Hariyo Ban Program

CHITWAN-ANNAPURNA LANDSCAPE
BIODIVERSITY IMPORTANT AREAS AND LINKAGES

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Hariyo Ban Program

CHITWAN-ANNAPURNA LANDSCAPE
BIODIVERSITY IMPORTANT AREAS AND LINKAGES


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FOREWORD

With its diverse topographical, geographical and climatic variation, Nepal is rich in biodiversity and ecosystem services. It boasts a large diversity of flora and fauna at genetic, species and ecosystem levels. Nepal has several critical sites and wetlands including the fragile Churia ecosystem. These critical sites and biodiversity are subjected to various anthropogenic and climatic threats.

The Government of Nepal is working with a number of development and conservation partners to conserve Nepal's natural heritage. USAID funded Hariyo Ban Program, implemented by a consortium of four partners with WWF Nepal leading alongside CARE Nepal, FECOFUN and NTNC, is working towards reducing the adverse impacts of climate change, threats to biodiversity and improving livelihoods of the people in Terai Arc Landscape and Chitwan-Annapurna landscape.

This set of publications – A Rapid Assessment, Biodiversity Areas and Linkages, and Drivers of Deforestation and Forest Degradation – mark a major step forward in developing a greater understanding of a key north-south linkage in Nepal that connects the Terai to the mid-hills and the mountains through the Gandaki River basin. It provides an important insight into the unique biodiversity and ecosystem services, current land uses, core biological areas and corridors, and drivers of deforestation and forest degradation. The Government of Nepal, Ministry of Forests and Soil Conservation appreciates the multi-disciplinary approach taken by the Hariyo Ban Program to understand the importance of this region. While all the three reports serve as a base to guide the work of Hariyo Ban Program for the coming years, they also provide information that will be useful to academia, local and international organizations and the government.

I would like to thank all institutions and individuals involved in undertaking this set of three studies, including the USAID and the Hariyo Ban Program consortium partners WWF Nepal, CARE Nepal, FECOFUN and NTNC.

Krishna Prasad Acharya
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Foreword

The Government of Nepal has identified landscape level planning and conservation as a broad strategy to conserve biodiversity and improve livelihoods of local communities dependent on natural resources. It has therefore recognized two landscapes in Nepal, Terai Arc Landscape (TAL) in 2000 and Sacred Himalayan Landscape (SHL) in 2006, to help establish east-west connectivity that is crucial for biodiversity conservation. WWF Nepal is an active partner of the Government of Nepal and works closely with conservation agencies and local communities in both the landscapes to conserve the rich biological diversity of Nepal.

Recognizing the need to develop a north-south linkage that is vital to provide a safe passage of river and forest corridors for wildlife, migratory birds and aquatic animals, the Chitwan Annapurna Landscape (CHAL) was envisioned. CHAL is not a new concept. It is based on the Chitwan-Annapurna Linkage for which WWF Nepal had produced a report, 'Biodiversity Assessment and Conservation Planning', in 2000.

Since 2011, through the Hariyo Ban Program funded by the United States Agency for International Development (USAID), WWF Nepal together with the consortium partners – CARE Nepal, FECOFUN and NTNC – has started working in CHAL to empower local communities in safeguarding Nepal's living heritage and adapting to climate change through conservation and livelihood approaches.

The three CHAL reports – A Rapid Assessment, Biodiversity Important Areas and Linkages, and Drivers of Deforestation and Forest Degradation – provide important insights in understanding this important landscape in terms of its rich biodiversity, eco-regions, community and threats to further help develop pathways to build the landscape as a leading example in functional connectivity across multiple ecological communities.

I would like to thank the Government of Nepal for their support and invaluable feedback throughout various stages of this study. I also thank USAID for funding this study under the Hariyo Ban Program, and the Hariyo Ban consortium partners.

Anil Manandhar
Country Representative
WWF Nepal

Preface

The Chitwan Annapurna Landscape (CHAL) supports over 4.5 million people of diverse ethnicities, cultures and religions, many of whom are dependent on forest resources and ecosystem services for their livelihoods and wellbeing. The CHAL is one of two priority working areas for the USAID funded Hariyo Ban program. This remarkable geographic area encompasses an altitudinal range of over 8000m. Comprising the Gandaki River basin in Nepal, the CHAL spans a diverse topography which runs from the trans-himalayan rain-shadow on the Tibet border and part of the Himalaya range in the north, down through the mid-hills and Churia range, to the fertile plains of the Terai in the south bordering with India. This landscape has high biodiversity value and contains seven major sub-river basins: Trishuli, Marsyangdi, Seti, Kali Gandaki, Budi Gandaki, Rapti and Narayani.

Environmental degradation and high poverty rates create a potent mix of threats to both people and biodiversity in the CHAL. These threats are aggravated by limited understanding of the impacts of climate variability and climate change on the people and biodiversity in the CHAL.

In the growing context of increasing temperature and environmental change, the CHAL will play a crucial role in long-term biodiversity conservation and building resilience to climate change in Nepal. The three CHAL reports – A Rapid Assessment, Biodiversity Areas and Linkages, and Drivers of Deforestation and Forest Degradation – are expected to provide an in-depth understanding of the landscape, its biodiversity and threats to help build people's resilience to climate change and conserve biodiversity. USAID intends these reports to form the foundation for long-term conservation and development in the CHAL.

USAID Nepal would like to thank the Government of Nepal for their valuable support and suggestions in developing this study. We also acknowledge the untiring efforts of WWF Nepal, CARE Nepal, FECOFUN and NTNC team along with USAID's Mr. Netra Sharma (Sapkota) to shape, review and enrich this document. While this report and the other related studies will be used intensively by the Hariyo Ban Program as a basis for USAID's future work in the landscape, the information within is intended for use by a much wider audience - e.g., the Government of Nepal, civil society, private sector and donors working in the CHAL area - for the ultimate benefit of the people and biodiversity of Nepal.

Ms. Tahalia Barrett
Acting Director
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I would like to express our great appreciation to the Kathmandu Forestry College team for undertaking the study which was authored by Dr. Uday R. Sharma.

Several organizations and individuals made significant contributions to the study. This work would not have been possible without the support of the Government of Nepal. We would like to thank senior officials in the Ministry of Forest and Soil Conservation (MoFSC) and its various departments for their valuable contributions. Special thanks go to Dr. Rajan Pokharel, Regional Director, Western Regional Directorate of Forests, for his excellent support and coordination with government line agencies. Comments and suggestions provided by Krishna Acharya, Chief, Planning Division, MoFSC, and Dr. Maheshwar Dhakal, Ecologist, Department of National Parks and Wildlife Conservation were very helpful in enriching the reports.

Special thanks also go to the heads of several district level government line agencies, particularly District Forest Offices, District Soil Conservation Offices, District Livestock Offices, District Women Development Offices, and District Development Offices. I would also like to thank individual experts and representatives of various NGOs and civil society who generously provided their valuable time to enhance this report with their insights and suggestions. Representatives from FECOFUN district chapters and Community Forest User Groups made significant contributions during the consultations. Thank you to Purna Kunwar, Dev Raj Gautam, Ganga Neupane, Raj Kumar Gurung and their respective teams in the Hariyo Ban consortium partners for their active participation in the study and support to the consultation meetings.

I highly appreciate the inputs of Hariyo Ban central level team members, in particular Sandesh Hamal, Dr. Shant Raj Jnawali, Dr. Sunil Regmi, Keshav Khanal and Shikha Shrestha for their critical inputs, review and suggestions at various stages of the study. Pallavi Dhakal managed the complex production process. Jayendra R. Koirala, Prabita Shrestha and Salina Shrestha provided administrative and contractual support.

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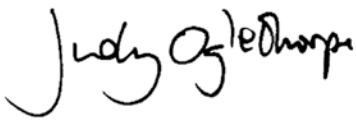
Finally, this report would not have been possible without the generous support of the American people through the United States Agency for International Development (USAID). I would like to give heartfelt thanks to Netra Sharma Sapkota, USAID Agreement Officer's Representative (Project Manager) for the Hariyo Ban Program, for his helpful engagement at various times during the study, and suggestions for the final document.



Judy Oglethorpe
Chief of Party
Hariyo Ban Program

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Acronyms and Abbreviations

ACA	Annapurna Conservation Area
BA	Biodiversity Area
BIA	Biodiversity Important Areas
BPP	Biodiversity Profiles Project
BZ	Buffer Zone
CA	Conservation Area
CAMP	Conservation Assessment and Management
CBAPO	Community Based Anti-Poaching Operation
CBD	Convention on Biological Diversity
CF	Community Forest
CHAL	Chitwan-Annapurna Landscape
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNP	Chitwan National Park
DDC	District Development Committee
DFO	District Forest Office/Officer
DFSCC	District Forest Sector Coordination Committee
DNPWC	Department of National Parks and Wildlife Conservation
DoF	Department of Forests
EIA	Environmental Impact Assessment
GHL	Greater Himalayan Landscape
GIS	Geographic Information System
GoN	Government of Nepal
HBP	Hariyo Ban Program
IAPS	Invasive Alien Plant Species
IBA	Important Bird Area
ICIMOD	International Centre for Integrated Mountain Development
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature
LNP	Langtang National Park
MAP	Medicinal and Aromatic Plant
MCA	Manaslu Conservation Area
MIST	Management Information System Tool
MoE	Ministry of Environment
MoFSC	Ministry of Forests and Soil Conservation
MW	Megawatt
NAPA	National Adaptation Plan of Action
NGO	Non-governmental Organization
NP	National Park
NTCC	National Tiger Conservation Committee
NTFP	Non-Timber Forest Product
NTNC	National Trust for Nature Conservation
PA	Protected Area
PWR	Parsa Wildlife Reserve
REDD	Reducing Emissions from Deforestation and Forest Degradation
SAWEN	South Asia Wildlife Enforcement Network
SHL	Sacred Himalayan Landscape
SNNP	Shivapuri Nagarjun National Park
TAL	Terai Arc Landscape
TAR	Tibet Autonomous Region
UK	United Kingdom
USA	United States of America
VDC	Village Development Committee
WCCB	Wildlife Crime Control Bureau

Executive Summary

The Chitwan-Annapurna Landscape (CHAL) in central Nepal is known for its biodiversity. The landscape is drained by eight major rivers (Kali Gandaki, Seti, Madi, Marsyangdi, Daraundi, Budi Gandaki, Trishuli, Rapti) and their tributaries of the broader Gandaki River system. It includes the whole of the Kali Gandaki River Basin in Nepal, encompassing all or part of 19 districts that fall within CHAL, with all or part of six protected areas represented in this landscape. The proposed landscape is 32,068 km^2 – 11.4 percent in the Siwaliks, 37.8 percent in the midhills, and 50.8 percent in the mountains. CHAL is a portion of a larger landscape, the Greater Himalayan Landscape, conceived in 1999.

Of the 17 priority "Conservation Landscapes" identified at that time, this Greater Himalayan Landscape, covering a vast area of 69,200 square km, was intended to provide adequate space for large vertebrates and facilitate ecological processes dependent on altitudinal connectivity. WWF Nepal in 2000 explored potential linkages following the existing major river systems and their tributaries. The terrestrial connectivity using the existing forests, including the community forests, was not explored in that study. The protected areas established in Nepal so far have no north-south landscape linkages. The proposed corridors and biodiversity areas recognized under this study are based on the information generated through cluster level and community level meetings coupled with experts' prior experience in those areas and careful analysis of Geographic Information System (GIS) maps. The information, however, is not exhaustive and needs field verification.

Highlights of biodiversity in CHAL have been summarized for the Siwaliks, midhills and mountains as follows: (i) The Siwaliks zone has unique grasslands and riverine forests, high ungulate density, high numbers of carnivore species, and a growing population of tiger and rhino. Chitwan National Park and Barandabhar Forest and Wetlands are recognized as Important Bird Areas of the country. The Beeshazari Lake is also a Ramsar site. (ii) The midhills have *Schima-Castanopsis* forests, which are denuded near settlements or encroached for agriculture. This zone has a recorded high number of flowering plants. Diversity of orchids is high, especially in the Panchase Hills. Shivapuri Nagarjun National Park also represents the unique biodiversity of the midhills. The forest provides suitable habitat for laughing thrushes, barbets and bulbuls, and for leopard, clouded leopard and a number of small mammals. (iii) The mountains are represented by the Annapurna Conservation Area, Manaslu Conservation Area and Langtang National Park, which harbor unique biodiversity of northern Nepal, including a stable population of snow leopard and its prey species. The Annapurna Conservation Area (ACA) lists 102 mammals, 39 reptiles and 23 amphibians. ACA is recognized as an Important Bird Area of Nepal. (iv) Being situated at the divide of the Eastern and Western Himalaya, the Kali Gandaki gorge is a recognized corridor for birds to migrate. (v) A list of ponds and water bodies has been described, but is not an exhaustive list and further study would be required to understand the wetland ecosystems of CHAL. The Goisankunda-Naukunda Lake System, a Ramsar site, through its 16 interconnected lakes provides critical habitat for rare and endemic plants and animal found in the highlands of Langtang National Park. (vi) Protected plants and wildlife, CITES listed plants and animals, and endemic plants and animals found in CHAL have also been described.

