflorum, D. microphyllum, D. multiflorum, D. nepalense, D. podocarpum subsp. mandschuricum, D. podocarpum subsp.oxypohyllum, D. renifolium, D. retusum, D. sequax, D. tilliaefolium D. triflorum, D. velutinum, Dolichos falcatus, D. lablab, D. tenuicaulis, Dumasia villosa, Dunbaria rotundifolia, Entada phaseoloides, Eriosema himalaicum, Erythrina arborescens, E. variegata, Flemingia macrophylla, Glycine max, Gueldenstaedtia himalaica, Indigofera atropurpurea, I. dosua, I. exilis, I. heterantha, I. linifolia, I. pseudoreticulata, I. pulchella, I. stachyodes, I. trifoliata, Macrotyloma uniflorum, Meizotropis pellita, Mezoneurum cucullatum* var. *cucullatum, M. cucullatum* var. *grandis, Millettia auriculata, Mimosa pudica, M. rubicaulis, Mucuna macrocarpa, M. nigricans, Oxytropis microphylla, Parochetus communis, Phaseolus lunatus, P. pubescens, P. pulchellum, Piptanthus nepalensis, Pisum sativum, Pterocarpus marspium, Pueraria peduncularis, P. phaseoloides, P. tuberosa, P. wallichii, Senna floribunda, Shuteria vestita, Smithia ciliata, S. sensitiva, Spatholobus parviflorus, Stizolobium pruriens, Tadehagi triquetrum, Tamarindus indica, Tephrosia candida, Thermopsis inflata, Tibetia himalaica, Trifolium repens, Uraria lagopodioides, U. lagopus, Vicia bakeri, V. hirsuta, Vigna angularis, V. sinensis, V. umbellata, V. unguiculata, Zornia gibbosa*

Fagaceae (3 genera, 17 species): *Castanopsis hystrix, C. indica, C. tribuloides, Lithocarpus elegans,*

L. fenestratus, L. pachyphyllus, Quercus glauca, Q. incana, Q. lamellosa, Q. lanata, Q. lineata, Q. lobbii, Q. mespilifolioides, Q. oxyodon, Q. pachyphylla, Q. semecarpifolia, Q. spicata

Gentianaceae (9 genera, 32 species): *Canscora decussata, Crawfurdia angustata, C.speciosa, Exacum teres, E. tetragonum, Gentiana capitata, G. cephaloides, G. depressa, G. elwesii, G. ornata, G. pedicellata, G. sikkimensis, Gentianella paludosa, G. pedunculata, Halenia elliptica, Lomatogonium brachiantherum, L. carianthiacum, L. sikkimense, Swertia angustifolia, S. bimaculata, S. chirayita, S. dilatata, S. hookeri, S. macrosperma, S. multicaulis, S. nepalensis, S. nervosa, S. paniculata, S. pedicellata, S. petiolata, Tripterospermum nigrobaccatum, T. volubile*

Geraniaceae (1 genus, 10 species): *Geranium donianum, G. lambertii, G. nakaoanum, G. nepalense, G. polyanthes, G. pratense, G. procurrens, G. refractum, G. robertianum, G. wallichianum*

Gesneriaceae (9 genera, 21 species): *Aeschynanthus bracteatus, A. hookeri, A. parviflorus, Chirita macrophylla, C. pumila, C. urticifolia, Corallodiscus lanuginosus, Didymocarpus albicalyx, D. andersoni, D. aromaticus, D. macrophyllus, D. oblongus, D. primulifolius, D. pulcher, D. villosus, Henckelia pumila, Leptoboea multiflora, Loxostigma griffithii, L. serrata, Rhynchoglossum obliquum, Rhynchotechum ellipticum*

Grossulariaceae (1 genus, 5 species): *Ribes acuminatum, R. glaciale, R. griffithii, R. luridum, R. takare*

Hamamelidaceae (1 genus, 1 species): *Exbucklandia populnea*

Helwingiaceae (incl. Cornaceae**; 1 genus, 1 species):** *Helwingia himalaica*

Hydrangeaceae (4 genera, 10 species): *Deutzia bhutanensis, D. compacta, D. hookeriana, D. staminea, Dichroa febrifuga, Hydrangea anomala, H. heteromalla, H. paniculata, H. robusta, Philadelphus tomentosus*

Hypericaceae/Clusiaceae (1 genus, 9 species): *Hypericum choisianum, H. cordifolium, H. elodeoides, H. hookeranum, H. japonicum, H. patulum, H. perforatum, H. petiolulatum, H. uralum*

Icacinaceae (1 genus, 1 species): *Natsiatum herpeticum*

Juglandaceae (2 genera, 2 species): *Engelhardtia spicata, Juglans regia*

Lamiaceae (incl. Verbenaceae**; 42 genera, 88 species):** *Achyrospermum wallichianum, Ajuga bracteosa, A. lobata, A. macrosperma* var. *macrosperma, A. macrosperma* var. *thomsonii, Anisochilus carnosus, A. pallidus, Anisomeles indica, Callicarpa arborea, C. macrophylla, C. vestita, Caryopteris foetida, Clerodendrum chinense, C. colebrookeanum, C. infortunatum, C. japonicum, C. viscosum, C. wallichii, Clinopodium umbrosum, Colebrookea oppositifolia, Coleus barbatus, C. forskohlii, Colquhonia coccinia, Craniotome furcata, C. versicolor, Elsholtzia blanda, E. ciliata, E. flava, E. fruticosa, E. incisa, E. pilosa, E. stachyodes, E. strobilifera, Geniosporum coloratum, Gmelina arborea, Gomphostemma melissaefolium, Holmskioldia sanguinea, Hyptis suaveolens, Isodon coetsa, I. lophanthoides, I. maddeni, I. repens, I. scrophularioides, I. striatus, I. ternifolius, Lamium amplexicaule, Leucas cephalotes, L. ciliata, L. indica, L. lavandulaefolia, L. mollissima* var. *mollissima, L. mollissima* var. *scaberula, Leucosceptrum canum, Melissa axillaris, M. parviflora, Mentha arvensis, Micromeria nepalensis, Microtoena nepalensis, Nepeta laevigata, N. lamiopsis, Notochaete hamosa, Ocimum basilicum, O. canum, O. grattissimum, O. tenuiflorum, Orthosiphon incurvus, Perilla frutescens, Phlomis macrophylla, P. setigera, Plectranthus incanus, P. mollis, Pogostemon amarantoides, P. benghalensis, Premna barbata, Prunella vulgaris, Rotheca serrata, Salvia campanulata var. hirtella, S. coccinea, S. hians, S. leucantha, Scutellaria discolor, S. grossa, S. prostrata, S. repens, S. scandens, S. violacea, Stachys melissaefolia, Teucrium viscidum, Vitex negundo, V. peduncularis*

Lardizabalaceae (1 genus, 1 species): *Holboellia latifolia* var. *angustifolia, H. latifolia* var. *latifolia*

Lauraceae (11 genera, 33 species): *Actinodaphne reticulata, Beilschmiedia roxburghiana, Cinnamomum bejolghota, C. glanduliferum, C. glauscescens, C. impressinervum, C. parthenoxylon, C. tamala, Cryptocarya amygdalina, Dodecadenia grandiflora, D. griffithii, Lindera assamica, L. heterophylla, L. neesiana, L. pulcherrima, Litsea cubeba, L. elongata, L. glutinosa, L. kingii, L. monopetala, L. salicifolia, L. sericea, Machilus duthiei, M. gammieana, M. glaucescens, Neolitsea cuipala, N. foliosa, N. pallens, N. umbrosa, Persea gammieana, P. lanceolata, P. odoratissima,Phoebe pallida*

Lecythidiaceae (1 genus, 1 species): *Careya arborea*

Lentibulariaceae (1 genus, 4 species): *Utricularia aurea, U. gibba, U. scandens, U. striatula*

Linaceae (2 genera, 3 species): *Anisadenia saxatilis,*

Reinwardtia cicanoba, R. indica

Linderniaceae (incl. Scrophulariaceae**; 3 genera, 14 species):** *Lindernia antipoda, L. ciliata, L. crustacea, L. oppositifolia, L. parviflora, L. pusilla, L. ruellioides, Torenia asiatica, T. cordifolia, T. diffusa, Vandellia anagalis* var. *verbenafolia, V. antipoda, Vandellia pusilla, V. tenuifolia*

Loganiaceae (1 genus, 1 species): *Mitreola oldenlandioides*

Loranthaceae (5 genera, 10 species): *Dendrophthoe falcata, D. granulata, D. pentandra, Loranthus odoratus, Macrosolen cochinchinensis, Scurrula elata, S. parasitica, S. pulverulenta, Taxillus cuneatus, T. umbellifer*

Lythraceae (incl. Sonneratiaceae**; 5 genera, 8 species):** *Ammannia baccifera, Duabanga grandiflora Lagerstroemia parviflora, Rotala diversifolia, R. indica, R. rotundifolia, R. rubra, Woodfordia fruticosa*

Magnoliaceae (2 genera, 8 species): *Magnolia campbellii, M. doltsopa, M. globosa, M. lanuginosa, Michelia champaca, M. doltsopa, M. kisopa, M. velutina*

Malpighiaceae (2 genera, 2 species): *Aspidopterys nutans, Hiptage benghalensis*

Malvaceae (incl. Bombacaceae, Sterculiaceae, Tiliaceae**; 15 genera, 32 species):** *Abelmoschus manihot* var. *manihot, A. manihot* var. *pungens, Abroma augusta, Bombax ceiba Corchorus aestuans, C. capsularis, C. olitorius, Gossypium hirtusum, Grewia eriocarpa, G. laevigata, G. multiflora, G. oppositifolia,Hibiscus cannabinus, H. furcatus, H. rosa-sinensis, H. sabdariffa, H. solandra, H. syriacus, Kydia calycina, Melochia corchorifolia, Pterospermum acerifolium, Sida acuta, S. cordata, S. cordifolia, S. multicaulis, S. rhombifolia, S. veronicaefolia, Sterculia hamiltonii, Thespesia lampas, Triumfetta annua, T. bartramia, T. pilosa, Urena lobata*

Mazaceae (incl. Scrophulariaceae**; 1 genus, 4 species):** *Mazus arvense, M. japonicus, M. pumilus, M. surculosus*

Melastomataceae (5 genera, 9 species): *Melastoma melabathricum, M. normale, Osbekia nepalensis, O. nutans, O. sikkimensis, O. stellata, Oxyspora paniculata, Sarcopyramis nepalensis, Sonerila tenera*

Meliaceae (6 genera, 7 species): *Azadirachta indica, Cipadessa baccifera, Heynea trijuga, Melia azaderach, M. dubia, Munronia pinnata, Toona ciliata*