The potential four north-south corridors and three east-west corridors proposed by the study are:

North-South Corridors:
Barandabhar Forest – Gaighat – Seti River Valley – Panchase – Annapurna Conservation Area (ACA);
Barandabhar Forest – Gaighat – Seti River Valley – Madi River Valley – ACA;
Buffer Zone forests of Chitwan National Park in Nawalparasi – Churia Range – Mahabharat Range – Panchase – ACA, and
Manhari, Parsa Wildlife Reserve – Namtar – Simbhanjyang – Shivapuri Nagarjung National Park – Langtang National Park.

East-West Corridors:
Rasuwa – Gorkha – Dhading along Ganesh Himal base camp (200 m counter line);
Dhorpatan – ACA (taking 2,000 m contour line); and
ACA – Manaslu Conservation Area (MCA) Bhimtan Block (taking 2,000 m contour line).

In terms of priority, the corridor, Barandabhar-Gaighat-Seti River Valley-Panchase-ACA has been given the highest priority. The study recommends 23 biodiversity areas for focused conservation. The information on some of the biodiversity important areas proposed are sketchy, for which further field work would be required.

The top ten conservation issues described and discussed in the report are (i) degradation of wildlife habitat due to deforestation and degradation of wetland and rangeland; (ii) poaching and trade of wildlife including protected species due to absence/inadequate effective control mechanism; (iii) illegal harvest of forest resources, especially Non-Timber Forest Products (NTFPs); (iv) adverse effects due to alien invasive plant species; (v) forest fires, floods and landslides; (vi) diversion of rivers or construction of dams; (vii) crop and livestock depredation by wildlife, and human injuries or casualties; (viii) conversion of forest/forest land for non-forestry uses; (ix) inadequate awareness and motivation to protect biodiversity, and (x) weak institutional capacity.

Many of the identified biodiversity important areas, especially those falling in the corridors, function as climate refugia. The protected areas have altitudinal variations, creating opportunity for climate refugia. Increased temperatures over recent decades have made possible upward movements of vegetation; encroachment of invasive species; spread of new diseases and pests; increased incidence of dryness and fires; changed grass composition in the rangelands; and loss of local crop varieties. Upward migration of species would affect the composition of plant communities and vulnerable species may decrease in abundence if environmental factors such as soil and moisture become limiting factors. The effects of climate change will tend to aggravate the complex mountain poverty situation, which is affected by the fragility of ecosystems, remoteness, poor accessibility and marginalization of mountain communities from the mainstream. Community based forest management systems are recognized as opportunities for implementing adaptation and mitigation measures to address the adverse impacts of climate change in CHAL, as elsewhere in Nepal.

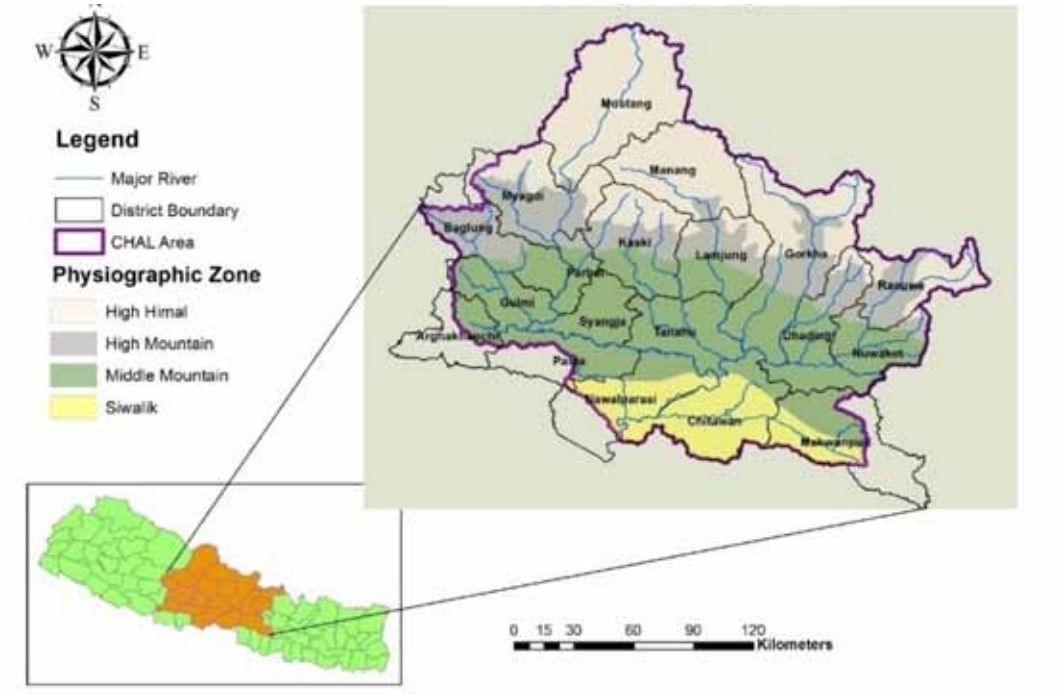
Recommendations are made to create a sound policy and legislative environment for conserving corridors and biodiversity areas, to establish a system for documentation of the status and management of biodiversity, and to address several current management related issues.

1 Introduction

The Chitwan-Annapurna Landscape (CHAL) in central Nepal is known for its rich biodiversity. The landscape is drained by eight major rivers (Kali Gandaki, Seti, Madi, Marsyangdi, Daraundi, Budi Gandaki, Trishuli, Rapti) and their tributaries of the broader Gandaki River system (Fig 1). The coverage of CHAL has been described to include the whole of the Kali Gandaki River Basin in Nepal, encompassing all or part of 19 districts with all or part of six protected areas. The districts represented in CHAL are Mustang, Manang, Gorkha, Rasuwa, Nuwakot, Dhading, Lamjung, Tanahu, Chitwan, Nawalparasi, Syanja, Kaski, Parbat, Baglung, Myagdi, Gulmi, Arghkhachi, Makwanpur, and Palpa. Chitwan and Nawalparasi Districts overlap both Terai Arc Landscape (TAL) and CHAL. The protected areas are Chitwan National Park (CNP) and its Buffer Zone, a portion of Parsa Wildlife Reserve (PWR) and its Buffer Zone, Shivapuri Nagarjung National Park (SNNP), Annapurna Conservation Area (ACA), Manaslu Conservation Area (MCA), and a portion of Langtang National Park (LNP) and its Buffer Zone.

The Chitwan-Annapurna Landscape (CHAL) is a portion of a larger landscape, the Greater Himalayan Landscape; the latter, conceived during a workshop organized for developing a biodiversity vision in Nepal in December 1999 (see WWF and International Centre for Integrated Mountain Development (ICIMOD) 2001). Of the 17 priority "Conservation Landscapes" identified by the team, this Greater Himalayan Landscape of a vast area of 69,200 square km was intended to provide adequate space for large vertebrates and facilitate ecological processes dependent on altitudinal connectivity.

Figure 1.1 Location of the Study Area



The Eastern Himalayan Ecoregion, which consists of diverse forest ecosystems of alpine, temperate and subtropical forests, includes three ecoregions belonging to the WWF's Global 200 Ecoregions: the Eastern Himalayan Alpine Meadows, the Eastern Himalayan Broadleaf and Conifer Forests, and Terai-Duar Savannas and Grasslands. The Eastern Himalaya, which extends eastwards from the gorge of the Kali Gandaki River to Myanmar, hosts part of the global biodiversity "hotspot" – the Himalaya Biodiversity Hotspot and harbors diverse ecosystems, species and genetic resources of global significance (Mittermeier et al. 2004). There is also a high level of endemism (Myers et al. 2000).

The Greater Himalayan Landscape extends south to the Chitwan-Parsa-Valmiki protected areas of Nepal and India, and comprises Terai grasslands, riverine forests and subtropical forests, predominated by sal (*Shorea robusta*). The Chitwan National Park harbors an exceptionally diverse wildlife population. It provides stable populations of tiger, leopard and their prey species and also includes rhinoceros and several other species of mammals, and harbors more than 540 species of birds (Baral and Upadhyaya 2006). On the northern side of the landscape are Qomolongma Nature Preserve in Tibet Autonomous Region (TAR) of China and Sagarmatha and Langtang National Parks, Annapurna Conservation Area, Manaslu Conservation Area, and Shivapuri Nagarjun National Park.

The linkages between the north and south in CHAL and its ecologically unique ecoregions have been studied by Basnet et al. (2000). The area falls in the watersheds of the Kali Gandaki, Marsyangdi, Modi, Seti, Madi, Trishuli, Rapti and Narayani Rivers. The potential linkages identified were by following the existing major river systems including their tributaries. The terrestrial connectivities using the existing forests, including community forests, were not explored in that study. It should be noted that the protected areas established in Nepal have no north-south landscape linkages. The buffer zones created around the national parks and reserves have increased the size of park/reserve and have also provided suitable habitats for plants and animals for local movements and also to some extent provide options for adaptation to climate change. Creation of corridors connecting two or more protected areas can also provide suitable habitat for plant and animal and options for adaptation to climate change. Furthermore, corridors would act as climate refugia where species could move to avoid temperature rise and other environmental constraints. More work of this type is required to identify the local biodiversity rich areas and climate refugia in the landscape, which would require more attention for conservation and integration at the landscape level.

Also, an issue for discussion could be whether CHAL should justifiably concern itself with the linkages between Annapurna Conservation Area (ACA) and Chitwan National Park, or a larger landscape of 19 districts, as has been proposed by the Hariyo Ban Program. Similarly, what would be the model to protect CHAL? Should it be similar to the model adopted in TAL, where the government agencies, especially the Department of National Parks and Wildlife Conservation, and the Department of Forests undertake the functions of biodiversity conservation and associated livelihood related activities in coordination with district level government line agencies including District Forest Offices (DFOs), District Development Committees (DDCs) and Protected Areas (PAs) at the district/PA level, and in coordination with user groups, user group network, and Buffer Zone Council at grassroots level? Or, should the area be declared as a conservation area, as opined by Wikramanayake et al. (1998). Some of the questions raised here are clearly beyond the scope of the current work, but this rapid assessment provides insights on the way forward.

In any case, earlier works (Basnet et al. 2000 and WWF and ICIMOD 2001) and current understandings have amply justified the need for the connectivity and linkages: (i) altitudinal connectivity is considered beneficial for maintaining the ecological integrity of the larger landscape; (ii) over 400 species of birds undertake seasonal migration from the lower forest areas to the higher elevation habitats; connectivity would assure their vital seasonal activity; (iii) the connectivity permits the migration of flora and fauna, or to accommodate adaptation to changes in climate; (iv) even maintaining fragmented forest patches as "stepping stones" for birds and possibly other species is a better strategy than loss of those forests; and (v) some floral endemism hotspots are outside the PAs and need equal efforts for their conservation.

This study has identified and mapped (using GIS) biodiversity rich areas and potential areas for biodiversity conservation in CHAL, with particular focus on areas that lie outside the PAs. It has also identified existing and potential biological corridors (including forest and freshwater) that could effectively serve as north-south linkages and potential climate change refugia. In addition, the study has broadly assessed the current status of biodiversity, major management issues and threats, and recommends major activities and approaches required for addressing the issues.

2 Brief Methodology

A detailed methodology has been described in a separate report. This paper summarizes the mechanisms used to generate primary information for this work.

Two teams comprising biodiversity or forestry experts visited several field sites representing all 19 districts of CHAL. Cluster level meetings were organized to understand the view points of district based government agencies, Non-governmental Organizations (NGOs), civil society and experts. The two teams split after the first joint, larger meeting in Pokhara, in which all key Hariyo Ban professional staff participated. The eastern team participated in two all-day cluster-level meetings organized in Besisahar, Lamjung and Bidur, Nuwakot, and 10 community level meetings. The western team participated in two similar cluster level meetings organized in Beni, Myagdi district and Palpa district. There were seven community level meetings organized for the western team. The community level meetings lasted usually for about 2-3 hours. There was a checklist of questions for these meetings (Annex A); questions were asked to seek first hand experience. These meetings were held to determine if the proposed linkage(s) are suitable for recommendation; to explore unique biodiversity sites that can be identified as biodiversity areas in the landscape, and to determine if the chosen linkages are functional and if there is adequate local and agency support for their proposal. In essence, the proposed corridors and biodiversity areas are recognized based on the information generated through these meetings coupled with experts' prior experience in those areas and careful analysis of GIS maps.

There was limited travel within the proposed corridors and biodiversity areas. Where possible, the team tried to visually evaluate their condition and enquire on-site about the issues and challenges for biodiversity conservation.

3 Highlights of Biodiversity in CHAL

It's unique geographical position and altitudinal and climatic variations make CHAL rich in floral and faunal diversity.

3.1 Siwaliks

Including a few small patches of Terai areas in the districts of Nawalparasi and Chitwan, which fall within the landscape, the Siwaliks range comprises 11.4 percent of the total 32,068 km² CHAL area.

An older technical report compiled by the Biodiversity Profile Project (BPP 1995a) for the Terai and Siwaliks zone, shows that this physiographic zone contains species and ecosystems of global significance. The grasslands of Chitwan are considered as being biologically outstanding and are among the last remaining patches in the Indo-Gangetic Plains. The riverine grasslands and grassland-forest mosaics support extremely high ungulate biomass. *Saccharum spontaneum* is the dominant tall grass that emerges from the silt deposited after floods retreat. This grass is the most nutritious of all grasses and provides the major food for ungulates and domestic stock, including the domestic elephants. In Chitwan, grasslands comprise about 20 percent of the park. In moist areas, *Saccharum*, *Narenga* and *Themeda* species form tall grass communities. In old agricultural sites, *Imperata cylindrica*, a short grass, occurs in almost pure stands. The diversity of grassland can be appreciated by the fact that over 40 species of grasses have been identified from the Sauraha area alone (Laurie 1978). The grasslands in recent times are increasingly invaded by scrub and forests (Department of National Parks and Wildlife Conservation (DNPWC), 2006). On the other hand, resettlement of Padampur Village Development Committee (VDC), which used to be a large enclave settlement in CNP, has increased new grasslands in the park.

The World Wildlife Fund (WWF) has identified Chitwan's grasslands as being part of one of the important ecoregions for biologically outstanding grasslands (Olson and Dinerstein 1998). Named as Terai-Duar savannas and grasslands, it extends from Dehradun, India, across Nepal's Terai zone to the Duar grasslands of Bhutan. This type of grassland is today no more than two percent of the alluvial grasslands of Indo-Gangetic Plains, and one of the best examples of this can be seen in CNP (Dinerstein 2003).

This grassland and the adjoining riverine forest ecosystem support two of the last remaining populations of rhinoceros and tiger. There are healthy populations of several species of deer, and at least 17 species of carnivores are found in the park (Sunquist 1981). A total of 56 species of mammals is recorded in the park (DNPWC 2001), and the crude biomass estimate for ungulates in Chitwan has been reported as high as 28,076 kg/sq km, which is comparable to figures in East Africa (Seidensticker 1976). The high productivity of riverine forest ecosystem has provided this opportunity. Rhinoceros comprise much of this biomass. Other species include sambar (*Cervus unicolor*), chital (*Axis axis*), hog deer (*Axis porcinus*), barking deer (*Muntiacus muntjack*), and wild boar (*Sus scrofa*). In the Siwaliks and their foothills, gaur (*Bos gaurus*) are found in good number. The continuous belt of forest from Parsa Wildlife Reserve to the east, and Valmikinagar Wildlife Sanctuary in India to the south, has provided good habitat for healthy populations of tiger (*Panthera tigris)* and leopard (*Panthera pardus)*. The tiger density is high compared to other areas of Asia (Sunquist et al. 1999).

The tiger census conducted in 1995-1996 in CNP showed the tiger population of Chitwan as 48-49 breeding animals (DNPWC 1999); the tiger census in 2005 reported 50-60 adult breeding individuals

(DNPWC 2006); the census of 2008/2009 in CNP put the number at 91 and four adult breeding animals in Parsa Wildlife Reserve (PWR) (DNPWC 2012); and the 2010 census showed CNP to have 125 and PWR to have four breeding adults, (DNPWC 2012). These figures show a growing tiger population in CNP and surrounding forests. In addition, CNP has a transient population of wild elephant (*Elephas maximus*) that visit the park from the east from time to time.

The vegetation of the lowlands of CHAL is dominated by sal forests (*Shorea robusta*). In CNP sal forests comprise about 70 percent of the park and are considered climax forest. Sal forests occur in almost pure stands in many situations and also in association with other trees, including *Terminalia* spp., *Dillenia pentagyana, Syzyigium cumini*, *Lagerstroemia parviflora*, and *Phyllantus emblica*. The understory consists of tall grasses or sparse growth of scrub. Riverine forest occurs along rivers, oxbow lakes and on islands in the rivers. These deciduous forests are found in two distinct associations based on the stage of succession, the association of *Acacia catechu* and *Dalbergia sissoo* in the earlier stage, and the association of *Bombax ceiba* and *Trewia nudiflora* in the later stage.

Chitwan National Park is recognized as an Important Bird Area (IBA) of Nepal and harbors a total of 540 bird species (Baral and Inskipp 2005, Baral and Upadhyay 2006). The high diversity of birds is attributed to the diverse habitat types which consist of forests, grasslands and wetlands. The park is the stopover for many long-range migratory birds. Inskipp (1989) lists 55 breeding bird species in Chitwan, 36 of which have been classified as endangered or vulnerable. Chitwan is particularly important for several grassland species, including Bengal Florican, Grey-crowned Prinia and Slender-billed Babbler, and also for Lesser Adjutant.

There are 47 species of reptiles and nine species of amphibians reported in the park (DNPWC 2001). Edds (1989) has recorded 120 species of fish in the Kali Gandaki/Narayani River. Fish are important food for gharial, mugger (*Crocodylus palustris*), otter (*Lutra perspicillata*), turtle, and fish-eating birds.

Chitwan National Park is recognized as a World Heritage Site for Nature for (i) being the last remaining stronghold of natural areas of high biological diversity protected from human interference; (ii) including habitats of endangered tiger, rhinoceros, gaur, gharial and Gangetic dolphin; (iii) being an outstanding and beautiful ecosystem of the Churia Valley; and (iv) enjoying the highest level of protection provided by the Government of Nepal (Sharma 1991).

The Siwaliks physiographic zone provides enormous ecological services. The stretch of the Churia hills (often called the Siwaliks) falling within Parsa Wildlife Reserve and Chitwan National Park has continued to remain as wilderness area. Until the 1950s, the Churia area was sparsely populated. But, with increased pressure on the plains and better access, the land opened new opportunities for poor settlers. The deforestation and over harvesting of natural resources, unsustainable agriculture and currently growing trend of excavating riverbeds and hillsides for stones and boulders have accelerated soil erosion, adversely affecting the environmental condition of Churia. The Churia hills outside of CNP and PWR, especially in Makwanpur and Nawalparasi Districts, need special attention to prevent further degradation (Sharma 2012). Stabalizing the slopes of the Churia would prevent soil erosion, recharge ground water for the plains, and prevent natural disasters in terms of flash floods and deposition of soil and debris on fields. Well protected Churia forests are the best wilderness areas in Nepal, being home to a complex vegetation mix including several endemic species (BPP 1955b, Bhuju, 2000). Bhuju (2000) found in a sample study a tremendous floral diversity of over 265 vascular plant species, including rare species such as *Dalbergia latifolia* and one endemic species, *Ormosia glauca*.

Adjacent to CNP to the north, Barandabhar Forest is a narrow strip (1.8-7 km) joining CNP with the foothills of the Mahabharat Range. The area south of the East-West Highway is part of the Buffer Zone of CNP, whereas the area north of the highway is declared a protection forest.

The Barandabhar Forest and other forests in the foothills of the Mahabharat near Jutpani exhibit similar floristic and faunal composition to the typical lowland sal forest found in CNP. Sal is the dominant species together with other co-dominant tree species such as *Terminalia*; its second layer of tree comprises *Careya arborea*, *Semecarpus anacardium* and *Dillenia pentagyana*. Good forest protected against over-grazing has a rich shrub layer of various species. The forest in Barandabhar is interspersed with grasslands and wetlands. The Beeshazari Tal, a Ramsar site, in the Barandabhar

forest provides the best wetland habitats in this area.

The foothills of the Mahabharat Hills including the Barandabhar Forest are the best habitats for large carnivores, including tiger and leopard and large ungulates including rhinoceros and deer. Other wildlife includes sloth bear, primates and rodents. Several migratory and resident birds find these areas suitable habitat. The site is recognized as an Important Bird Area of Nepal, where several globally threatened species reside or pass through; they include the Great Hornbill, Pallas's Fish Eagle, several other eagles, vultures and storks. It is home to about 282 bird species including the Lesser Adjutant, Great Hornbill, Grey-headed Fish Eagle and Darter (Baral and Inskipp 2005). This site serves as an important corridor for migrating birds and other wildlife.

The tropical sal forest extends only up to 300 m in elevation. The forests of riverine khair – sissoo occurring close to sal forest along the floodplains in Terai and Dun Valleys extends up to 500 m. *Acacia catechu* and *Dalbergia sissoo* form pure or inter-mixed stands and provide good habitat for wildlife of lowland plains. CHAL has a predominance of hill sal forest, which occurs between 300 and 1,000 m. Sal is associated with other tree species including *Terminalia*, *Anogeissus* and *Lagerstroemia*. On dry slopes, the forest is not very rich in species, but in river gorges and ravines the number of tree species, shrubs and epiphytes increases substantially. Orchids are abundant in ravine areas and wild mangoes and bananas together with species such as *Cycas pectinata*, *Gnetum montanumm,* and *Cyathea spinolosa* occur in unique combination (Department of Forests (DoF), 2002).

3.2 Midhills

The midhills occupy 37.8 percent of CHAL and have a sub-tropical to temperate monsoonal climate and are characterized by intensive farming on hillside terraces. The forest of *Schima-Castanopsis* is an important forest in the Mahabharat Hills between 1,000 and 2,000 m. *Schima wallichii* is distributed over all of central Nepal, east of the Kali Gandaki River. *Schima wallichii* occurs in association with *Castanopsis indica* at lower elevation (1000-2,000 m) and with *Castanopsis tribuloides* at higher elevations (1,500-2,000 m); at times both species can be found in the same forest as their altitudinal distribution is not sharply differentiated (DoF 2002). This altitudinal zone is under intense use for terraced agriculture and human settlement, often referred to as one of the world's agricultural wonders. As a result the *Schima-Castanopsis* forests are denuded near settlements or encroached for agriculture. Community forest management, in recent times, has helped to restore some of the denuded forests in some areas. BPP (1995a) has compiled a list of flowering plants in Central Nepal across different physiographic zones and has recorded high numbers of flowering plants in the midhills. *Schima-Castanopsis* is well known for hosting laughing thrushes, barbets and bulbuls, among other birds. The forest provides suitable habitat for leopard, clouded leopard and a number of small mammals.

Alnus nepalensis (found between 500 and 2,700 m) forms dense forest along moist sites, especially in ravines, river banks and areas of fresh landslides. The species is liked by villagers for timber and fuel wood because it occurs in waste lands such as ravines and does not require much effort to grow. On the higher reaches of CHAL, above 2,000 m extending up to 2,500 m, lower temperate oak forest appears. Dense oak forests with hanging moss are seen on the hill tops and provide valuable fodder and fuelwood inputs to villagers. *Quercus langinosa*, *Q. incana* and *Q. lamellose* in association with *Rhododendron arboream* and a number of lauraceous plants occur in this type of forest. Among birds, sibia, blackbirds and laughing thrushes are typical. An earlier study (Basnet et al. 2000) has concluded that the Madi River Valley, of all the river valleys, carries a high plant diversity in terms of species and high tree density in terms of ratio between tree density and basal area. The Madi Valley, similarly, has been found to have a high altitudinal gradient and habitat diversity and is less disturbed and provides large midhill forest blocks.

Midhills mammals include Chinese pangolin (*Manis pentadactyla)*, rhesus macaque (*Macacca mullata*), jackal (*Canis* aureus), barking deer (*Muntiacus muntjak*), red fox (*Vulpes vulpes*), Himalayan black bear (*Ursus thibetanus*), hanuman languor (*Presbytes entellus*), jungle cat (*Felis chaus*), common leopard (*Panthera pardus*), Himalayan goral (*Naemorhedus goral*) and serow (*Capricornis sumantraensis*).

3.3 Mountains

The mountains of CHAL are characterized by high steep slopes, deep gorges and cold temperate climates. They harbor luxuriant natural conifer forests in some locations. Areas located above 4,000 m above sea level comprise sub-alpine and alpine climates and associated vegetation types. Summer grazing pastures are common and high altitude plant species adapted to extremes of cold and desiccation are found in higher elevations. Mountains comprise 50.8 percent of CHAL area.