Menispermaceae (3 genera, 8 species): *Cissampelos pariera, Pericampylus glaucus,Stephania delavayi, S. elegans, S. glabra. S. glandulifera, S. gracilenta, S. japonica* var. *discolor*

Molluginaceae (1 genus, 3 species): *Mollugo nudicaulis, M. pentaphylla, M. stricta*

Moraceae (4 genera, 22 species): *Artocarpus Chama, A. heterophyllus, A. integra, A. lakoocha, Ficus benghalensis, F. curtipes, F. drupacea* var. *pubescens, F. hederacea, F. hispida, F. hookeriana, F. lacor, F. laevis, F. neriifolia, F. pubigera, F. religiosa, F. roxburghii, F. rumphii, F. sarmentosa, F. semicordata, F. subincisa, Morus australis, Streblus asper*

Moringaceae (1 genus, 1 species): *Moringa oleifera*

Myricaceae (1 genus, 1 species): *Myrica esculenta*

Myrtaceae (3 genera, 5 species): *Eucalyptus camaldulensis, Psidium guajava, Syzygium cumini, S. tetragonum, S. wallichii*

Nelumbonaceae (1 genus, 1 species): *Nelumbo nucifera*

Nyctaginaceae (1 genus, 1 species): *Bougainvillea spectabilis*

Nymphaeaceae (1 genus, 1 species): *Nymphaea odorata*

Oleaceae (6 genera, 9 species): *Fraxinus floribunda, Jasminum dispermum, J. humile* var. *humile, J. humile* var. *pubigerum, J. sambac, Ligustrum confusum, L. indicum, Nyctanthes arbor-tristis., Osmanthus suavis, Syringa emodi*

Onagraceae (4 genera, 10 species): *Circaea alpina* var. *alpina, C. alpina* var. *imaicola, Epilobium brevifolium, E. cylindricum, E. wallichianum, Ludwigia adscendens,L. hyssopifolia, L. octovalis, L. perennis, L. prostrata, Oenothera erythrosepala*

Opiliaceae (1 genus, 1 species): *Lepionurus sylvestris*

Orobanchaceae (incl. Scrophulariaceae**; 8 genera, 35 species):** *Aeginetia indica, Boschniakia himalaica, Buchnera hispida, Centranthera grandiflora, Euphrasia himalayica, E. platyphylla, Lindenbergia grandiflora, L. indica, Orobanche cernua, Pedicularis albiflora, P. anserantha, P. bifida, P. clarkei, P. collata, P. confertiflora, P. elwesii, P. flexuosa, P. furfuracea, P. gracilis, P. heydei, P. instar, P. kansuensis, P. lachnoglossa, P. longiflora, subsp. tubiformis, P. megalantha, P. microcalyx, P. mollis, P. nepalensis, P. oxyrhyncha, P. pennelliana, P. roylei, P. scullyana, P. siphonantha, P. tamurensis, P. terrenoflora*

Oxalidaceae (2 genera, 4 species): *Biophytum sensitivum, Oxalis acetosella* var.*acetosella, O. acetosella var.griffithii, O. corniculata, O. latifolia*

Papavaraceae (4 genera, 23 species): *Cathcartia villosa, Corydalis cashmeriana var. ecristata, C. casimiriana, C. chaerophylla, C. cornuta, C. juncea, C. leptocarpa, C. longipes, C. pachypoda, C. polygalina, C. staintonii, C. stracheyi, Dicentra macrocapnos, D. scadens, Meconopsis bella, M. grandis, M. horridula, M. lyrata, M. napaulensis, M. paniculata, M. simplicifolia, M. sinuata, M. villosa*

Passifloraceae (1 genus, 3 species): *Passiflora caerulea, P. edulis, P. nepalensis*

Pedaliaceae (1 genus, 1 species): *Sesamum orientale*

Pentaphylacaceae (incl. Theaceae**; 1 genus, 2 species):** *Eurya acuminata, E. cerasifolia,*

Phrymaceae (1 genus, 1 species): *Mimulus tenellus var. nepalensis*

Phyllanthaceae (incl. Euphorbiaceae, Staphyleaceae**; 8 genera, 19 species):** *Antidesma acidum, A. acuminatum, Aporosa octandra, Baccaurea ramiflora, Bischofia javanica, Bridelia retusa, B. stipularis, B. tomentosa, Glochidion metanubigenum, G. velutinum, Phyllanthus emblica, P. glaucus, P. nirurii, P. parvifolius, P. reticulatus, P. sikkimensis, P. urinaria, Sauropus androgynus, S. compressus*

Piperaceae (2 genera, 8 species): *Peperomia heyneana, P. pellucida, P. tetraphylla, Piper betle, P. longum, P. mullesua, P. peepuloides, P. wallichii*

Plantaginaceae (incl. Callitrichaceae, Scrophulariaceae**; 13 genera, 24 species):** *Adenosma indianum, Callitriche stagnalis, Digitalis purpurea, Dopatrium junceum, Ellisiophyllum pinnatum, Hemiphragma heterophyllum, Lagotis clarkei, Limnophila aromatica, L. repens, L. sessiliflora, Microcarpaea minima, Neopicrorhiza scrophulariiflora, Plantago erosa, P. himalaica, P. major, Scoparia dulcis, Veronica cana, V. deltigera, V. himalensis, V. javanica, V. retusum, V. robusta, V. umbelliformis, V. undulata,*

Plumbaginaceae (1 genus, 1 species): *Plumbago zeylanica*

Podostemaceae (1 genus, 1 species): *Hydrobruym griffithii*

Polygalaceae (1 genus 4 species): *Polygala arillata, P. chinensis, P. furcata, P. persicarifolia*

Polygonaceae (9 genera, 37 species): *Aconogonum campanulatum, A. molle var. molle, A. molle var. frondosum, Bistorta affinis, B. amplexicaulis, B. diopetes, B. emodi, B. jaljalensis, B. macrophylla, B. vaccinifolia, B. vivipara, Fagopyrum dibotrys, F. esculentum, F. tataricum, Fallopia pterocarpa, Koenigia nepalensis, Persicaria barbata, P. capitata, P. chinensis var. chinensis, P. chinensis var. brachiata, P. chinensis var. ovalifolia, P. hydropiper, P. kawagoeana, P. microcephala var. microcephala, P. microcephala var. wallichii, P. nepalensis, P. perfoliata, P. polystachya, P. posumbu, P. pratermissa, P. pubescens, P. punctata, P. runcinata var. runcinata, P. runcinata var. acuminata, P. thunbergii var. hastata, P. wallichii, Polygonum plebeium, Rheum australe, R. nobile, Rumex acetosa, R. nepalensis, R. vesicarius*

Primulaceae (incl. Myrsinaceae**; 7 genera, 47 species):** *Anagallis pumila, Androsace geranifolia, A. lehmanii, A. selago, A. strigillosa, Ardisia macrocarpa, A. solanacea, Lysimachia alternifolia, L. debilis, L. ferruginea, L. japonica, L. laxa, L. ramosa, Maesa argentea, M. chisia, M. indica, M. macrophylla, M. montana, Myrsine capitellata, M. semiserrata, Primula atrodentata, P. boothii, P. buryana, P. calderiana, P. capitata, P. denticulata, P. deuteronana, P. elongata, P. floribunda, P. glabra, P. glomerata, P. gracilipes, P. ianthina, P. listeri, P. macrophylla, P. megalocarpa, P. muscoides, P. obliqua, P. petiolaris, P. primulina, P. rotundifolia, P. sikkimensis, P. soldanelloides, P. stirtoniana, P. stuartii, P. tenuiloba, P. wattii*

Proteaceae (1 genus, 1 species): *Grevillea robusta*

Ranunculaceae (12 genera, 57 species): *Aconitum alpine-nepalense, A. bisma, A. deltoideum, A. elwesii, A. ferox, A. funiculare, A. gammiei, A. heterophyllum, A. heterophylloides, A. hookeri, A. novoluridum, A. orochryseum, A. spicatum, A. staintonii, Adonis nepalensis, Anemone fusco-purpurea, A. obtusiloba, A. rivularis, A. rupicola, A. trullifolia, A. vitifolia, Caltha palustris, C. scaposa, Cimicifuga foetida, Clematis buchananiana, C. connata, C. gouriana, C. grewiiflora, C. montana, C. napaulensis, C. tongluensis, C. tortuosa, Delphinium caeruleum, D. cooperi, D. nepalense, D. stapeliosmum, Dichocarpum adiantifolium, Naravelia zeylanica, Ranunculus adoxifolius, R. affinis, R. brotherusii, R. diffusus, R. ficariifolius, R. hirtellus, R. microphyllus, R. pegaeus, R. pulchellus, R. tricuspis, Thalictrum cultratum, T. elegans, T. foliolosum, T. montanum, T. reniforme, T. rotundifolium, T. saniculiforme, T. virgatum, Trollius pumilus*

Rhamnaceae (6 genera, 11 species): *Berchemia flavescens, B. floribunda, Gouania leptostachya, Hovenia acerba, Rhamnus purpureus, R. virgatus,*

Sageretia filiformis, Ziziphus incurva, Z. jujuba, Z. oenoplia, Z. xylopyrus

Rosaceae (18 genera, 85 species): *Agrimonia pilosa, Cotoneaster acuminatus, C. adpressus, C. congestus, C. frigidus, C. microphyllus, C. nitidus, C. staintonii, Docynia indica, Duchesnea indica, Eriobotrya elliptica, E. hookeriana, Fragaria nilgerrensis, F. nubicola, F. rubiginosa, Geum elatum, G. sikkimense, Neillia rubiflora, N. thyrsiflora, Photinia integrifolia, Potentilla biflora, P. cuneata, P. eriocarpa, P. fructicosa var. rigida, P. fulgens, P. griffithii, P. kleiniana, P. leuconata, P. lineata, P. microphylla, P. monanthes var. alata, P. peduncularis, P. polyphylla, P. saundersiana, P. sundaica, P. turfosoides, P. williamsii, Prunus cerasoides, P. cornuta, P. napaulensis, P. persica, P. rufa, P. napaulensis, P. undulata, P. venosa, Pyracantha crenulata, Pyrus communis, P. pashia, Rosa sericea, Rubus acuminatus, R. biflorus, R. calycinoides, R. calycinus, R. diffusus, R. ellipticus, R. fockeanus, R. foliolosus, R. fragaroides, R. griffithii, R. hamiltoni, R. hexagynus, R. hypargyrus var. niveus, R. nutaniflorus, R. paniculatus, R. pentagonus, R. reticulatus, R. rugosus, R. splendidissimus, R. thomsonii, R. truetleri, Sibbaldia cuneata, S. micropetala, S. purpurea, Sorbus arachnoidea,* S. cuspidata, S. foliolosa, S. hedlundii, S. insignis, S. kurzii, S. microphylla, S. rhamnoides, Spiraea arcuata, S. bella, S. canescens, S. micrantha