Annapurna Conservation Area (ACA) dominates the landscape in this category. Two distinct climatic regions (rainfall, 3000 mm; <500 mm) fall within a span of 120km and altitudes of 1,000-8,000 m. The ACA initiated in 1986 as a pilot project in an area of 200 sq. km was expanded, due to tremendous interest among local communities, to an area of 7,629 sq. km covering 57 VDCS in five districts (Bajracharya 1995, National Trust for Nature Conservation (NTNC) 2008). The ACA is the largest protected area in Nepal. Gazetted in 1992, it is managed on the concept of Integrated Conservation and Development (ICDP). The northern range of the landscape harbors viable populations of argali (*Ovis ammon*), blue sheep (*Psudois nayur*) and Asiatic wild ass (*Equus hemionus*). The range of blue sheep extends south to Annapurna and Manaslu. The upper elevations include habitats of snow leopard (*Uncia uncia*), and Himalayan tahr (*Hemitragus jemlahicus*), while serow (*Capricornis sumatraensis*) and goral (*Nemorhaedus goral*) ranges extend further south. The Tibetan wolf (*Canis lupus*) and lynx (*Felis lynx*) are other predators found in these ranges.

ACA is recognized as an Important Bird Area of Nepal and a total of 486 birds have been reported there (Baral and Inskipp 2005). The ACA Management Plan lists 102 mammals, 39 reptiles and 23 amphibians. Being situated at the divide of the Eastern and Western Himalaya, the Kali Gandaki gorge is a recognized corridor for migrating birds. The Kali Gandaki River originates in Nepal near Tibet, flows southward through the Mustang Basin, crosses the Himalayas in a gorge, and descends to the lowlands of Nepal. The total length in the Nepalese territory is about 300km. Compared to other rivers, the Kali Valley is the deepest gorge, at 5,486m. The gorge provides a natural east-west barrier for plants and animals. It provides an ideal site for research to understand the effects of barriers on the distribution of species and other associated factors.

Manaslu CA and Langtang NP harbor similar biodiversity of the northern Nepal. Shivapuri Nagarjun NP represents the unique biodiversity of the midhills of Nepal.

Dobremez (1996, cited in HMGN/MoFSC 2002) has described an altitudinal distribution of flora of central Nepal. The eleven ecological levels from lower tropical level (below 500 m) to highest level (above 5,000 m) are represented in CHAL. The BPP (1995a) has shown the distribution of flowering plants (Table 3.1), which shows high numbers of flowering plants in the midhills. Diversity of orchids is high, especially seen in the Panchase Hills, where Kaski, Parbat and Syangja District boundaries meet (DoF 2012c).

Similarly, 283 Bryophytes and 97 Pteridophytes are recorded from Central Nepal. BPP (1995a) lists a further twelve gymnosperms in CNP and ACA. Other flora include lichens and fungi; algae are little known in CHAL.

Because of the high floral and ecosystem diversity, CHAL also has equally high faunal diversity. Mammals are distributed in Nepal's three physiographic zones as 56 species in the Terai-Siwaliks (DNPWC 2001), 32 species in the midhills, and 30 species in the highlands (Suwal and Verheuugt 1995). More recent tabulation by altitude by Baral and Shah (2008) has reported 79 mammals below 1,000 m, 52 between 1,000 and 3,000 m, and 20 above 3,000 m. A separate listing of mammals for CHAL is not available.

Table 3.1 Distribution of Flowering Plants in Different Physiographic Zones in the Central Region of Nepal

Zone	No. of Plants
High Himalaya (Nival)	181
High Mountain (Alpine and sub-alpine)	1.602
Midhills (Temperate and sub-tropical)	2,727
Silwalik and Terai	1,420
Total	**5,930**

Source: (Biodiversity Profiles Project 1995a)

4 Wetlands of CHAL

There are numerous natural lakes and man made ponds and reservoirs in the Gandaki Basin. Pokhara Valley contains nine lakes, namely Fewa (443 ha), Begnas (373 ha), Rupa (115 ha), Khaste (13.57 ha), Dipang (8.9 ha), Gunde (4.98 ha), Neurani (2.8 ha), Maidi (1.17 ha) and Nandi. The cluster of lakes that lies in the Gosaikunda-Naukunda Lake area, Tilicho in Manang, and Beeshazari Tal in Chitwan are important lakes in CHAL. Box 4.1 lists some ponds and water bodies reported during the field trip. This is not an exhaustive list and further study would be required to understand wetland ecosystems in CHAL.

Wetland ecosystems are recognized as an important category of ecosystems that have rich biological diversity and are known to support more than 200,000 waterfowl in Nepal during the peak period of migration, between December and February (MoFSC 2002). Although surveys of wetlands of the country in all three physiographic zones have been conducted, it is still an area with insufficient information. A detailed inventory of wetlands carried out in Terai (International Union for Conservation of Nature (IUCN) - Nepal 1996) has reported 32 wetland sites in the lowlands of CHAL: nine in Nawalparasi and 23 in Chitwan District. However, a recent study on the wetlands of CNP and its Buffer Zone has shown 44 wetlands in these areas alone (J. B. Karki, Pers. Com, 17 July 2012) (Box 4.2). In higher areas, the Goisankunda–Naukunda Lake system (4,054–4,609 m asl) spread across 54 ha through its 16 interconnected lakes, providing critical habitat for a number of rare and endemic plants and animals (Karki et al. 2005).

BOX 4.1 Natural Lakes Reported from the Gandaki Basin

Nuwakot:	Suryakund, Sagarkund, Baldehital
Rasuwa:	Gosainkund, Bhairavkund, Surajkund, Saraswotikund, Parbatikund, Ganeshkund, Jalesworkund
Gorkha:	Kalchhuman (1.5 km long), Narad Kund, Dudhpokhari, Bhulbhulekhar, Birendra Chhosong, Pushkar Tirtha, Ranipokhari, Manepani
Lamjung:	Dudhpokhari, Mamepokhari, Ilampokhari, Barhapokhari
Kaski:	Fewa, Begnas, Rupa, Khaste, Dipang, Gunde, Neurani, Maidi, Nandi lakes and Shanti Kund
Mustang:	Damodar Kund, Dhumba Tal, Titi Tal, Sekong Tal
Baglung:	Gajako Dah (Damek), Rudratal, Bobang, Nildah (Bhakunde)
Nawalparasi:	Small lakes above Daunne
Arghakhanchi:	Thadadah, Senglengdah, Gahachaurdah, Paneradah
Palpa:	Satyabati Tal, Suke, Nandan, Sitakund
Syangja:	Andhaandhi Dah, Chhangchhangdi
Manang:	Tilicho Lake, Gangapurna Lake, Mringchho Lake, Ngyamcho, Ponkar, Himlung Lake, Kecho Lake
Chitwan:	Satrahazar Tal, Beeshazari Tal, Sattaishazar Tal, Atthaishazar Tal, Mundatal, Devital, Lamital, Tamorghaila Tal, Kasaratal, Nandbahuju Tal, Anjuratal, Manjuratal, Gaduwatal, Anjanatal, Parshuram Kund, Baikuntha Kund

BOX 4.2 Wetlands of Chitwan National Park and its Buffer Zone

In National Park: 1. Gaidakhasa Ghol East of Gaidakhasa 2. Temple Tiger Ghol in front of former Temple Tiger Hotel 3. Jamuna Ghol Bandarjhula Island 4. Mardi Ghol Bandharjhula Island 5. Devi Tal South of Khoriyamuhan 6. Lamo Tal East of Khoriyamuhan 7. Munda Tal South-east of Baghmara 8. Singe Tal South of Baghmara 9. Nanda Bhauju Tal North-west of Bhimle 10. Suksuke Tal South of Bhimle 11. Budhi Rapti Ghol East of Bhimle 12. Thotari Tal West of Bankatta 13. Kamal Tal East of Sukhibhar 14. Sera Tal West of Dhruba 15. Thapaliya Tal South-west of Kasara 16. Niure Ghol Kasara 17. Tamor Tal South of Kasara 18. Lami Tal West of Ghatgai 19. Simara Ghol Near Botesimara 20. Sapnawoti Ghol East of Bankatta 21. Laguna Tal West of Jarneli 22. Gaur Machan Ghol Near Gaur Machan 23. Dumariya Ghol North-west of Dumariya 24. Majur Tal West of Charahara Khola 25. Nandan Tal South of Bhawanipur 26. Jayamangala Ghol Padampur west 27. Marchauli Ghol Padampur 28. Garud/Patna Tal Padampur 29. Python Tal West of Bhimpur 30. Chaparchuli Ghol Near Chaparchulli Post 31. Ghol near former Chitwan Jungle Lodge 32. Liglige Ghol West of Sunachuri 33. Icharni Ghol complex Icharni.

In Buffer Zone: 34. Lamichaur Ghol complex Lamichaur 35. Beeshazari Tal complex Barandabhar 36. Chepang Tal Tikauli 37. Tikauli Tal Tikauli 38. Bob Tal Barandabhar 39. Kumrose Tal Kumrose BCF 40. Musahar Tal Baghmara BCF 41. Kuchkuche Ghol Kuchkuche BCF 42. Kumal Tal Milijuli BCF 43. Belsahar Tal Belsahar BCF 44. Sitamai Tal Near Sitamai Ghat.

Source: Chitwan National Park Buffer Zone (CNP BZ) Management Plan (2012-2016), under preparation

5 Threatened and Endemic Species

5.1 Flora

The Government of Nepal has yet to produce a list of threatened and endangered plants for Nepal. It, however, imposes bans from time to time on collecting plant resources from the wild and export of plant materials in the raw form and imposes felling bans for selected tree species by publishing notifications in the Nepal Gazette. The list of these plants can be considered as being the protected plant list of Nepal (Table 5.1). These plants occur in CHAL.

The Conservation Assessment and Management Workshop (CAMP), held in Pokhara in 2000 assessed the conservation and management status of Medicinal and Aromatic Plants of Nepal using IUCN guidelines and produced a list of 51 plants under various threat categories (Bhattarai et al. 2002). Nine more species have been added to the list by Sharma et al. (2004).

Fourteen plants of Nepal, occuring in CHAL, have been listed in the Annexes of CITES (Table 5.2). Of the 14 CITES listed species, *Dioscorea deltoidea, Podophyllum hexandrum, Rauvolfia serpentine, Taxus wallichiana* and some species of the family *Orchidaceae* are important medicinal plants.

Table 5.1 Protected Plants of Nepal

Scientific Name	Local name
I Banned for collection, transportation and trade	
Dactylorhiza hatagirea	Panchaunle
Root bark of *Juglans regia*	Okhar ko bokra
Picrorhiza scrophulariiflora	Kutki
II. Banned from export outside the country in raw form	
Nardostachys grandiflora	Jatamansi
Rauwalfia serpentina	Sarpagandha
Sinnamomum glaucescens	Sugandhokokila
Valeriana jatamansi	Sugandhawaal
Lichen species	Jhyaau
Abies spectabilis	Taalispatra
Taxus wallichiana	Lauth salla
Cordyceps sinensis	Yarshagomba
III Banned for felling, transporation and export	
Shorea robusta	Sal
Dalbergia latifolia	Satisal
Pterocarpus marsupium	Bijaysal
Juglans regia	Okhar
Bombax ceiba	Simal

Source: Department of Forests, Government of Nepal

Table 5.2. CITES Listed Plants found in Nepal

	Plant Name	Nepali Name	Appendix
1.	*Sausurea lappa**	Kuth	I
2.	*Ceropegia pubescens*	Mirke laharo	II
3.	*Cythea spinosa*	Rukh unyu	II
4.	*Cycas pectinata*	Jokar, Jaggar, Kalbal	II
5.	*Diascorea deltoidea*	Bhyakur	II
6.	*Orchidaceae* family	Sunakhari	II
7	*Picrorhiza kurroa*	Kutki	II
8.	*Podophyllum hexandrum*	Laghupatra	II
9.	*Rauvolfia serpentine*	Sarpagandha	II
10.	*Taxas wallichiana*	Lauth salla	II
11.	*Gnetum montanum*	Bhote lahara	III
12.	*Meconopsis regia*	Kyashar	III
13.	*Podocarpus neriifolius*	Gunsi	III
14.	*Talauma hodgsonii*	Magnolia	III
15.	*Tetracentron sinense*	Jharokote	III

**This is an exotic species to Nepal. Source: CITES: http://www.cites.org*

Endemic flowering plants of Nepal are described in three volumes published by the Department of Plant Resources, Government of Nepal (Rajbhandari and Adhikari 2009, Rajbhandari and Dhungana 2010, and Rajbhandari and Dhungana 2011). The total number of plants listed so far is 282, of which 69 percent grow in Central Nepal, of which CHAL is a part. Most of the endemic plants are found in higher elevations above 2,000 m; the highest recorded was at 5,500 m. More work is required to complete this picture, specially the non-flowering plants.

5.2 Fauna

The National Parks and Wildlife Act lists 39 wildlife species as protected, and many of these species are listed in the CITES Annexes as well as in the IUCN threat categories (Table 5.3). Of these animals black buck, wild water buffalo and swamp deer are not reported to be found in the CHAL area.

Aryal (2009) has analyzed and listed the Nepalese species falling in the Appendices of CITES. Table 5.4 summarizes his listing for animals; almost all of these listed species are represented in CHAL.

Only one bird species is considered as endemic. The Spiny Babbler *Turdoides nipalensis* is found between 915 and 1,830 m in winter and 1,500-2,135 m in summer (Grimet et al. 2003). CHAL provides ideal habitat for this bird.