Rubiaceae (31 genera, 64 species): *Adina cordifolia, Anthocephalus cadamba, Borreria laevicaulis, B. latifolia, B. setidens, Canthium parvifolium, Catunaregam longispina, C. spinosa, Coffea bengalensis, Fagerlindia fasciculata, Galium acutum, G. asperifolium* var. *asperifolium, G. asperifolium* var. *sikkimense, G. asperuloides* var. *hofffmeisteri, G. elegans* var. *elegans, G. elegans* var. *glabriusculum, G. hirtiflorum, Hedyotis corymbosa, H. diffusa, H. ovatifolia, H. scandens, H. verticillata, Hymenodictyon excelsum, H. flaccidum, Hymenopogon parasiticus, Hyptianthera stricta, Knoxia corymbosa, Leptodermis lanceolata, L. ludlowii, Luculia gratissima, Meyna pubescens, M. spinosa, Morinda angustifolia, Mussaenda roxburghii, M. treutleri, Mycetia longifolia, Neanotis calycina, N. gracilis, N. ingrata, N. wightiana, Neohymenopogon parasiticus, Oldenlandia diffusa, Ophiorrhiza fasciculata, O. harrissiana, O. nepalensis, O. succrirubra, O. treutleri, Paederia foetida, P. scandens, Pavetta indica, P. polyantha, P. tomentosa, Psychotria erratica, Randia tetrasperma, Rubia cordifolia, R. manjith, R. sikkimensis, R. wallichiana, Spermadictylon suaveolens, Uncaria pilosa, U. sessilifructus, Wendlandia coriacea, W. exserta, W. puberula, W. sikkimensis*

Rutaceae (8 genera, 17 species): *Aegle marmelos, Boenninghausenia albiflora, Citrus aurantium, C. hystrix, C. limon, C. medica, Euodia fraxinifolia, Micromelum minutum, Skimmia arborescens, S. laureola, S. melanocarpa, Toddalia asiatica, Zanthoxylum acanthopodium, Z. armatum, Z. nepalense, Z. nitidum, Z. oxyphyllum*

Sabiaceae (2 genera, 6 species): *Meliosma delleniifolia, M. pungens, M. simplicifolia, Sabia campanulata, S. leptandra, S. paniculata*

Salicaceae (incl. Flacourtiaceae**; 4 genera, 15 species):** *Casearia graveolens, C. zeylanica, Homalium nepalense, Populus ciliata, Salix anticecrenata, S. babylonica, S. daltoniana, S. disperma, S. hylematica, S. lindleyana var. microphylla, S. myrtillacea, S. plectilis, S. serpyllum, S. sikkimensis, S. wallichiana*

Santalaceae (incl. Loranthaceae, Viscaceae**; 3 genera, 4 species):** *Osyris wightiana, Pyrularia edulis, Viscum album, V. articulatum*

Sapindaceae (incl. Aceraceae**; 4 genera, 11 species):** *Acer campbellii, A. caudatum, A. laevigatum, A. oblongum, A. pectinatum, A. sikkimense, A. spicatum, A. sterculiaceum, Cardiospermum halicacabum, Mischocarpus pentapetalous, Sapindus mukorossi*

Sapotaceae (2 genera, 2 species): *Diploknema butyracea, Madhuca longifolia*

Saururaceae (1 genus, 1 species): *Houttuynia cordata*

Saxifragaceae (5 genera, 30 species): *Astilbe rivularis, Bergenia ciliata, B. purpurascens, Chrysosplenium carnosum, C. griffithii, C. lanuginosum, C. nepalense, C. singalilense, Saxifraga brachypoda, S. consanguinea, S. diversifolia, S. tilicaulis, S. flagellaris, S. glabricaulis, S. hemisphaerica, S. kingiana, S. kumaunensis, S. latiflora, S. montanella, S. moorcroftiana, S. pallida, S. parnassifolia, S. pseudopallida, S. punctulata, S. saginoides, S. strigosa, S. umbellulata, S. viscidula, S. williamsii, Tiarella polyphylla*

Schisandraceae (1 genus, 3 species): *Schisandra grandiflora, S. neglecta, S. propinqua*

Scrophulariaceae (incl. Buddlejaceae**; 3 genera, 6 species):** *Buddleja asiatica, B. colvilei, Scrophularia elatior, S. pauciflora, S. urticaefolia, Wightia speciosissima*

Solanaceae (9 genera, 24 species): *Capsicum annum, C. frutescens, Cestrum aurantiacum, C. elegans, C. nocturnum, C. purpureum, Datura stramonium, D. suaveolens, Lycianthes biflora, Mandragora caulescens, Nicandra physaloides, Nicotiana tabacum,Physalis peruviana, Solanum aculeatissimum, S. biflorum, S. crassipetalum, S. indicum, S. lysimachioides, S. melongena, S. nigrum, S. pseudocapsicum, S. surattense, S. torvum, S. tuberosum*

Stachyuraceae (1 genus, 1 species): *Stachyurus himalaicus*

Staphyleaceae (1 genus, 1 species): *Turpinia nepalensis*

Styracaceae (1 genus, 2 species): Styrax grandiflorus, S. serrulatus

Symplocaceae (1 genus, 9 species): *Symplocos caudata, S. dryophila, S. glomerata, S. laurina, S. lucida, S. phyllocalyx, S. pyrifolia, S. ramosissima, S. theifolia*

Tamaricaceae (2 genera, 2 species): *Myricaria rosea, Tamarix dioica*

Theaceae (2 genera, 3 species): *Camelia kissi, C. sinensis, Schima wallichii*

Thymelaeaceae (3 genera, 5 species): *Daphne bholuavar. bholua, D. bholua var. glacialis, D. papyracea, D. sureil, Edgeworthia gardneri, Stellera chamaejasme*

Trochodendraceae (incl. Tetracentraceae**; 1 genus, 1 species):** *Tetracentron sinense*

Ulmaceae (1 genus, 2 species): Ulmus lanceifolia, U. wallichiana

Urticaceae (13 genera, 34 species): *Boehmeria clidemioides, B. hamiltoniana, B. macrophylla, B. platyphylla, B. polystachya, B. rugulosa, B. sidaefolia, B. ternifolia, Chamabainia cuspidata, Debregeasia salicifolia, D. wallichina, Elatostema monandrum, E. obtusum, E. platyphyllum var. polycephalum, E. platyphyllum var. platyphyllum, E. sessile, E. surculosum, Girardinia diversifolia, G. palmata, Gonostegia hirta, Laportea terminalis, Lecanthus peduncularis, Maoutia puya, Oreocnide frutescens, Pilea anisophylla, P. bracteosa, P. glaberrima, P. scripta, P. symmeria, P. ternifolia, P. umbrosa, Pouzolzia hirta, P. zeylanica, Urtica atrichocaulis, U. dioica*

Verbenaceae (3 genera, 3 species): *Duranta repens, Lantana camara, Verbena officinalis*

Violaceae (1 genus, 13 species): Viola betonicifolia, V. biflora, V. bulbosa, V. canescens, V. diffusa, V. glaucescens, V. hookeri, V. inconspicua, V. paravaginata, V. pilosa, V. serpens, V. thomsonii, V. wallichiana

Vitaceae (incl. Leeaceae**; 7 genera, 20 species):** *Ampelocissus barbata, A. divaricata, A. rugosa, A. sikkimensis, Cayratia trifolia, Cissus adnata, C. assamica, C. javana, C. repanda, C. repens, Leea aequata, L. macrophylla, Parthenocissus semicordata, Tetrastigma bracteolatum, T. dubium, T. hookeri, T. leucostaphyllum, T. rumicispermum, T. serrulatum, Vitis lanata*

MONOCOTYLEDONAE (Monocots)

Acoraceae (1 genus, 1 species): *Acorus calamus*

Amaryllidaceae (2 genera, 5 species): *Allium cepa, A. fasciculatum, A. sativum, A. wallichii, Zephyranthes carinata*

Araceae (10 genera, 19 species): *Alocasia fornicata, Arisaema costatum, A. flavum, A. griffithii, A. intermedium, A. jacquemontii, A. nepenthoides, A. speciosum, A. tortuosum, Colocasia esculenta, Gonatanthus pumilus, Lasia spinosa, Pothos cathcartii, Remusatia hookeriana, R. vivipara, Rhaphidophora decursiva, R. glauca, Sauromatum brevipes, Scindapsus officinalis*

Arecaceae/ Palmae (5 genera, 7 species): *Areca catechu, Calamus acanthospathus, C. latifolius, Cocos nucifera, Phoenix acaulis, P. humilis, Wallichia densiflora*

Asparagaceae (incl. Agavaceae, Liliaceae**; 10 genera, 26 species):** *Agave americana, Asparagaus filicinus var. brevipes, A. filicinus var. lycopidanales, A. racemosus var. racemosus, A. racemosus var. subacerosus, Campylandra aurantiaca, Chlorophytum breviscapum, C. nepalense, Maianthemum fuscum, M. oleraceum, M. purpureum, Ophiopogon intermedius, O. parviflorus, O. wallichianus, Peliosanthes griffithii, P. macrophylla, Polygonatum cathcartii, P. cirrhifolium, P. hookeri, P. kansuense, P. leptophyllum, P. oppositifolium, P. punctatum, P. sibiricum, P. singalilense, P. verticillatum, Theropogon pallidus, Tupistra aurantiaca*

Burmanniaceae (1 genus, 1 species): *Burmannia nepalensis*

Butomaceae (1 genus, 1 species): *Butomopsis latifolia*

Cannaceae (1 genus, 2 species): Canna edulis, Canna speciosa

Colchicaceae (1 genus, 1 species): *Disporum cantoniense*

Commelinaceae (10 genera, 19 species): *Amischophacelus axillaris, Amischotolype hookeri, Aneilema scaberrimum, Commelina benghalensis, C. diffusa, C. hasskarlii, C. maculata, C. paludosa, Cyanotis cristata, C. fasciculata, C. vaga, Dictyospermum scaberrium, Floscopa scandens, Murdannia edulis, M. elata, M. nudiflora, M. spirata, Rhopalephora*

scaberrima, Streptolirion volubile

Cyperaceae (15 genera, 73 species): *Blysmus compressus, Bulbostylus densa, Carex anomoea, C. atrata, C. baccans, C. capillacea, C. cruciata var. argocarpa, C. cruciata var. cruciata, C. duthiei, C. filicina, C. foliosa, C. inanis, C. inclinis, C. insignis, C. japonica subsp. chlorostachys, C. longipes, C. moorcroftii, C. nubigena, C. orbicularis, C. parva, C. polycephala, C. setigera, C. stramentitia, C. vesiculosa, Cyperus brevifolius, C. compactus, C. cuspidatus, C. difformis, C. diffusus, C. haspan, C. iria, C. malaccensis, C. michelianus, C. niveus, C. pilosus, C. pseudokallingoides, C. pumilus,C. rotundus, C. sanguinolentus, C. substramineus, C. tenuispica, Eleocharis chaetaria, E. congesta, E. palustris, E. tetraquetra, Eriophorum comosum, Fimbristylis aestavalis, F. complanata, F. dichotoma, F. littoralis, F. miliacea, F. schoenoides, F. squarrosa, Kobresia curvata, K. filicina, K. nepalensis, K. seticulmis, K. uncinoides, Kyllinga brevifolia, K. nemoralis, Lipocarpha squarrosa, Mariscus sumatrensis, Pycreus diaphanous, P. flavidus, P. pumilus, P. sanguinolentus, Schoenoplectus juncoides, S. supinus, Scirpus comosus, S. grossus, S. juncoides, S. mucronatus subsp. robustus, S. supinus subsp. lateriflorus, Scleria terrestris*

Dioscoreaceae (1 genus, 8 species): *Dioscorea alata, D. bulbifera, D. deltoidea, D. glabra, D. kamoonensis, D. pentaphylla, D. pubera, D. prazeri*

Eriocaulaceae (1 genus, 6 species): *Eriocaulon cinereum, E. exsertum, E. obclavatum, E. nepalense, E. staintonii, E. trisectoides*

Hydrocharitaceae (2 genera, 3 species): Blyxa aubertii B. echinosperma, Hydrilla verticillata

Hypoxidaceae (1 genus, 3 species): Curculigo capitulata, C. crassifolia, C. orchioides

Iridaceae (2 genera, 2 species): Belamcanda chinensis, Iris clarkei

Juncaceae (2 genera, 18 species): Juncus allioides, J. benghalensis, J. bhutanensis, J. bufonius, J. chrysocarpus, J. clarkei, J. duthiei, J. grisebachii, J. inflexus, J. khasiensis, J. luteocarpus, J. monticola, J. prismatocarpus, J. sphenostemon, J. thomsonii, J. uniflorus, J. wallichianus, Luzula effusa

Lemnaceae (1 genus, 1 species): Lemna perpusilla

Liliaceae (9 genera, 13 species): *Cardiocrinum giganteum, Clintonia udensis var. alpina, Diosporum cantoniense, Fritillaria cirrhosa, Lilium nanum, L. nepalense, Lloydia flavonutans, L. serotina var. parva, Notholirion bulbuliferum, N. macrophyllum, Streptopus parasimplex, S. simplex, Tricyrtis maculata*

Marantaceae (1 genus, 1 species): *Phrynium placentarium*

Melanthiaceae (incl. Liliaceae**; 2 genera, 3 species):** *Paris polyphylla var. polyphylla, P. polyphylla var. wallichii, P. violacea, Trillidium govanianum*

Musaceae (1 genus, 2 species): *Musa balbisiana, Musa paradisiaca*

Nartheciaceae (incl. Liliaceae**; 1 genus, 4 species):** *Aletris glabra, A. gracilis, A. pauciflora, A. sikkimensis*

Orchidaceae (62 genera, 171 species): *Acampe papillosa, Aerides multiflorum, Agrostophyllum callosum, A. planicaule, Anthogonium gracile, Arundina graminifolia, Ascocentrum ampullaceum, Bulbophyllum affine, B. careyanum, B. cylindraceum, B. dyerianum, B. guttulatum, B. leopardium, B. parvulum, B. polyrhizum, B. reptans, B. retusiusculum, B. sterile, B. viridiflorum, B. wallichii, Calanthe brevicornu, C. chloroleuca, C.griffithii, C. mannii, Chilochista lunifera, Cleisostoma filiforme, C. racemiferum, Coelogyne corymbosa, C. cristata, C. elata, C. fimbriata, C. flavida, C. longipes, C. ochracea, C. stricta, Cremastra appendiculata, Cryptochilus lutea, C. sanguineus, Cymbidium aloifolium, C. devonianum, C. elegans, C. gammieanum, C. grandiflorum, C. hookerianum, C. longifolium, C. pendulum, C. simulans, Cypripedium elegans, Dactylorhiza hatagirea, Dendrobium amoenum, D. ampulum, D. anceps, D. aphyllum, D. candidum, D. chrysanthum, D. densiflorum, D. eriiflorum, D. fimbriatum, D. formosum, D. heterocarpum, D. longicornu, D. moschatum, D. nobile, D. porphyrochilum, Diphylax urceolata, Ephemerantha macraei, Epigeneium amplum, E. fuscescens, Epipactis helleborine, Eria acervata, E. coronaria, E. discolor, E. excavata, E. graminifolia, E. lasiopetala, E. muscicola, Esmeralda clarkei, Eulophia dabia, Flickingeria fugax, Galearis spathulata, Gastrochilus affinis, G. bigibbus, G. calceolaris, G. distichus, Goodyera biflora, G. foliosa, G. repens, G. vittata, Habenaria arietina, H. bicornuta, H. densa, H. dentata, H. diphylla, H. goodyeroides, H. latilabris, H. malleifera, H. pectinata, Herminium angustifolium, H. fallax, H. josephii, H. lanceum, H. macrophyllum, H. quinquelobum, Kingidium taenalis, Liparis cordifolia, L. deflexa, L. nervosa, L. platyrachis, L. resupinata, L. togashii, L. viridiflora, Listera tenuis, Malaxis latifolia, M. muscifera, Neottianthe secundiflora, Nervilia crociformis, Oberonia acaulis, O. brachystachys, O. ensiformis, O. falcata, O. falconeri, O. iridifolia, O. myriantha, O. pachyphylla, O. pachyrachis,*

Oreorchis micrantha, Ornithochilus difformis, Otochilus albus, O. fuscus, O. porrectus, Panisea parviflora, P. uniflora, Papilionanthe uniflora, Peristylus aristatus, P. densus, P. fallax, P. goodyeroides, P. richardianus, P. tipuliferus, Phalaenopsis decumbens, P. mannii, P. taenialis, Pholidota articulata, P. imbricata, P. protracta, Platanthera bakeriana, P. clavigera, P. exelliana, P. latilabris, Pleione hookeriana, P. praecox, Podochilus cultratus, Poneorchis chusua, Porpax elwesii, P. meirax, Rhynchostylis retusa, Satyrium ciliatum, S. nepalense, Schoenorchis gemmata, Smitinandia micrantha, Spathoglottis ixioides, Spiranthes sinensis, Sunipia bicolor, S. scariosa, Thunia alba, Tipularia josephii, Vanda cristata, V. parviflora, V. teres, Vandopsis undulata, Zeuxine flava

Pandanaceae (1 genus, 2 species): Pandanus fascicularis, P. nepalensis

Poaceae/ Gramineae (82 genera, 161 species): *Agrostis micrantha, A. pilosula, A. zenkeri, Alopecurus aequalis, Andropogon brevifolius, Apluda mutica, Arthraxon lanceolatus, A. lancifolius, A. quartinianus, A. sikkimensis, Arundinaria falcata, A. hookeriana, A. intermedia, A. suberecta, Arundinella bengalense, A. birmanica, A. nepalensis, A. pumila, A. setosa, Avena fatua, Axonopus compressus, Bambusa nutans, Bothriochloa intermedia* var. *intermedia, B. intermedia* var. *punctata, Brachiaria subquadripara, B. villosa, Brachypodium pinnatum, B. sylvaticum, Bromus himalaicus, B. ramosus, Calamagrostis emodensis, C. pseudophragmites, Capillipedium assimile, C. parviflorum, Centotheca lappacea, Chrysopogon aciculatus, C. gryllus, C. serrulatus, Coelorhachis striata, Coix lachryma-jobi, Cymbopogon microtheca, C. pendulus, C. stracheyi, Cynodon dactylon, Cyrtococcum accrescens, Dactylis glomerata, Dactyloctenium aegyptium, Danthonia schneideri, Dendrocalamus hamiltonii, D. hookeri, Desmostachya bipinata, Deyeuxia scabrescens, Dicanthium annulatum, D. caricosum, Digitaria adscendens, D. cruciata, D. longiflora, D. radicosa, D. setigera, D. stricta, D. timorensis, Echinochloa colonum, E. crusgalli, E. frumentacea, E. picta, E. pyramidalis, Eleusine coracana, E. indica, Elymus nutans, Elytrophorus spicatus, Eragrostiella nardoides, Eragrostis atrovirens, E. japonica, E. nigra, E. tenella, E. tremula, E. unioloides, Erianthus longisetosus* var. *longisetosus, E. longisetosus* var. *hookeri, E. ravennae, E. rufipilus, E. sikkimensis, Eulalia leschenaultiana, E. mollis, Eulaliopsis binata, Festuca ovina, F. parvigluma, Garnotia emodi, Glyceria tonglensis, Helictotrichon virescens, Hemarthria compressa, H. vaginata, Heteropogon contortus, Hordeum vulgare, Hygroryza aristata, Hymenachne pseudointerrupta, Imperata cylindrica, Isachne albens, I. miliacea, I. sikkimensis, Ischaemum rugosum* var. *rugosum, I. rugosum* var. *segetum, Leersia hexandra, Melica scaberrima, Microstegium ciliatum, M. nudum, M. vagans, M. vimineum, Miscanthus nepalensis, Muhlenbergia huegelii, Narenga porphyrocoma, Neyraudia reynaudiana, Oplismenus burmanii, O. compositus, Oryza sativa, Panicum notanum, P. paludosum, P. trypheron, P. walense, Paspalidium punctatum, Paspalum conjugatum, P. distichum, P. longifolium, P. scrobiculatum, Perotis hordeiformis, P. indica, Poa annua, P. himalayana, P.hirtiglumis, P.imperialis, P. nepalensis, P. pagophila, P. sikkimensis, P. stewartiana, P. supina, Pogonatherum crinitum, P. paniceum, Polypogon fugax, Pseudechinolaena polystyacha, Pseudopogonatherum contortum, Saccharum spontaneum, Sacciolepis indica, S. interrupta, Setaria geniculata, S. glauca, S. pallida-fusca, S. palmifolia, S. plicata, S. verticillata, S. viridis, Sporobolus diander, S. fertilis, S. piliferus, Stipa roylei, Thamnocalamus aristatus, Themeda caudata, T. hookeri, T. triandra, T. villosa, Thysanolaena maxima, Tripogon trifidus, Triticum aestivum, Vetiveria lawsonii, Yushania maling*

Pontederiaceae (2 genera, 2 species): Eichhornia crassipes, Monochoria vaginalis

Smilacaceae (1 genus, 13 species): Smilax aspera, S. aspericaulis, S. elegans, S. ferox, S. glaucophylla, S. lanceifolia, S. menispermoidea, S. minutiflora, S. ocreata, S. ovalifolia, S. prolifera, S. rigida, S. vaginata