One rodent species, the Himalayan field mouse *Apodemus gurkha* is endemic to Nepal. It occurs in central Nepal between 2,200 and 3,600 m in coniferous forest; several districts of CHAL, from Gorkha to Mustang, provide habitat for this endemic mammal (Suwal and Verheugt 1995). Further, Baral and Shah (2008) have reported Csorba's mouse-eared bat (*Myotis csorbai*) as an endemic bat found in the midhills, including those of CHAL.

Biodiversity information for CHAL is sporadically spread over much literature. More detailed research by a team comprising experts in various disciplines of biodiversity would be required to catalogue the available information, verify species presence in CHAL, and explain their status. Such information would be valuable to a large audience; therefore, it should be disseminated through a web-based portal.

Table 5.3 Protected Wildlife of Nepal

	Scientific Name	Common Name	IUCN Threat cat.	CITES Appen
1	*Ailurus fulgens*	Red panda	Endangered	I
2	*Antilope cervicapra*	Black buck	Near threatened	III
3	*Bos gaurus*	Gaur	Vulnerable	I
4	*Bos mutus*	Wild yak	Vulnerable	I
5	*Bubalus arnee*	Wild water buffalo	Endangered	III
6	*Canis lupus*	Tibetan wolf	Least concern	I
7	*Caprolagus hispidus*	Hispid hare	Endangered	I
8	*Cervus duvauceli*	Swamp deer	Vulnerable	I
9	*Elephas maximus*	Asiatic elephant	Endangered	I
10	*Felis lynx*	Himalayan lynx	Near threatened	II
11	*Hyaena hyaena*	Striped hyena	Near threatened	III
12	*Macaca assamensis*	Assamese monkey	Vulnerable	II
13	*Manis crassicaudata*	Indian pangolin	Near threatened	II
14	*Manis pentadactyla*	Chinese pangolin	Near threatened	II
15	*Moschus chrisogaster*	Musk deer	Near threatened	I
16	*Ovis ammon*	Great Tibetan Sheep	Vulnerable	I
17	*Panthera tigris*	Bengal tiger	Endangered	I
18	*Uncia uncia*	Snow leopard	Endangered	I
19	*Pantholops hodgsoni*	Tibetan antelope	Endangered	I
20	*Pardofelis nebulosa*	Clouded leopard	Vulnerable	I
21	*Platanista gangetica*	Gangetic dolphin	Endangered	I
22	*Prionailurus bengalensis*	Leopard cat	Least concern	I
23	*Prionodon pardicolor*	Spotted linsang	Least concern	I
24	*Rhinoceros unicornis*	Asian one horned rhinoceros	Endangered	I
25	*Sus salvanius*	Pygmy hog	Critically endangered	I
26	*Tetraceros quadricornis*	Four-horned antelope	Vulnerable	III
27	*Ursus arctos*	Brown bear	Least concern	I
28	*Buceros bicornis*	Giant Hornbill	I	
29	*Catreus wallichii*	Cheer Pheasant	Endangered	I
30	*Ciconia ciconia*	White Stork		
31	*Ciconia nigra*	Black Stork	III	
32	*Eupodotis bengalensis*	Bengal Florican	Endangered	I
33	*Grus grus* (*G. antigone*)	Common Crane	II	
34	*Lophophorus impejanus*	Impeyan Pheasant	I	
35	*Sypheotides indica*	Lesser Florican	Endangered	II
36	*Tragopan satyra*	Crimson-horned Pheasant		III
37	*Gavialis gangeticus*	Gharial	Endangered	I
38	*Python molurus*	Asiatic rock python	Vulnerable	I
39	*Varanus flavescens*	Golden monitor lizard	I	

Sources: HMGN (2002) and Aryal (2009)

Table 5.4. Nepalese Species in the Appendices of CITES

	Appendix 1	Appendix 2	Appendix 3	Total
Wild mammals	29	15	3	47
Birds	18	91	1	110
Reptiles	8	10	-	18
Amphibians	-	1	-	1
Butterfly	-	3	-	3
Total	55	120	4	179

Source: Aryal (2009)

6 Corridors

Corridors connect two or more protected areas, providing suitable habitat for plants and animals to move through. Nepal has considerable experience in creating and working in the Terai Arc Landscape (TAL), which spans the lowlands of Nepal and India. More and more countries are adopting policies to undertake conservation at landscape level using corridors to link biodiversity important areas. Bhutan has adopted the Biological Conservation Complex Plan (MoA 2004), which provides the necessary blueprint for integrated management of PAs and connecting biological corridors. Corridors vary in land use composition, width, human use, and ownership patterns. There is no one uniform design, but attempts are made to select sites that are still forested, have suitable habitat structures and functional ecological processes. The corridors tend to reduce the effects of island biogeography and provide opportunities to species to migrate to avoid harmful effects of climate change and other adverse environmental factors. The width of corridor should be as wide as possible but not less than 0.5-3.0 km. Where land uses in the corridors are particularly unfavorable, legal and economic incentives can help land owners to voluntarily shift their practices to nature-friendly uses.

In 1999, identification of "Priority Landscapes" was conducted by experts in a workshop held in Kathmandu (WWF and ICIMOD 2001). The work of the biological assessment and gap analysis of the Himalaya by Wikramanayake et al. (1998) provided much needed background for this proposition. The subsequent outputs included approximate areas, now called TAL and CHAL, which were recommended as requiring focused conservation work. Five river valleys were considered as potential south-north corridors: (i) Chitwan-Langtang corridor; (ii) Chitwan-Manaslu corridor; (iii) Chitwan-Narayani-Kali-Annapurna linkages; (iv) Chitwan-Narayani-Marsyangdi-Annapurna linkages, and (v) Parsa-Makwanpur-Chandragiri-Shivapuri-Langtang corridor. Wikramanayake et al. (1998) also recommended the Chitwan Annapurna linkage area as "biodiversity conservation areas." They further proposed that as large blocks of most ecoregions remain outside the boundaries of existing protected areas, declaration of new protected areas or realignments of boundaries of existing protected areas should be considered. For example, Terai-Duar Savanna and Grasslands, although well represented in lowland protected areas of Nepal, have several large blocks of habitat remaining unprotected to the west of Chitwan National Park.

The experts' group delineated the "Greater Himalayan Landscape" (GHL) which incorporated several protected areas of Nepal in the Eastern Himalaya including Chitwan National Park, Parsa Wildlife Reserve, Koshi Tappu Wildlife Reserve, Langtang National Park, Sagarmatha National Park, Makalu Barun National Park, Manaslu Conservation Area and Annapurna Conservation Area. But later the GHL idea was reformulated and the Government of Nepal (MoFSC 2006) adopted the Sacred Himalayan Landscape (SHL) of 39,021km^2, of which about 73.5 percent falls in Nepal and rest in India and Bhutan. The SHL extends east of Langtang National Park (including all its area) and connects to the proposed Kangchenjunga Landscape and overlaps its area in India (Sikkim and Darjeeling Hills) and Bhutan Toorsa Strict Nature Reserve (Sharma 2010). The SHL represents significant areas of two globally important ecoregions: the Eastern Himalayan Alpine Meadow and the Eastern Himalayan Broadleaf and Conifer Forests. It should be noted that the SHL does not link with TAL; so that the opportunity of conservation on a river basin basis is not possible through SHL and TAL alone, thus not fulfilling the vision of the GHL. CHAL provides the critical linkages north-south, including the

important areas of the midhills of Nepal. This linkage is highly important for climate adaptation as well as for freshwater conservation.

It is learnt that the Government of Nepal (GoN), MoFSC, has decided to expand the SHL westward to include the majority of the area covered by CHAL. When the GoN's Sacred Himalayan Landscape strategy is revised in a few years, it is envisaged that the CHAL strategy will be merged in a new strategy for the expanded landscape. This measure would bring connectivity of one more globally important ecoregion, the Terai-Duar Savanna and Grasslands and create linkages with eight protected areas of Nepal alone. CHAL and SHL are contiguous with a large protected area of the Tibet Autonomous Region - Qomolongma Nature Preserve; and they together have continuity with the Kangchenjunga Landscape in India and Bhutan and would subsequently connect to Bhutan's Biological Conservation Complex (MoA 2004).

Basnet et al. (2000) studied six districts, Kaski, Lamjung, Gorkha, Tanahu, Chitwan and Nawalparasi, covering a total area of 11,230 km^2. This landscape extends from the lowland plains to upland mountains with an altitudinal range of 200-2,200 m. Several important rivers, Trishuli, Marsyangdi, Madi, Seti and Kali Gandaki flow through these areas. Although not explicit about their recommendation, the team seems to have been proposing this landscape for the CHAL.

The naturally existing corridors are shown in Figure 6.1. It should be noted that north-south connectivity through forest possibly existed prior to the major settlements in the midhills, but documentation of this aspect is not readily available.

The field work and number of interactions at cluster and community level shows that there are seven naturally existing corridors having a number of bottlenecks. The earlier approach of using river basins for connectivity has one major drawback. The connectivity becomes dependent on a very narrow segment of the river valley at the lower end of CHAL, which makes it very critical and vulnerable.

The study team has proposed four north-south corridors and three east-west corridors, which is not entirely based on a river valley system but includes terrestrial segments, wholly or in part. Also they are proposed based on their current

Figure 6.1 Naturally Existing Corridors in CHAL Area

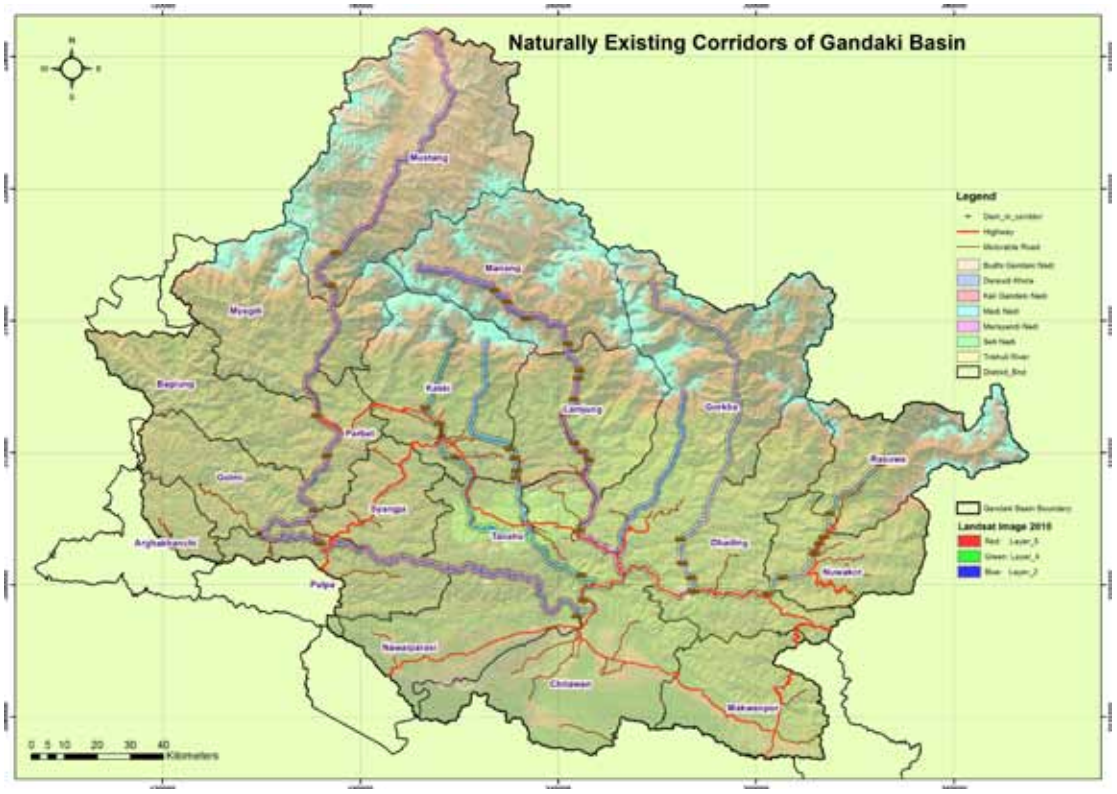
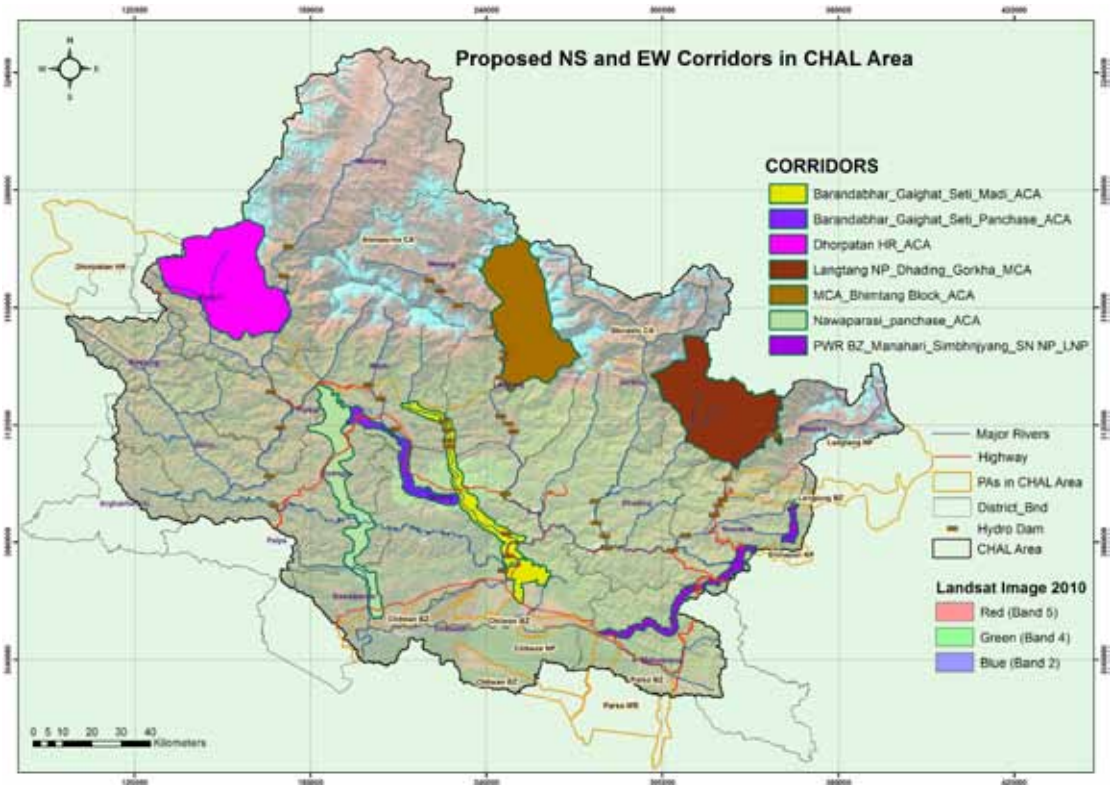


Figure 6.2 Proposed North-South and East-West Corridors in CHAL Area



conditions and the ongoing efforts and desire of local communities and the GoN to conserve these components of the landscape (Figure 6.2). The analyses of GIS maps show their potentialities, but ground-truthing must be carried out for further verification.

The proposed corridors are based largely on secondary information (including GIS) on the existence of forest, waterways and freshwater biodiversity, and rare/endangered/endemic wildlife and plant species. The proposed corridors have relatively low levels of human disturbance, while likelihood to generate local support for their conservation and management is relatively high.

6.1 Naturally Existing Corridors

6.1.1 Kali Gandaki River Valley

Bottlenecks:

Kali Gandaki-1 [144 Megawatt (MW)]: The largest hydropower project in operation.
At least three hydropower projects under construction:
Kali Gandaki Kowan (100 MW)
Kali Gandaki Gorge (100 MW)
Raghughat (30 MW)
Two more planned: Kali Gandaki-2 (660MW) and Beni Kali Gandaki (50MW)
Cultivated fields and settlements in places.

6.1.2 Seti River Valley

Bottlenecks:

One hydro power plant in the Fewa Lake, Pokhara (1 MW).
Storage type hydropower plant planned for the Upper Seti (122 MW).
Settlements and cultivated fields in places.

6.1.3 Madi River Valley

Bottlenecks:

Four hydro power plants under construction:
Madi 1 (20MW)
Madi 2 (7 MW)
Upper Madi (19.2 MW)
Super Madi (7.1 MW)
One hydropower plant planned: Madi Bhorletar (9MW).
Cultivated fields and settlements in places.

6.1.4 Marsyangdi River Valley

Bottlenecks:

Marsyangdi Hydropower plant in operation (69 MW)
Three hydropower plants under construction:
Upper Marsyangdi 1 (50 MW)
Upper Marsyangdi 2 (125 MW)

Three new hydro power plants are planned:
Marsyangdi 3 (42 MW)
Marsyangdi Besi (50 MW)
Upper Marsyangdi 1 (100 MW.)
Cultivated fields and settlements in places.

6.1.5 Trishuli River Valley

Bottlenecks:
One hydro plant under operation (24 MW)
Four hydro power plants under construction:
Upper Trishuli, storage type (128 MW)
Upper Trishuli 3a (61 MW)
Upper Trishuli 3b (44 MW)
Devghat Cascade (10.2 MW).
Six hydropower plants planned for the future:
Seti-Trishuli (142 MW)
Trishuli Nadi (20.1 MW
Trishuli Galchhi (10 MW)
Bhotekoshi Trishuli (75 MW)
Upper Trishuli 1 (75 MW)
Langtang khole storage (218 MW).
Several tributaries are also dammed or are planned for power generation.
Cultivated fields and settlements in places.

6.1.6 Daraundi River Valley

No major bottlenecks except a few cultivated fields.

6.1.7 Budi Gandaki River Valley

Storage type hydro power plant is under construction (600 MW).
Cultivated fields and settlements at places.

6.2 Potential Corridors Proposed

North-South Corridors:
Barandabhar Forest – Gaighat – Seti River Valley – Panchase – Annapurna Conservation Area (ACA)
Barandabhar Forest – Gaighat – Seti River Valley – Madi River Valley – ACA
Buffer Zone (BZ) Forest of CNP in Nawalparasi – Churia Range – Mahabharat Range – Panchase – ACA.
Manhari, Parsa Wildlife Reserve – Namtar – Simbhanjyang – Shivapuri Nagarjung NP – Langtang NP

East-West Corridors:
Rasuwa – Gorkha – Dhading along Ganesh Himal basecamp (2,000 m counter line)
Dhorpatan – ACA (taking 2,000 m contour line)
ACA – MCA Bhimtan Block (taking 2,000 m contour line)

All four north-south corridors are important for connectivity in CHAL. In terms of priority, it seems, the corridor, Barandabhar-Gaighat-Seti River Valley-Panchase-ACA should be given the highest priority. Panchase and Barandabhar Forests are very unique in many ways, thus a corridor connecting through these important biodiversity areas should be given higher priority. Among the east-west corridors, the Rasuwa-Gorkha-Dhading areas along Ganesh Himal should be given higher priority as the access to these sites is increasing and timely conservation work would be important.

Biodiversity Important Areas in CHAL

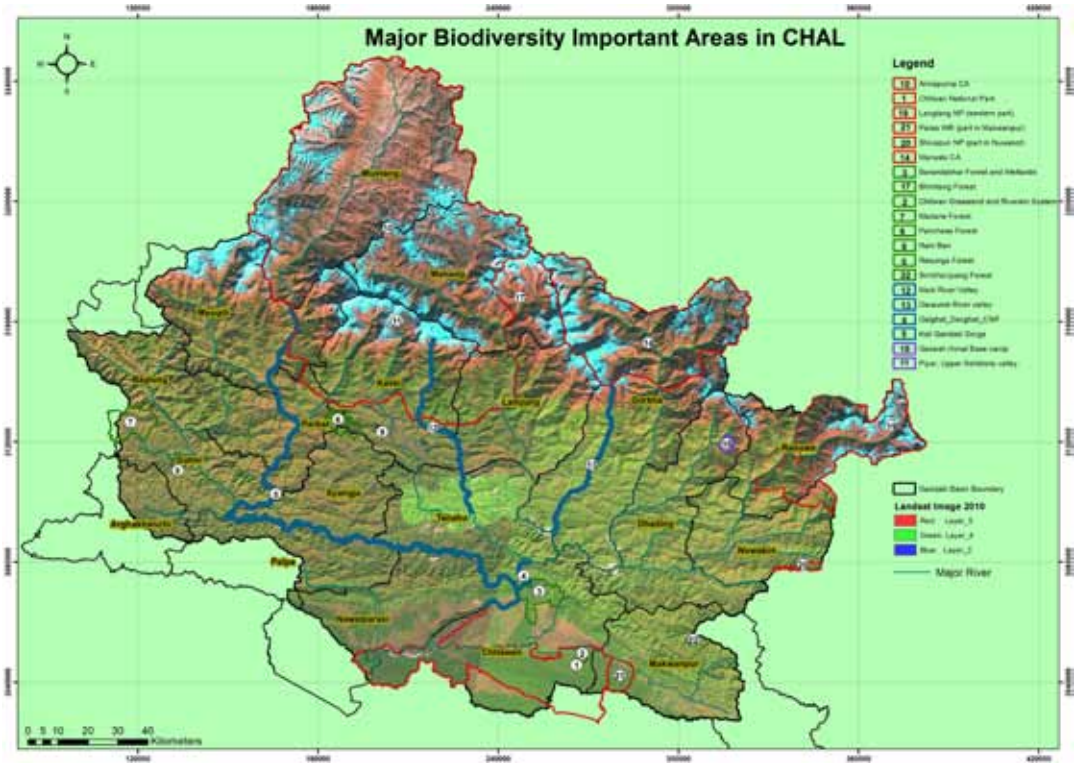
7

Several biodiversity important areas were reported in the landscape. Some of them are well established and are already under protected regimes while others need further exploration. The list, however, is not exhaustive and District Forest Offices and park authorities should be entrusted to locate more such areas and be requested to suggest mechanisms to protect them. The team recommends 23 biodiversity important areas for focused conservation (Figures 7.1 and 7.2). It should be noted that biodiversity important areas, listed below, are largely based on the findings from the interaction meetings, seconded by the opinion of the experts consulted in the field and in Kathmandu. The descriptions of some of the Biodiversity Important Areas (BIAs) proposed are sketchy; this is because of the limited time available for the work, during which it was not possible to visit the sites or interview the local residents. Such BIAs require further field work.

7.1 Chitwan National Park

- A World Heritage Site for nature.
- Last remaining relatively undisturbed Churia Valley.
- Several endangered species including tiger, rhinoceros, gaur, Gangetic dolphin and gharial are found in the park. It has stable populations of tiger and rhinoceros (DNPWC 2001).
- Identified as an Important Bird Area of Nepal.

Figure 7.1: Major Biodiversity Important Areas in CHAL



7.2 Chitwan Grasslands and Riverine Ecosystem

- Highly productive ecosystem supporting ungulate biomass comparable to East Africa (Siedensticker 1976).
- Presence of several threatened and vulnerable grassland bird species, including Bengal Florican, Grey-crowned Prinia and Slender-billed Babbler.
- Represents one of the last surviving outstanding grasslands of the Gangetic Plains. In moist areas, *Saccharum*, *Narenga* and *Themeda* species form the legendary tall grass communities.
- Represents Terai-Duar Savanna and Grasslands, one of the Global 200 Ecoregions
- As grasslands are being converted into scrublands and forests, the status of this ecosystem should be regularly monitored through inventory and GIS mapping.

7.3 Barandabhar Forest and Wetlands

- Critical connecting corridor to CNP to the Mahabharat Hills in the north.
- Divided east-west by the highway; the area south of the highway is part of the CNP Buffer Zone which includes a man-made wetland, Beeshazari Tal. The lake is a popular birding area and about 282 bird species including the Lesser Adjutant, Great Hornbill, Grey-headed Fish Eagle and Darter are dependent upon this forest and wetland.
- The area north of the highway has been declared by the Government as a Protection Forest for its unique biodiversity (DoF 2012a). It includes several wetlands.
- Identified as an Important Bird Area of Nepal (Baral and Inskipp 2005).

7.4 Gaighat-Devaghat-Chitwan Stretch of Waterways and Surrounding Valleys

- The confluences of Seti and Trishuli, and Kali Gandaki and Trishuli (further down) and associated river valleys in three districts (Chitwan, Nawalparsi and Tanahu) provide a valuable corridor for aquatic species and other wildlife.
- Undisturbed riverbeds provide good basking sites for gharial.
- If the stretch of the Narayani River from Gaighat to Gunjanagar (the place where the river enters the CNP) could be protected from over fishing, industrial pollution, other pollution and disturbances, it could help restore the gharial population of CNP.
- Places of high religious significance.

7.5 Kali Gandaki Gorge

- Distinct ecological barrier for plants and animals, it divides the Eastern Himalaya from the West.
- Important bird flyway. More than 40 species of bird migrate, including Demoiselle Crane.
- Important corridor for south-north connectivity and provides opportunity on research, especially on species segregation and distribution patterns.
- Despite several bottlenecks because of the dams for hydro power, stretches of the valley still can provide stepping stones for migratory birds.