Tofieldiaceae (1 genus, 1 species): Tofieldia himalaica

Typhaceae (1 genus, 1 species): Typha angustifolia

Xanthorrhoeaceae (incl. Liliaceae**; 1 genus, 1 species):** Aloe vera

Zingiberaceae (7 genera, 16 species): *Amomum subulatum, Cautleya gracilis, C. spicata, Costus speciosus, Curcuma angustifolia, C. aromatica, C. longa, Globba clarkei, Hedychium coccineum, H. densiflorum, H. glaucum, H. spicatum, H. thyriforme, Roscoea alpina, R. capitata, R. purpurea.*

ANNEX VII: ENDEMIC FLOWERING PLANTS OF KANGCHENJUNGA LANDSCAPE NEPAL

SN	Family	Species	Elevation (m)	Location and district	Collectors/References
1.	Acanthaceae	*Justicia tukuchensis* V.A.W. Graham	1,700-2,400	Bomrang–Singoa Kharka, Taplejung	H. Ohba et al. 9120372 (TI). Rajbhandari & Adhikari (2009)
2.	Apiaceae	*Cortia staintoniana* Farille & SB Malla	4,000	S. Topke Gola, Arun-Tamur watershed, Taplejung	JDA Stainton 894 (Holotype: E). Rajbhandari & Dhungana (2011)
3.	Apiaceae	*Cortiella lamondiana* F. Fullarton & MF Watson	4,200	Kambachen–Lhonak, Taplejung	KEKE 506 (Holotype: E). Rajbhandari & Dhungana (2011)
4.	Asteraceae	*Senecio topkegolensis* Kitam.	3,600-4,350	Tashi Gaon–Topke Gola, Taplejung	H. Ohashi et al. 775175 (Holotype: TI). Rajbhandari & Adhikari (2009)
5.	Begoniaceae	*Begonia dolichoptera* S. Rajbhandary & KK Shrestha	2,500	SW of Amjilassa, Ghunsa Khola, Taplejung	M. Crawford et al. 248 (Holotype: K); Rajbhandary (2010)
6.	Begoniaceae	*Begonia leptoptera* H. Hara	1,500-2,600	Kiwa–Tapethok, Taplejung	TI 6304546 (TI). Rajbhandari & Adhikari (2009)
7.	Begoniaceae	*Begonia Panchtharensis* S. Rajbhandary	2,250	Pranbung, Sisire, Panchthar	U. Thumsuang s.n. (Holotype: E). Rajbhandary, Hughes and Shrestha (2010)
8.	Berberidaceae	*Berberis mucrifolia* Ahrendt	2,100-4,500	Nessum–Surkepati, Taplejung	H. Ohashi 771165 (TI). Rajbhandari & Adhikari (2009)
9.	Boraginaceae	*Onosma verruculosum* I.M. Johnst.	2,000-3,000	Papung–Sangrapati, Taplejung	H. Ohashi et al. 775380 (TI). Rajbhandari & Adhikari (2009)
10.	Eriocaulaceae	*Eriocaulon exsertum* Satake	200-300	Ghorwa–Sanischare, Jhapa	H. Hara et al. 6305472 (Holotype: TI); Hara et al. 6300935 (TI). Rajbhandari & Dhungana (2011)
11.	Eriocaulaceae	*Eriocaulon obclavatum* Satake	200-300	Ghorwa–Sanischare, Jhapa	H. Hara et al. 6305469 (Holotype: TI); Rajbhandari & Dhungana (2011)
12.	Eriocaulaceae	*Eriocaulon trisectoides* Satake	700-2,400	Dobhan–Mul Pokhari, Taplejung; Chyangthapu–Birwa, Panchthar	H. Hara et al. 6305468 (Holotype: TI). Rajbhandari & Dhungana (2011)
13.	Euphorbiaceae	*Euphorbia pseudosikkimensis* (Hurusawa & Ya. Tanaka) Radcl.-Smith	1,500-3,200	Helok–Baroya Khimty, Taplejung	H. Hara et al. , 6306781 (Holotype, TI). Rajbhandari & Adhikari (2009)
14.	Orobanchaceae (Scrophulariaceae)	*Pedicularis anserantha* T. Yamaz.	3,490	Mane Bhanjyang–Jaljale Pokhari (Taplejung/ Sankhuwasabha)	Y. Omori et al. 9950025 (TI). Rajbhandari & Dhungana (2011)
15.	Orobanchaceae (Scrophulariaceae)	*Pedicularis oxyrhyncha* T. Yamaz.	4,100	Tashi Gaon–Topke Gola, Taplejung	Ohashi et al. 770870 (Holotype: TI). Rajbhandari & Dhungana (2011)
16.	Orobanchaceae (Scrophulariaceae)	*Pedicularis tamurensis* T. Yamaz.	3,500	Tamur valley, Mewa khola, Taplejung	Stainton 1313 (Holotype: BM). Rajbhandari & Dhungana (2011)
17.	Orobanchaceae (Scrophulariaceae)	*Pedicularis terrenoflora* T. Yamaz.	2,000-2,200	Shewaden–Mewa Khola; Shewaden – Papung, Taplejung	H. Kanai et al. 720925 (Holotype: TI); Ohashi et al. 773961 (TI)
18.	Poaceae	*Poa imperialis* Bor	4,400	Yangma Khola, NE of Olungchung Gola, Taplejung	Stainton 1105 (Holotype: BM). Rajbhandari & Dhungana (2010)

19.	Polygonaceae	*Bistorta diopetes* H. Ohba & S. Akiyama	3,570-4,360	Shuwan Kharka–Topke Gola, Taplejung	TI 9110377 (TI). Rajbhandari & Dhungana (2010)
20.	Ranunculaceae	*Aconitum staintonii* Lauener	3,510	Tamur Valley, Olangchung Gola, Taplejung	Stainton 1034 (Holotype: BM). Rajbhandari & Dhungana (2011)
21.	Ranunculaceae	*Anemone fusco-purpurea* H. Hara	3,600-4,400	Saju Pokhari–Topke Gola, Taplejung	H. Kanai et al. 723626 (TI); Shrestha & Ghimire (1996). Rajbhandari & Dhungana (2011)
22.	Salicaceae	*Salix plectilis* Kitam.	200	Gauriganja–Kathgara, Jhapa	Kanai et al. 6304749 (Holotype; TI). Rajbhandari & Dhungana (2011)
Doubtful endemic species (Data deficient)					
1.	Apiaceae	*Heracleum lallii* C. Norman	1,500-3,650	Failaincha, Gairi-Sukhadhap, Panchthar; Maimajhuwa, Sisne, Ilam	Kunwar et al. (2008). Rajbhandari & Dhungana (2011)
2.	Asteracaeae	*Saussurea topkegolensis* H. Ohba & S. Akiyama	4,500	Topke Gola–Bomrang, Taplejung	H. Ohba et al. 9153380 (Holotype: TI). Rajbhandari & Adhikari (2009)
3.	Gentianaceae	*Swertia nepalensis* J. Shah	3,300	Falaincha, Dund, Panchthar	Kunwar et al. (2008). Rajbhandari & Dhungana (2010)
4.	Hypericaceae	*Hypericum cordifolium* Choisy	2,350-3,150	Gyabla, Olangchung Gola, Taplejung	Shrestha & Ghimire (1996). Rajbhandari & Dhungana (2010)
5.	Lamiaceae	*Micromeria nepalensis* Kitam. & Murata	1,900-3,600	Ghunsa Valley, Taplejung	R. Tamang (2013). Rajbhandari & Dhungana (2010).
6.	Lamiaceae	*Microtoena nepalensis* Stearn	2,100-2,600	Above Lelep, Taplejung; Memeng, Prangbung, Panchthar	Shrestha & Ghimire (1996); Kunwar et al. (2008). Rajbhandari & Dhungana (2010)
7.	Lythracaeae	*Rotala rubra* (Buch.-Ham. ex D. Don) H. Hara	1,000-1,700	Bharomdin–Khebang, Taplejung	H. Hara et al. 6306593 (TI). Rajbhandari & Dhungana (2010)

Source: Shrestha and Ghimire (1996), Kunwar et al. (2008), Rajbhandari and Adhikari (2009), Rajbhandari and Dhungana (2010, 2011), Rajbhandary (2010), Rajbhandary et al. (2010)

ANNEX VIII: RARE AND THREATENED PLANT SPECIES OF KANGCHENJUNGA LANDSCAPE NEPAL

SN	Family	Species	Altitude (m)	Locality	Threatened category
1.	Anacardiaceae	*Choerospondias axillaris* (Roxb.) Brutt.	1,300–1,500	Tapethok–Helok (Taplejung)	Threatened (IUCN–V)
2.	Apiaceae	*Heracleum lallii* C. Norman	3,640	Gairi–sukhkhadhap Failaincha (Panchthar)	Rare and Endemic
3.	Apocynaceae (Asclepiadaceae)	*Ceropegia hookerii* C.B. Clarke ex Hook.f.	2,480	Maklabu (Panchthar)	Threatened (CITES–II)
4.	Berberidaceae	*Sinopodophyllum hexandrum* (Royle) T.S. Ying	3,220	Mabu, Bikhe Bhanjyang, (Ilam)	Threatened (IUCN–V)
5.	Boraginaceae	*Maharanga emodi* (Wall.) A.DC.	2,800–3,400	Prangbung, Ghamaile, (Panchthar); Thakma Khola, Deurali-Hellok (Taplejung)	Threatened (IUCN–K)
6.	Caprifoliaceae (Valerianaceae)	*Nardostachys grandiflora* Pennell	3,200–4,300	Paharemeghu, Falaincha-9 (Panchthar); Olangchung, Topke Gola–Chhyongo (Taplejung)	Threatened (IUCN–V, CITES–II)
7.	Dioscoreaceae	*Dioscorea deltoidea* Wall. ex Griseb.	1,800–3,820	Falaincha, Betini, (Panchthar); Mamankhe (Taplejung)	Threatened (IUCN–CT, CITES–II)
8.	Dioscoreaceae	*Dioscorea prazeri* Prain & Burkill	1,570	Falaincha, Betini, (Panchthar)	Threatened (IUCN–CT, CITES–II)
9.	Eriocaulaceae	*Eriocaulon exsertum* Satake	200–300	Ghorwa–Sanischare (Jhapa)	Rare and Endemic
10.	Eriocaulaceae	*Eriocaulon trisectoides* Satake	700–2,400	Chamling gaun, Chyangthapu (Panchthar); Taplejung	Rare and Endemic
11.	Fagaceae	*Lithocarpus fenestratus* (Roxb.) Rehder	3,210	Faleke–Betini, Falaincha (Panchthar)	Threatened (IUCN–K)
12.	Gentianaceae	*Swertia chirayita* (Roxb.) Karsten	1,500–3,000	Menjuwa (Panchthar); Helok, Lelep (Taplejung)	Threatened (IUCN–V)
13.	Juglandaceae	*Juglans regia* L.	1,900–2,400	Mai Majhuwa (Ilam); Mamankhe, Lungthung (Taplejung)	Threatened (Gon–I, III)
14.	Lauraceae	*Cinnamom glaucescens* (Nees) Hand.-Mazz.	2,870	Sidin, Jamle (Panchthar)	Threatened (GoN–II)
15.	Magnoliaceae	*Magnolia campbelli* Hook.f. & Thoms.	2,000–2,800	Faleke–Betini, Falaincha (Panchthar); Dorangding–Amje Khola (Taplejung)	Threatened (IUCN–R, CITES–II)
16.	Magnoliaceae	*Magnolia globosa* Hook.f. & Thomson	2,040	Mai Majuwa, Naule Gaun (Ilam)	Threatened (IUCN–R, CITES–II)
17.	Magnoliaceae	*Michelia champaca* (L.) Baill. ex Pierre	2,040	Mai Majuwa, Naule Gaun (Ilam)	Threatened (IUCN–E, CITES–II, GoN–III)
18.	Magnoliaceae	*Michelia kisopa* Buch.-Ham. ex DC.	1,500–2,000	Helok–Ila danda, Mamankhe, Lungthung (Taplejung)	Endangered
19.	Magnoliaceae	*Michelia velutina* DC.	1,700–2,650	Newa khola, Mai Majhuwa (Ilam); Fungling, Gairibas, Yamphudin (Taplejung)	Threatened (CITES–II)

20.	Melanthiaceae (Trilliaceae)	*Paris polyphylla* Sm.	2,680–3,100	Mabu, near Mai Khola, Chauri Chowk (Ilam), Talkharka-Prangbung, (Panchthar)	Threatened (IUCN–V)
21.	Pinaceae	*Abies spectabilis* (D.Don) Mirbel	2,800–3,800	Mai Majuwa, Dhupi (Ilam); Simbua Khola, Gyapla-Ghunsa–Olangchung (Taplejung)	Threatened (IUCN–V, GoN–II)
22.	Pinaceae	*Larix griffithiana* Carriere	2,800–3,900	Gyapla–Kambachen, Simbua Khola Valley (Taplejung)	Rare, Threatened (CT)
23.	Pinaceae	*Pinus roxburghii* Sargent	1,000–2,000	Maimajuwa, Naule Gaun (Ilam); Sinam, Tellok, Fundraba (Taplejung)	Threatened (IUCN–V)
24.	Plantaginaceae (Scrophulariaceae)	*Neopicrorhiza scrophulariiflora* (Pennell) D.Y. Hong	3,000–4,330	Timbu Falaincha (Panchthar); Yamphudin, Olangchung Gola (Taplejung)	Threatened (IUCN–V, CITES–II, GoN–I)
25.	Polygonaceae	*Rheum nobile* Hook.f. & Thomson	4,330	Timbu Falaincha (Panchthar)	Threatened (IUCN–R)
26.	Ranunculaceae	*Aconitum spicatum* (Bruhl) Stapf	300–3,850	Dund, Falaincha (Panchthar); Olangchung Gola (Taplejung)	Threatened (IUCN–CT)
27.	Saxifragaceae	*Bergenia ciliata* (Haw.) Sternb.	1,600–2,300	Sekathum –Mamankhe (Taplejung)	Threatened (CT)
28.	Taxaceae	*Taxus wallichiana* Zucc.	2,600–3,000	Dabale Deurali (Panchthar); Guranse danda, Helok, Thakma Khola (Taplejung)	Threatened (IUCN–V, CITES–II, GoN–II)
29.	Trochodendraceae (Tetracentraceae)	*Tetracentron sinense* Oliv.	2,600–3,200	Thakma Khola–Deurali Bhanjyang, Mewa–Tamur (Taplejung)	Rare (IUCN), CITES Appendix III
30.	Ulmaceae	*Ulmus wallichiana* Planch.	1,700	Above Helok (Taplejung)	Rare (IUCN)

Source: Shrestha and Ghimire (1996), Shrestha and Joshi (1996), Kunwar et al. (2008)

ANNEX IX: LIST OF REGULATIONS RELATED TO THE FORESTRY SECTOR

SN	Name of Regulations	Remarks
	Sector-specific Regulations	
1.	National Parks and Wildlife Conservation Regulations 1974	Framed as provisioned by Section (33) of National Parks and Wildlife Conservation Act (1973)
2.	Himalayan National Parks Regulations 1980	Framed as provisioned by Section (33) of National Parks and Wildlife Conservation Act (1973)
3.	Forest Regulations 1995	Framed as provisioned by Section (72) of Forest Act (1993)
4.	Buffer Zone Management Regulations 1996	Framed as provisioned by Section (33) of National Parks and Wildlife Conservation Act (1973)
5.	Conservation Area Management Regulations 1997	Framed as provisioned by Section (33) of National Parks and Wildlife Conservation Act (1973)
6.	Kangchenjunga Conservation Area Management Regulations 2008	Framed as provisioned by Section (33) of National Parks and Wildlife Conservation Act (1973)
	Other Related Regulations	
7.	Land Regulations 1964	Framed as provisioned by Section (61) of Lands Act (1964)
8.	Electricity Regulations 1993	Framed as provisioned by Section (40) of Electricity Act (1992)
9.	Water Resources Regulations 1993	Framed as provisioned by Section (24) of Water Resources Act (1992)
10.	Drinking Water Regulations 1998	Framed as provisioned by Section (24) of Water Resources Act (1992)
11.	Environmental Protection Regulations 1999	Framed as provisioned by Section (24) of Environment Protection Act (1996)
12.	Local Self-Governance Regulations 2000	Framed as provisioned by Section (265) of LSG Act (1999)
13.	Land Survey and Measurement Regulations 2002	Framed as provisioned by Section (14) of Land Survey and Measurement Act (1963)
14.	Irrigation Regulations 2003	Framed as provisioned by Section (24) of Water Resources Act (1992)

Source: Belbase and Thapa (2007) www.lawcommission.gov.np

ANNEX X: LIST OF DIRECTIVES/GUIDELINES RELATED TO FORESTRY SECTOR

Directives/Guidelines	Approved/Published by	Focus
Community Forest Directives 1996	Department of Forests	Setting working procedures of the community forestry process
Leasehold Forest and Pasture Development Project Programme Implementation Guidelines 1998	Department of Forests	Processes for the formation of LFUGs and formulation of the operational plan and its implementation.
Buffer Zone Management Guidelines 1999	Department of National Parks and Wildlife Conservation	Setting working procedures for the sustainable utilization and conservation of the natural resources and community development in the buffer zone.
Standard Norms for Development Activities in the Forestry Sector 2000	Ministry of Forests and Soil Conservation	Revised norms for implementing the development and conservation activities.
Collaborative Forest Management Directive 2003	Ministry of Forests and Soil Conservation	Establishing collaborative forest, formulation of operational plan and organizational structure of the collaborative forest.
IEE Directives for Forestry Sector 2003	Ministry of Forests and Soil Conservation	Guidelines for the preparation of terms of reference and initial environmental examination for forestry sector projects
Guidelines for Review of IEE and EIA of Forestry Sector 2004	Ministry of Forests and Soil Conservation	Guidelines to assist in the review process of IEE, EIA and associated documents of forestry projects or others projects likely to affect forest and biodiversity environments in order to provide information for decision-making process
Non Government Service Provider Guidelines 2004	Ministry of Forests and Soil Conservation	Involvement of NGOs in provision of services in forestry sector development and sustainable forest management
Forest Sector Foreign Aid Policy Guidelines 2004	Ministry of Forests and Soil Conservation	Sector- wide approach in foreign sector development, donor coordination, sustainable forest development and poverty reduction
Community Forestry Resource Inventory Guidelines 2005	Department of Forests	Setting different procedures and processes to carry out resource inventory for forest products in community forests
Biosafety Guidelines 2005	Department of Plant Resources	Establishment of procedures in the protection of natural environment, human health, and biodiversity from the adverse impact of the use of modern biotechnology, and regulate trans-boundary movement of genetically modified organisms
Operational Directives for Allocation/Utilization of National Forest for Non Forestry Purposes 2006	Ministry of Forests and Soil Conservation	Establishment of operational procedures for allocation/ utilization of National Forests to national development priority programmes with prior approval of GoN
District Forest Products Supply Committee Directives 2006	Ministry of Forests and Soil Conservation	Establishment of operational procedures for collection and sales/distribution of the forest products by the committee
Operational Directives of Fund Mobilisation for Timber/ Firewood Collection and Depot Management 2006	Ministry of Forests and Soil Conservation	Operational procedures for mobilizing fund for Timber/ Firewood Collection and Depot Management in the Government Managed Forests of Tarai and Inner Tarai Districts.
Forest Products Auctioning and Selling Operational Directives 2007	Ministry of Forests and Soil Conservation	Establishment of procedures to be followed for auctioning/ selling forest products of the national forests
Forest Products Collection and Distribution Directives 2007	Ministry of Forests and Soil Conservation	Establishment of procedures for collection and sales/distribution of the forest products under government managed forests
Resin Collection Operational Directives 2007	Ministry of Forests and Soil Conservation	Setting different procedures and processes to carry out resin collection in community and government managed forests.
Operational Guidelines for Community Forestry Development Programme 2008	Department of Forests	Processes of the formation of CFUGs, formulation of constitution and the operational plan and operational procedures
Operational Directives for Physical Infrastructure Development and Implementation in the Protected Areas 2008	Ministry of Forests and Soil Conservation	Establishment of operational procedures for handing over protected area and implementation of programmes in the protected areas with prior approval of GoN
Wildlife Damage Relief Directives 2009	Ministry of Forests and Soil Conservation	Establishment of procedures for compensatory measures in the wildlife damage relief activities
Operational Directives for Rastrapati Churia Conservation Program 2011	Ministry of Forests and Soil Conservation	Guidelines for the protection of Churia forest area, formulation of operational plans and operational procedures, and coordination mechanism at central, regional and district levels
District Forest Sector Coordination Committee Establishment and Implementation Directives 2011	Ministry of Forests and Soil Conservation	Guidelines for procedures and processes for preparation of the plan, policy recommendation, facilitation for forest products distribution, monitoring and coordination and fund mobilization

Source: DoF (2009), MoFSC (2013), www.mofsc.gov.np; www.dof.gov.np; www.dnpwc.gov.np