7.6 Panchase Hill

- For it's biodiversity value, the Department of Forests has declared Panchase Hill as a Protection Forest under the Forest Act. It covers an area of 5775.73 ha (28° 10' 55"-28° 15' 56" North, 83° 48' 03"-83° 49' 53" East) (DoF 2012c).
- Represents unique midhill ecosystems of Nepal of which more than two thirds is covered by forests and a good portion falls under highland pastures. Midhill ecosystems are under-represented in Nepal's protected area system.
- Among 386 species of orchid reported in Nepal, 113 are reported from Panchase (DoF 2012c). Of which *Panisea panchaseensis* and *Eria pokharensis* are endemic to the area (Rajbhandari and Dhungana 2010; Subedi et al. 2011). Besides, the area is rich in medicinal and aromatic plants.
- Of the total forest in the declared Protection Forest area, 79 percent is managed by 144 CFUGs and only 21 percent is managed directly by the government.
- Panchase is seen as an ideal place to undertake watershed conservation work based on the sub-watershed conservation and management model. The DoF intends to test the concept

of PES in this area and prepare local people to undertake Reducing Emissions through Deforestation and Forest Degradation (REDD) related projects (DoF 2012c).
- A number of NGOs and government agencies of three districts (Kaski, Parbat and Syangja) are taking initiatives to protect this area for its biodiversity value and touristic potential.

7.7 Madane Forest, Gulmi

- GoN has declared this forest as a Protection Forest for its biodiversity value DoF 2012b.
- Located at the confluence of three district boundaries, Gulmi, Pyuthan and Baglung, it covers an area of 13,761 ha. Of this area 38.6 percent is covered by forest, 52.6 percent by agriculture and settlements, and the remaining 8.8 percent by open space, grasslands and wetlands.
- The area forms the headwaters of several rivers flowing in the three districts.
- A sizeable forest is managed as community forests; 47 CFUGs manage nearly 1,903 ha of forest.
- The altitude varies from 975 to 2,657 m. Trees including *Schima* sp, *Castanopsis,* pines, and oaks are the main species. Twenty four species of mammals including the Himalayan black bear, barking deer and leopard are reported from the area. Three species of pheasants are also reported.
- Represents unique midhills ecosystems of Nepal and with the forests in the adjoining districts, Baglung and Pyuthan, the area can be managed as a corridor to Dhorpatan Hunting Reserve. Such connectivity can help endangered species such as red panda and musk deer.
- The forest is good for medicinal and aromatic plants such as *Swertia*, *Morchella*, *Cinnamomum glaucescens*, and orchids, and also for commercially important non-timber forest products such as *Daphne* species.
- This Protection Forest is managed with a five year management plan starting in 2011, under government budget.

7.8 Resunga Forest, Gulmi

- The Department of Forests recognizes this forest as having high biodiversity value, and it will soon be recognized as a Protection Forest (DoF interaction meeting).
- It serves as the water tower for the area.
- High religious and historic significance.
- Needs further study.

7.9 Rani Ban, Kaski

- GoN declared, in 2011, an area of 164.76 ha of forest in Pokhara, Kaski to create a World Peace Biodiversity Garden (Dhungana et al. 2012). The Garden will be the starting point for the trail to Panchase Hill.
- The proposed garden aims to conserve the biodiversity found in the area. It adjoins Fewa Lake on its northern face, providing good habitats for plants and birds. Also, it is a noted area for orchids.

7.9 Annapurna Conservation Area

- Some of the world's highest snow peaks that tower over 8,000m and the world's deepest valley – the Kali Gandaki River.
- Two distinct climatic regions (rainfall, 3,000 mm; <500 mm) within a span of 12 km and altitude of 1,000-8,000 m
- Inhabited by several rare and endangered species of mammals such as snow leopard, musk deer, argali and Tibetan wolf.
- Being the transition zone between the Eastern and Western Himalaya, the faunal richness is high.
- Several endemic plants recorded from higher areas of the conservation area. Provides habitat for one endemic bird and one endemic mammal.
- Unique and successfully functioning model of integrated conservation and development. Over 100,000 people reside within ACA from various ethnic and religious backgrounds (NTNC 2008).

7.10 Pipar, Upper Setikhola Valley, ACA

- Exceptionally rich area for pheasants, where all of Nepal's six species of Himalayan pheasants are found.
- Also rich for other bird species.
- Globally threatened endangered Egyptian Vulture is also recorded.
- Three restricted range species: Hoary–throated Barwing, White-throated Tit and Spiny Babbler (which is endemic to Nepal) are also recorded from the site (Thakuri and Poudyal 2011).

7.11 Madi River Valley, ACA

- Carries high plant diversity.
- High altitudinal gradient and habitat diversity.
- Relatively less disturbed.
- Provides a large mid-hill forest blocks.
- Needs further study.

7.12 Daraundi River Valley, ACA

- One of the few wild rivers not dammed
- It originates from Manage; its headwater, Barpak, is a unique highland in the area outside MCA.
- People representing Gorkha and local communities living on the banks of the river strongly believe the river and Barpak should be identified as a biodiversity hotspot.
- Needs further study.

7.13 Manaslu Conservation Area

- Gazetted in 1998 by GoN, the CA covers as an area of 1,663 km² that includes seven VDCs of Gorkha District (between 28° 20' and 28° 45' latitude and 84° 29' - 85° 11' longitude) (NTNC 2011).
- It adjoins the protected area of TAR (China) providing an opportunity for trans-boundary conservation.
- The CA has more than half of its area as barren land, the available forests and grasslands harbor a large number of endemic plants: 22 species reported by Manaslu CA Management Plan (draft) (NTNC 2011). In addition, *Larix himalaya*, a conifer endemic to central Nepal and Tibet has its westernmost limit in MCA.
- The CA is rich in high-altitude medicinal and aromatic plants.
- Thirty eight species of mammals are reported, including endangered, threatened or vulnerable species, such as snow leopard, lynx, Assamese monkey and musk deer. It supports good populations of blue sheep, Himalayan tahr, serow and goral.
- The number of birds reported from MCA is 201, which includes endangered, threatened and globally threatened species. Himalayan pheasants are also reported.

7.14 Eastern Himalayan Broadleaf and Conifer Forest

- Needs further study.
- This Global 200 Ecoregion, found in CHAL, can be identified in the field and monitored for land cover to understand key landscape patterns and their changes.
- Can provide ideal site(s) for research to understand the effects of climate change.

7.15 Eastern Himalayan Alpine Meadow

- Needs further study.
- This Global 200 Ecoregion, found in CHAL, can be identified in the field and monitored for land cover to understand key landscape patterns and their changes.
- Can provide ideal site(s) for research to understand the effects of climate change.

7.16 Bhimtang Forest, an Area between ACA and MCA

- Needs further study.
- Potential migratory route for snow leopard to move between MCA and ACA.
- East-west corridor.

7.17 Ganesh Himal Base Camp

- Between Langtang NP and MCA: an area of north-eastern part of Gorkha, northern part of Dhading and north-west part of Rasuwa.
- Potential migratory route for snow leopard to move between Langtang and ACA.
- Needs further study.

7.18 Langtang National Park (western part)

- The park area includes the upper catchments of two major river systems. The one to the west drains into the Trishuli River.
- The 1,710 km² park has an altitudinal range of about 1,000 m to the alpine areas with its peak, Langtang Lirung (7,242 m).

- Several endangered species of wild animals are found in Langtang: red panda, snow leopard, clouded leopard, musk deer, Tibetan wolf and Assamese monkey, in addition to many birds.
- Several wetlands such as the RAMSAR listed Gosaikunda Lake add the cultural and biodiversity significance to the area.
- LNP is also equally rich in endemic plants. Plants such as *Rhododendron cowanianum, R. lowndesii,* at least four species of *Meconopsis (M. dwojii, M. regia, M. tylorii, and M. sharmae), Begonia flagellaris, Impatiens scullyi, Wendlandia appendiculata,* and more are recorded from the park (DNPWC 2011c).
- LNP is connected to Qomolongma Nature Preserve of TAR in China, Manaslu CA through Ganesh Himal range, and Shivapuri Nagarjung NP through stretches of community managed forests. Being the westernmost park on Sacred Himalayan Landscape, it joins SHL with CHAL.

7.19 Shivapuri Nagarjun National Park (part falling in Nuwakot District)

- Represents midhills ecosystem acting as transition between subtropical and temperate climates. Midhills are under-represented in protected area system.
- Vegetation consists of natural forest types including pine, oak and rhododendron.
- Mammals found in the park include Himalayan black bear, leopard, jungle cat and rhesus monkey. Park harbors a poulation of Assamese monkey, a protected wildlife species.
- Park is home to about 311 species of birds, including nine threatened species; 102 species of butterflies with a number of rare and endangered species, and 129 species of mushroom (DNPWC 2012).
- The watershed draining to the north of the Park falls under Nuwakot District, forming the part of CHAL.

7.20 Parsa Wildlife Reserve (part falling in Makwanpur District)

- Ecologically, Parsa Wildlife Reserve (PWR) is the eastern extension of Chitwan National Park. Its floral and faunal composition is similar except that PWR is much drier on its southern side. It provides prime habitat for several species of wildlife such as tiger, leopard, leopard cat and wild dog (Sah et al. 1999).
- On the northern boundary of PWR, falling in Makwanpur District and thus forming a part of CHAL, there are grasslands and riverine forests along the Rapti River, where rhinos are found.
- Ramauli and Pratapur villages are being resettled from PWR to the riverbed south of the highway at the request of the residents. After the resettlement, the place will develop into good grassland attracting many herbivores and big cats.
- The 499 km² reserve harbors a resident poulation of wild elephant (*Elephas maximus)* comprising more than 20 individuals.
- A good population of Giant Hornbill, a protected species of bird, is found in the reserve.

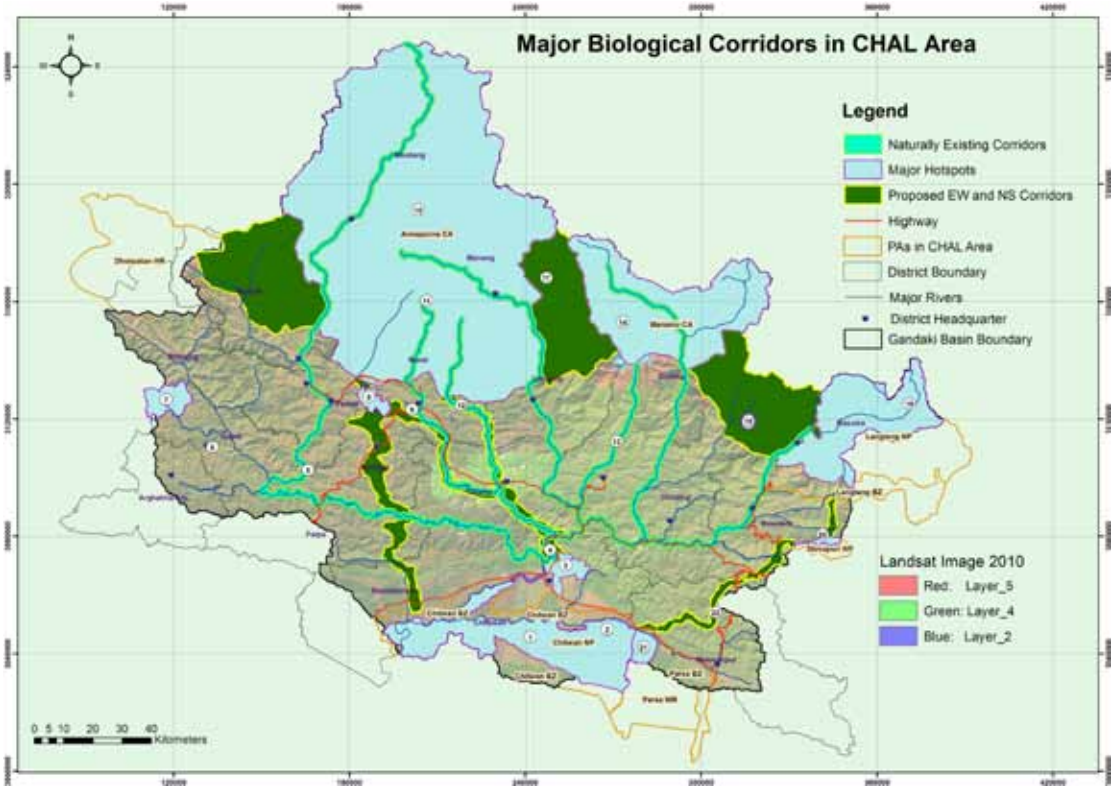
7.21 Simbhanjyang Forest, Makwanpur District

- Good diversity of orchids (> 80 species)
- Connecting forest to Chandragiri to the north and Namtar, the headwater of Manahari River, to the south. The latter connects to the forests in the Chitwan Valley.
- Needs further study.

7.22 Nuwakot Durbar Forest, Nuwakot District

- Typical new-growth hill sal forest.
- In river gorges and ravines other tree species, shrubs and epiphytes provide a unique mix of vegetation, providing home to several bird species.
- Orchids are plentiful in moist areas.
- Four community forests, covering over 300 ha, have been protected enthusiastically by CFUGs for over 15 years, recovering from a much denuded state when they were handed over to them.
- Being close to Bidur Municipality, visitors are likely to increase, particularly as these forests surround a historical monument.
- Increasingly becoming ideal climate refugia for animals found in the floodplains of Tandi and Trishuli Rivers.
- Falls on the proposed corridor linking Shivapuri Nagarjun NP to Langtang NP.