ANNEX XI: MAJOR INTERNATIONAL CONVENTIONS, TREATIES AND AGREEMENTS SIGNED BY NEPAL

Name of the Convention	Date signed	Remarks (Objectives/Obligations)
Plant Protection Agreement for the South East Asia and Pacific Region	12 August 1965	• Prevent introduction into and spread of destructive plant diseases and pests • Regulate trade in plants and plant products
Convention on International Trade in Endangered Species of Wild Fauna and Flora	16 September 1975	• Protect and regulate the trade of wild fauna and flora and their products • Legal protection to all species threatened with extinction with appropriate measures and trade regulation
Convention for the Protection of World's Cultural and Natural Heritage	20 September 1978	• Identify, protect, conserve and transmit its cultural and natural heritage for future generations • Take appropriate legal, scientific, technical or financial measure to conserve cultural and natural heritage
Convention on Wetlands of International Importance especially as Waterfowl Habitat (known as Ramsar Convention)	17 April 1988	• Conserve, manage and wise use of migratory waterfowl and promotion of wetland conservation. • Formulate and implement measures to make wise use of wetlands
Agreement on the Network of Aquaculture Centres in Asia and the Pacific	04 January 1990	• Promote aquaculture development for increasing production, improving rural income and employment • Strengthen institutional capacity • Promote the exchange of information
International Tropical Timber Agreement	03 July 1990	• Ensure conservation and sustainable use of timber • Implement activities for forest management and decisions on timber trade
Convention on Biological Diversity	21 February 1994	• Ensure conservation and sustainable use and equitable sharing of benefits of the biological diversity • Prepare and implement national strategies, plans and programme including NBSAP for the conservation and sustainable use of biodiversity • Conserve both *in-situ* and *ex-situ* conditions and promote biotechnology and genetic research
Global Tiger Forum	1994	• Promote the rationale of tiger preservation and provide leadership and common approach throughout the world in order to safeguard the survival of the tiger, its prey and its habitat in tiger range countries
United Nations Framework Convention on Climate Change	31 July 1994	• Adopt precautionary measures to prevent or minimize the release of green house gases and mitigate effects of climate change
Vienna Convention for the Protection of Ozone Layer	04 October 1994	• Adopt appropriate measures to protect human health and the environment resulting from change in ozone layer. • Adopt measures to reduce ozone depleting substances
United Nations Convention to Combat Desertification	13 January 1997	• Adopt measures to combat desertification • Address physical, biological, and socio-economic aspects of the processes of desertification and drought
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	13 January 1997	• Adopt measures for safe transport, disposal and management of hazardous waste for environment protection • Control illegal traffic in hazardous wastes
The World Trade Organization	23 April 2004	• Protect intellectual property over plant varieties through development of a patent regime (TRIPs agreement) • Make legal regime compatible with the WTO
Kyoto Protocol to UNFCCC	14 December 2005	• Regulate the reduction of GHG in Annex I countries with Kyoto mechanism to support Annex II countries

Source: Bhuju et al. (2007), MoSTE (2008), MoFSC (2014)

GLOSSARY

Abiotic	Non-living matter
Adaptation	Adjustments in ecological, social or economic systems in response to climatic conditions that may be used to reduce vulnerability
Agrobiodiveristy	Diversity of crops (varieties and variability among crops)
Alien	Species living outside of its native range
Alpine	Mountainous region above 4000m altitude above sea level (in Nepal Himalaya)
Angiosperms	Flowering plants
Aromatic	Spicy or fragrant organic compound or matter
Assessment	Estimate the size/quantity or quality or the value of a matter/resources
Asset	Useful or valuable thing or person or property, etc that can be set against debt
Awareness	State of being conscious or having knowledge
Biodiversity	The variety and variability of genes, species, and ecosystems in a particular place
Biome	Ecosystem that is characterized by the structure and characteristics of its vegetation, which supports unique biological communities
Biotic	Biological system, especially including all the species and the occurrence of all ecological processes
Botany (botanical)	Science that deals with study of plants
Census	A count of the number of individuals in a population
Climate	Climate can be viewed as average weather which represents the state of climate system over a given time period and usually described by the means and variation of variables such as temperature, precipitation, and wind
Climate change	Any change in climate over time, whether due to natural variability or as a result of human activity
Commodity value	Value assigned to products, such as timber and animals, harvested by peoples
Community	An assemblage of organisms that live in a particular habitat and interact with one another
Connectivity	Generally refers to the effect of terrestrial or wetland ecosystem structure on organisms' ability to move and survive within and among patches of resources/ habitats
Conservation	Maintenance of natural resources/biological diversity of a particular place (saving life)
Consultation	Meeting arranged to seek information or advice
Convention	Formal agreement on the matter of common interest by majority consent
Corridor	A dispersal/migration route that permits the direct spread of many or most taxa from one region to another
Cryosphere	Region of snow and ice
Cultural	Customs, achievements, practices, etc of a particular civilization or group
Deficiency	Lacking particular thing
Deforestation	Conversion of forest to non-forested ecosystem, persisting for a significantly prolonged period
Degradation	Reduction of the natural quality of a matter to lower level
Delineation	Drawing or to sketch out
Demography	The study of the statistics of births, deaths, disease, etc
Diversity	Variety and variability (also see biodiversity)
Ecological	Having relationships between organisms and their environments
Ecoregion	Geographic region based on ecological factors (not political boundaries)
Ecosystem	A group of interacting organisms (community) and the physical environment they inhabit at a given point in time
Ecosystem goods	Ecosystem goods are the products arising from the ecological functions of healthy ecosystems (eg. food, medicine etc)
Ecosystem services	Range of benefits provided to people from ecosystems, including flood control, clean water and reduction of pollution (eg. clean air, fresh water)

Ecotourism	Tourism focussed on viewing spectacular mountain views and landscape, biological communities and species
Endangered species	Species that is facing a very high risk of extinction in the wild based on several objective criteria (see threatened species)
Endemic species	A species found only in a defined geographic area
Endemism	Extent of having endemic species
Environment	Surrounding that include soil, water and air
Ethnobotany	The study of the way plants are identified, classified, and used by various ethnic (indigenous) and local groups
Exotic species	A species living outside its native range
Exploitation	Fundamental human activity to make use of wild plants and animals; including commercial, subsistence, recreational, non-consumptive, indirect, incidental, etc.
Extinct	A taxon is extinct when there is no reasonable doubt that the last individual has died
Extinction	Disappearance of a species from the earth
Family	A taxonomic category above the level of genus and below the level of order
Fauna	Animal life of a region or period
Feasibility	Possibility or practicability or implacability
Flagship species	Charismatic species that captures the public's heart and wins support for its conservation; often a fellow mammal
Flora	Plant life of a region or period
Food security	Having sufficient nutritious food for particular time period
Framework	Essential supporting structure
Gap analysis	A technique for determining the steps to e taken in moving from a current state to a desired future state
Genetic diversity	Variation in the gene composition of individuals within or among species; the heritable genetic variation within and among populations
Genus (pl. genera)	Unit of classification that includes one or more species
Geographic Information System (GIS)	Computer system for capturing, storing, checking, integrating, manipulating, analyzing, and displaying data related to positions on the earth's surface
Glacier	Mass of land ice formed by accumulation of snow
Globalization	State of having worldwide network or access
Goal	A desired result that a system invisions, plans and commits to achieve within a finite time by setting deadlines
Gradient	Gradual change in the value of any parameter
Grassland	Large open area dominantly covered with grasses (see also pastureland)
Gymnosperms	Plants, such as conifers and cycads, whose seeds are bare, the ovules not being enclosed in an ovary
Habitat	The physical and biological environment used by an individual, a population, a species, or perhaps a group of species
Habitat degradation	The process by which habitat quality of a given species is diminished/degraded
Habitat loss	When habitat quality is so low that the environment is no longer usable by a given species
Habitat corridors	Connections between protected areas/habitats that allow for dispersal/migration
Heritage	Historic buildings, monuments, natural/cultural landscapes, etc especially when regarded as worthy of preservation
Herpeto	Animals grouped under reptilian and amphibian groups
Hotspots	Areas with high biodiversity, endemism and facing imminent threat of habitat loss
Important Bird Areas	Natural or semi-natural sites exhibiting exceptional bird richness and/or supporting populations of rare, threatened and/or endemic bird species
Important Plant Areas	Natural or semi-natural sites 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 (eg. medicinal plants)

Indicator species	Health of these populations is an easy-to-monitor indication of environmental conditions or status of other species
Indigenous	Native or belonging naturally to a place
Infrastructure	Basic structural foundations of a society or enterprise, e.g. roads, bridges, electricity, etc.
Integrated	Brought or came into equal membership or unity
Intellectual property rights	Legal rights of ownership granted to the inventors who create products through their intellectual contribution
In situ conservation	Preservation of natural communities and populations of species in wild
Interim Plan	A provisional or temporary plan for an intervening time
Invasive species	Introduced species that increases in abundance at the expense of native species
Inventory	A count of the number of individuals in a population
Irrigation	Supplying water to land through channels
Landraces	Crop grown locally, often in only one small area of the world by traditional farmers
Land use	Pattern of a land mass being used for various purposes
Landscape	A large-scale mosaic of ecosystems often consisting of a matrix with patches (small ecosystems) imbedded within it
Literacy rate	Rate of peoples of a region being literate
Livelihood	The capabilities, assets (including both material and social resources), and activities required for a means of living (job, income, production, etc)
Management	Administration for sustainability
MAPs (Medicinal and Aromatic Plants)	Plants having medicinal values and possessing fragrant compounds
Marginalized	Made or treated as unimportant or insignificant
Mitigation	Entails all human interventions that reduce the sources of enhancing the sinks of greenhouse gases
Monitoring	Observation of species, ecosystems and communities over time
Mosaic	Diversified pattern or thing
Non-governmental organizations (NGOs)	A term covering a broad spectrum of private, not-for-profit groups
Non Timber Forest Products (NTFPs)	All the plant products derived from forest other than timber and fuel-wood (Non Wood Forest Products)
Objective	Something sought or aimed
Outcome	The end result or final product produced as a result of plan and process
Output	The action in which quantity of goods or services is delivered in a given time period
Overexploitation	Harvesting a resource or species at a high level, resulting in a decline or loss in that resource or species
Pasturelands	Open areas predominantly covered with grasses and other herbs which are used for grazing of cattle (see also grassland)
PES (Payment for Ecosystem Services)	Multiple benefits that people receive from nature, such as water purification, flood control by wetlands, etc. (also known as payment/benefits for environmental services)
PES scheme	Reward those whose lands provide these services, with subsidies or market payments from those who benefit
Pollution	Addition of any external matter in- or degradation of quality or quantity of- any component of environment to deplete its natural quality
Protected Area	Areas created for the preservation of historic, scenic, cultural and wildlife values of the territory
Ramsar Site	Wetland sites designated as having exceptionally rich biodiversity of international importance
Rangelands	High altitude areas dominantly covered with grasses and herbs (see also pastureland)
Rare species	Species that are geographically specific or habitat specific, or have naturally small populations
Red Data Book	List of endangered species prepared by the IUCN and other conservation organizations
Remote	Far away or far apart
Resilience	Ability of an ecosystem/communities to remain in the same state even with ongoing disturbances
Resource	Stock or supply that can be drawn on

Restricted range	Organism having a narrow range of distribution beyond which the organism can not migrate
Ritual	Prescribed order of a ceremony, etc.
Rural	Areas that are not urbanized, have a low population density and typically much of the land area is devoted to agriculture and animal husbandry
Sacred	Dedicated to a god, connected with religion, safeguarded or required by tradition
Sanitation	Make sanitary or disinfection, disposal of sewage, refuse, etc.
Species	Groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups
Species richness	Number of different species in an ecosystem or a geographical area
Stakeholder	Refers to a person, group, organization, or system who affects or can be affected by an organizations' actions
Strategy	Long-term plan or policy
Survey	Repeatable sampling method to estimate population size or density, or some other aspects of biodiversity
Sustainable	Something maintained over period of time without being diminished
Sustainable development	Development that meets the needs of the present without compromising the capacity of future generations to meet their own needs
Threatened species	Category of jeopardy one step below 'endangered' (see endangered species)
Traditional	Custom, opinion or belief handed down to posterity
Traditional knowledge	Knowledge or practices that has remained in societies through generations, and is being transferred orally from generation to generation
Transboundary	Across the politically defined boundaries
Trans-Himalaya	Across the Himalayan range (e.g., upper part of Darchula, Humla , Manang and Mustang districts)
Transhumance	Seasonal and migratory grazing practice followed by peoples of rural areas
Urbanization	Make urban or modern town/city especially by destroying rural quality of a region
Vision	Overall picture or sight about a thing or a program/project
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, the adverse effects and extremes
Vulnerable	A taxon is vulnerable if it faces a high risk of extinction in the wild based on several objective criteria
Watershed	Source region from where water is flowing to different rivers, basins, etc.
Wetland	Areas of peat, marsh, swamp and other damp areas
Wildlife	Wild animals

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ABOUT AUTHORS

Ram P. Chaudhary, PhD, Professor of Botany in Tribhuvan University (TU), Nepal, is the Executive Director of RECAST, TU. He has served as a member of the National Planning Commission, GoN, and Board Member of ICIMOD. Prof. Chaudhary has an experience of teaching and research for over 37 years, received several awards, conducted biodiversity conservation and development related research projects, supervised PhD and Masters theses, published books and articles in reviewed journals in the areas of systematics, conservation biology, traditional knowledge, climate change and livelihoods, and established academic collaboration of TU with other universities. He has an extensive field experience in several parts in the Himalayas.

Yadav Uprety, PhD, got his Master degrees in Botany (ecology specialization) and Human Ecology from TU, Nepal and Vrije Universiteit Brussel, Belgium, respectively. He received his PhD in Environmental Science from the University of Quebec, Canada, in 2013. He works at the interface of social and natural sciences. His research focuses on traditional ecological knowledge, restoration ecology, ecosystem services, human-environment interactions, biodiversity use and conservation, plant ecology, etc. He has published several peer-reviewed journal articles on different fields encapsulating geographical regions from Nepal and Canada. Currently, Dr. Uprety is coordinating landscape programmes in RECAST.

Surya P. Joshi has more than 30 years of working experiences at Ministry of Forests and Soil Conservation (MoFSC), GoN, in various capacities in the field of community-based forest management, forest policy and landscape management. He began his professional career after graduating from Indian Forest College, Dehra Dun (India) in 1976. Later, he received a Masters degree in Forest Resources Management from the University of Philippines (Los Banos) in 1985. Mr. Joshi also completed advanced international courses in forestry planning, management and policy analysis. Working as the Joint Secretary and Chief of Foreign Aid Coordination Division, he has successfully contributed in formulation, coordination and convergence of foreign aid programmes.

Krishna K. Shrestha, PhD, a Professor at the Central Department of Botany, TU, Nepal, has been teaching plant systematics, biodiversity and ethnobotany for the last 35 years. He obtained his PhD degree in plant systematics from the Komarov Botanical Institute, St. Petersburg (Russia) in 1993, and was deputed as the Postdoc Darwin Fellow at the Natural History Museum, London, during 1997-1999. He is the founder President of Ethnobotanical Society of Nepal (ESON) since 1997, and General Secretary of Nepal Botanical Society since 2005. He has published five books, 42 research articles in international journals, 30 research articles and over 30 popular articles in national journals. Prof. Shrestha also serves as the editorial board member of Flora of Nepal (10 volume).

Khadga B. Basnet, PhD, with 34 years of teaching and research experience, is currently a Professor at the Central Department of Zoology, TU. He has MSc in Zoology and PhD in Ecology and Environment. With research interests in biodiversity conservation, ecosystem services, EIA and climate change, he has led numerous research and conservation projects and supervised many graduate students. He was instrumental in conceptualizing and developing Banke National Park (1997-1998), Chitwan-Annapurna Landscape (1999-2000), Tarai Arc Landscape (2000-2001) and community-conserved conservation areas (2009-2012). He is associated with several professional societies and organizations, including IUCN/WCPA Commission Member.

Govinda Basnet got his PhD in Environmental Anthropology from the University of Georgia, Athens, USA, in 2007. Currently, he is working as a Freelance Consultant. He has worked for over 15 years in the fields of environmental conservation, climate change, water resources management and community development in policy analysis, programme development, implementation and evaluation. Coming from Solukhumbu district, he has worked extensively in remote areas of Nepal. His research focuses on interfaces of water resource management and environmental conservation and won prestigious research grants from institutions like National Science Foundation and Wenner-Gren Foundation for Anthropological Research (USA) among others.

Krishna R. Shrestha is a Professor at RECAST, Tribhuvan University, and has more than 35 years of professional experience in the field of renewable energy and holds a PhD degree in Chemical Engineering from IIT-Delhi. He has in-depth knowledge on research and development of technologies related to biomass energy systems, biomass densification, laboratory research and field-testing on biomass gasification, briquetting, biomass production from different agro-processing units, etc. His expertise lies in the application of appropriate technologies for enhancing the livelihood of rural communities. In the present study, he looks after the livelihood component of the project.

Kuber P. Bhatta did his Masters degrees in Botany (2004) and in Biodiversity and Environmental Management (2010) from TU, Nepal, and University of Bergen, Norway. He has been working as a Lecturer of Botany in TU since 2011. Currently, he is a PhD fellow in the University of Bergen, Norway. He also served as a core team member for the preparatory phase of Kailash Sacred Landscape Conservation and Development Initiative.

Krishna P. Acharya is the Joint Secretary and Chief of Planning and Human Resource Development Division of MoFSC, GoN. He is responsible for planning and budgeting of the programmes of MoFSC and its Departments, and coordinating and facilitating policy and strategy formulation. He is also the focal point for the United Nations Forum on Forests, Chairperson of Timber Corporation of Nepal, Member of REDD Working Group, faculty board member of the Institute of Forestry, TU, coordinator of KLCDI and TAL Strategy formulation team. He has served MoFSC in various capacities. He received Master degree in Forest Science from the University of Edinburgh, UK, in 1997. Since then, he has published about 50 papers and co-edited three books.

Nakul Chettri, PhD, a senior Biodiversity Specialist in ICIMOD, joined ICIMOD in 2002 as the Project Coordinator for Transboundary Biodiversity Conservation and Management, promoted to Action Area Team Leader for Biodiversity Conservation and Management (2006), has been promoting regional cooperation in conservation through participatory conservation planning, policy analysis and the development of a new policy framework in the Hindu Kush Himalayas. Dr. Chettri has an MSc (1995) and a PhD in Zoology (2000) from North Bengal University, India, and is leading a team of multidisciplinary professionals in Kangchenjunga and Kailash Sacred Landscapes.

ABOUT PUBLISHERS

Ministry of Forests and Soil Conservation, Government of Nepal

The Ministry of Forests and Soil Conservation (MoFSC) is the apex institution of the Government of Nepal mandated to the sustainable management of forests and watershed, protected area management, biodiversity conservation, employment generation through forest-based enterprises and poverty alleviation through people's inclusive participation. It facilitates in integrating conservation of biological diversity and sustainable use of its components with a focus on the need to the conservation of biological resources, its sustainable use, and fair and equitable sharing of its benefits arising out of the use of natural resources. The MoFSC is the national focal point for implementing the Convention on Biological Diversity (CBD). It is the nodal agency with an overall responsibility of formulating and implementing policies and programmes related to the conservation and sustainable use of biological diversity in the country, keeping records of relevant activities and communicating with the CBD Secretariat and other conventions related to biodiversity. The MoFSC undertakes monitoring and evaluation through five regional forest directorates, and implements its plans and programmes through the following five departments, namely, the Department of Forests, (DoF), Department of National Parks and Wildlife Conservation (DNPWC), Department of Soil Conservation and Watershed Management (DSCWM), Department of Plant Resources (DPR) and the Department of Forest Research and Survey (DFRS).

Research Centre for Applied Science and Technology, Tribhuvan University

Research Centre for Applied Science and Technology (RECAST) was established on September 8, 1977, as a premier Research and Development (R&D) institution within the organizational framework of Tribhuvan University (TU). RECAST functioned as a secretariat to the National Council for Science and Technology, Government of Nepal till 1999. It is designated as a national focal point of Asia-Pacific Centre for Transfer of Technology (APCTT) of the UNESCAP. The goal of RECAST is to contribute to rapid and sustainable development of the country through enhanced R&D with the optimum utilization of natural resources, improvement and dissemination of socio-economically relevant and environmentally sustainable technologies to the communities and the institutions concerned. The objectives of RECAST are to: undertake research for the identification, development, conservation, utilization and dissemination of indigenous technology; search and identify exogenous technologies appropriate to Nepal and explore their prospects for technology transfer and adaptation; and conduct research in basic and applied sciences. RECAST has been conducting research in the areas of (i) renewable energy, (ii) natural products utilization, (iii) biotechnology, (ii) low cost building materials, (iv) small scale food processing; (v) appropriate technology, (vi) ecosystem services and biodiversity conservation, and (vii) life Science. Currently, RECAST is a collaborating institution for Kailash Sacred and Kangchenjunga Landscape Conservation and Development Initiatives.

ICIMOD

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

RESEARCH CENTRE FOR APPLIED SCIENCE AND TECHNOLOGY (RECAST)
TRIBHUVAN UNIVERSITY
P.O. Box 1030, Kirtipur, Kathmandu, Nepal
Tel: +977-1-4330348 | Fax: +977-1-4331303
Web: www.recast.edu.np

978-9937-2-9275-7