Figure 7.2: Major Biological Corridors in CHAL



7.23 Biodiversity Important Areas Proposed by Local Communities Needing Further Verification

- Dhundur, Tanahu, Vanumati VDC, Kaski district, 60 ha.
- Dhonda Khola Sonatar Forest, Kaski District.
- Rani Ban, protected by several CFUGs including Chuchekhola CF, Makwanpur. An important area for Salak, a protected wildlife species.
- Damodar Kunda Valley, within ACA.
- Didha Pokhari of Manage.

8 Biodiversity Conservation Issues in CHAL

Based on interactions with villagers, protected areas officials, officials of District Forest Offices and Soil Conservation Offices, NGO officials and local government officials, the biodiversity conservation issues in the CHAL landscape have been summarized (Table 8.1). It should be noted that the figures given in the table represent the severity of any particular issue, ranking on the scale of 0-5, 0 meaning absence of the issue, whereas 5 means the highest severity of that issue. The CHAL has been divided into Chitwan National Park and its Buffer Zone (CNP), Midhill forests, and Mountain Protected Areas.

The summary of the top ten conservation issues, reported by the respondents, shows clearly that most of the conservation issues are not adequately addressed in the midhill forests compared to the protected areas to the north and south. As the proposed corridors fall mostly in the midhills area, it becomes very important to understand these issues and be able to address them through effective management and governance.

Midhill forests are mostly managed by the communities, while a large chunk of the forest is still under the direct control of the government and largely remains unmanaged. The community forests are managed with the over-riding purpose of providing timber and firewood to their users. The forests are cleared of undergrowth shrubs and grasses each year as a silvicultural operation to maximize the yield of the wood, especially during the period when the forests are still young. As reported in the field, the awareness and motivation to manage these forests to protect biodiversity is simply not there. There is no clarity of the ownership of wildlife species found in the community forests, which de-motivates users to focus on conserving wildlife in their community forests. Also, managing forests to optimize the yields of NTFPs and wood is only at its infancy. Therefore, CHAL's primary intervention in the midhill forests should be to manage resources for multiple benefits.

Table 8.1. Summary of Conservation Issues Identified in the CHAL Area

Conservation Issues	CNP	Midhill Forests	Mountain PAs
Degradation of wildlife habitat due to deforestation, degradation of wetland or rangeland, encroachment	1	4	3
Poaching and trade of wildlife including protected species due to absence of/inadequate controlling mechanism	1	4	2
Illegal harvest of forest resources, especially NTFPs	1	4	3
Adverse effects due to alien invasive plant species	5	3	3
Forest fires, floods and landslides	2	2	3
Diversion of river or construction of dams	0	4	1
Crop and livestock depredation by wildlife; human injuries or casualties	4	3	3
Diversion of forest/forest land for non-forestry uses	1	4	1
Inadequate awareness and motivation to protect biodiversity	1	4	2
Weak institutional capacity	2	4	4
Average	1.8	3.6	2.5

Source: Based on field interactions with villagers, NGO officials and district government officials.

Illegal harvest of non-timber forest products is prevalent in all geographic zones (Table 8.1). NTFPs provide medicine and food to the local people and also help them make additional income with lack of clear policy to harvest resources from the wild (including PAs), the issue requires to be resolved to benefit the primary collectors while not compromising the abundance and continuity of the species. The villagers at several community and cluster meetings said that banning collection and export of NTFPs from the conservation areas, as is being practiced now, cannot deter their illegal collection and trade. At the policy level, the government has made a good attempt to promote sustainable harvest of NTFP resources from the wild (Sharma et al. 2004), but its implementation has not been satisfactory. The policy also promotes commercial planting of selected Medicinal and Aromatic Plants (MAPs) in private and community lands so that collectors do not depend entirely on natural sources. Given the fact that so much private land remains vacant due to mass-migration of youths from the villages in search of work outside the country, planting of selected MAPs in large areas by involving commercial growers with provision for quality and quantity assurance for the buyers has great potential to generate huge income for land owners and traders.

Hydropower development in the key connecting rivers and streams in CHAL can be seen as a serious threat to freshwater biodiversity conservation. Dams can ruin the visual appeal of the area and adversely affect any potential for tourism. Also, people dependent on local fish and other freshwater resources for their food supply as well as livelihoods will greatly suffer. With inadequate policy to make these dams more biodiversity-friendly, the threat to biodiversity is likely to rise. Nepal's policy of restrictive use of waterways flowing within the protected areas (DNPWC 2011a) for power generation will probably stall harmful development within the protected areas; but it seems doubtful if MoFSC will continue to stand for its own policy for long, given the pressures to open up PA areas for hydropower.

Crop and livestock depredation is a serious conservation issue for all protected areas in CHAL and also in the midhill forests. Especially in lowlands and high rangelands, if the conflict is not addressed properly it may lead to increased retaliatory killings of wild animals. The provision of limited amounts of relief to the victims of wildlife (DNPWC 2011b) is a welcome step by the government; it must be popularized and backed with adequate budget and an institutional mechanism to promptly compensate for loss. As an indirect mechanism, livestock insurance can also be introduced as has been successfully done in the Kanchanjunga Conservation Area.

Effective control of poaching is another conservation issue requiring high commitment of PA and Community Forest (CF) managers. The control of poaching in CNP in recent times has been largely due to three major initiatives: (i) Community Based Anti-Poaching Operations (CBAPOs) formed in each User Committee and mobilized effectively by the park warden; (ii) effective patrolling by Nepal Army based inside the park; they are encouraged to do better through the implementation of the Management Information System Tool (MIST). MIST is a GPS based tool that helps supervisors to evaluate the effectiveness of the prevailing patrolling design; and (iii) able leadership of the park warden to motivate its staff and undertake skilled programs. Entry points to TAR from ACA and MCA have been recognized as trade routes for illegal shipment of valuable wildlife trophies and medicinal herbs. In this context, other PAs need to be as effective as CNP in controlling poaching and curbing illegal trade of wildlife parts, having their trade-nexus rooted in the international arena. For areas controlled by the Department of Forests, the DFOs should be encouraged to provide similar outputs involving District Forest Sector Coordination Committees (DFSCCs) and law enforcement agencies. One of the poorly documented illegal poaching events is fishing in rivers using electric current generated by batteries. This activity also needs to be closely monitored and controlled by seeking the support of communities and local law enforcement agencies.

Some of the invasive alien plants[1] recorded in the CHAL area have already threatened native species and habitats by competing for critical resources. For the purpose of CHAL, it seems, action on Alien

[1] Alien Invasive Species is defined in the Convention on Biological Diversity (CBD) as, "An alien species which threatens ecosystems, habitats or species" (Article 2). This definition is considered rather broad and several working definitions have been developed: A working definition by IUCN (2000, cited in Shine et al. 2000) is more relevant for the purpose of CHAL, "Invasive species means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity."
Another suitable working definition put forward by the Global Invasive Species Programme (2012) is, "IAS are organisms that have been moved from their native habitat to a new location when they cause significant harm to the environment, economic systems and/or human health." For Government of Nepal, Focal point of CBD is yet to adopt a working definition (Resham Dangi, personal communications).

Invasive Plant Species (IAPSs) should be limited to plants that have been introduced by humans either purposely or by accident and that have become a serious threat to the environment. Some of the IAPSs recorded in the CHAL area has already threatened native species and habitats by competing for critical resources. They have succeeded in growing and spreading rapidly, displacing native plant communities. It seems the GoN, especially the Department of Plant Resources, should work closely with international organizations such as CBD, IUCN and WWF to develop an Invasive Plant Atlas for identification, early detection, prevention and management of invasive plants, similar to US Park Service (University of Georgia and NPS 2010). The CHAL project should be involved in providing necessary assistance.

Invasive alien plant species have been assessed for Nepal (Tiwari et al. 2005). Of the 21 plant species identified by the team, the following species are of major concern to CHAL, particularly considering their harmful behavior in natural areas:

Ageratina adenophora (synonym: *Eupatorium adenophorum, E. gladulosum*)
Locally called kalo banmara, the plant grows profusely in disturbed forest, forest margins and fallow land at altitudes of 500-2,400 m. The plant was invasive more than 40 years ago, and has been seen in Langtang for the past decade. It has displaced native ground growth.

Chromolaena odorata (synonym: *Eupatorium odoratum*)
Locally called aule banmara or seto banmara, the plant grows in sunny, open and well drained areas. It occupies forest floors that are disturbed. Once established, it is difficult to remove manually. It displaces grasses in particular.

Eichhornia crassipes (synonym: *Pontederia crassipes*)
Locally called jal kumbhi, this is a very fast growing plant that covers the water surface of the wetlands and reduces light and air to submerged organisms. Local people remove water hyacinth from wetlands manually to open up water surface areas for improving fish stocks or for fishing. The wetlands of Chitwan National Park and Beeshazari Lake of the Barandabhar Forest have a serious invasion of this plant species and each year the Park tries to manually remove it. This plant is also seen invading Fewa Lake and other nearby lakes in Kaski District of CHAL.

Lantana camara (synonym: *L. aculeate*)
Locally called ban phanda, the plant is found in different habitats that range from 75 to 1,700 m. It is seen dominating scrublands, fallow lands and forest margins. Many native plants are reported to have been displaced due to the invasion of this plant.

Mikania micrantha (synonym: *M. scandens, M. cordata*)
Locally known as lahare banmara, this is a climber and spreads appallingly fast, blocking sunlight for the host plant and eventually killing other plants or stunting their growth. Its shoots were reported to grow so fast it is also called minute-a-mile plant. *Mikania* invasion has been a serious problem in the forests and grasslands of Chitwan. It has prevented the growth of palatable plants and in effect seems to have displaced many ungulates from their preferred areas.

Free grazing by domestic stock, considered as a threat to biodiversity until few decades ago, has not been reported as a serious threat in the interaction meetings. It is largely because youths leave villages for extended periods of time; as a result, the lands are fallow for years and the livestock is reduced to a minimum of a stall-fed buffalo or cow. There are still large numbers of goats, but they seem to have plenty of areas to graze. However, for transhumance grazing of sheep, it was reported in Lamjung that climate change effects are visible in rangelands and in the sheep-herding patterns there. The number of sheep in recent times has gone up from about 9,000 to about 15,000. The transhumance grazing has come into conflict with community forests, the user groups of which will not allow sheep grazing in their forests. The growth of grass in the rangeland is affected by the erratic moisture availability. It was reported that rangelands inside and outside of ACA and MCA are overgrazed and there is a shortage of water holes for animals. The issue of rangeland management is serious, warranting attention.

Similarly, firewood collection for household use does not seem as intense as before. Residents interviewed said they prefer a mix of energy options, using limited firewood, LPG gas and biogas. This change of energy options seems to have reduced the collection of firewood from forests. The change became necessary as CFs put occasional bans on the collection of firewood, and also since youths are not around to undertake this arduous task. It was felt that if an alternative energy program is carefully designed and implemented in suitable altitudes many villagers would be willing to own biogas

plants, especially of 6 cu m capacity. Each plant, if connected with toilet waste, it was reported, can run on the dung of only two or three cattle or buffalo.

Another important issue that was only sparingly reported in the interaction meetings was the issue of slash and burn agriculture. This could have been because of the composition of the respondents and inability for the team members to visit other sites. This practice, seemingly harmful to biodiversity conservation as it is practiced now, could be an issue for consideration for the Hariyo Ban Program to follow in a number of districts, including Nawalparasi, Tanahu, Palpa and Gorkha.

Diversion of forest or PA land for non-forestry uses has been identified as an important conservation issue. The spirit of the Forest Act or National Parks and Wildlife Conservation Act is to disallow any request for projects that intends to reduce the forest land coverage. But, the Forest Act, Article 68, provides opportunity to divert forest land for nationally important projects, when there is no alternative but to use the forest land. In such cases, after proper Initial Environmental Examination (IEE)/Environmental Impact Assessment (EIA), forest land can be allowed for non-forestry uses. In recent times, this provision of the Act has been liberally used and has been a cause for concern to conservationists. In the past, several hydroelectric dams, transmission lines, irrigation canals, roads and settlements (e.g. New Padampur settlement in Barandabhar Forest) in CHAL have been approved by the government to use forest lands. Currently, the proposed transmission lines that would pass through Barandabhar Corridor could have a big impact on wildlife and their movements.

Weak institutional capacity is considered as the most prominent conservation issue. This is reflected in inadequacy of staff, equipment and infrastructure such as staff quarters, office buildings and roads. It is also a reflection of lack of regular training opportunities for the field based staffs of PAs and midhill forests, NGOs, community-based organizations, and anti-poaching units. Inadequate funding to manage PAs and inadequate access to research-based information for PA management are also the part of the conservation issue under this category.

Climate Refugia and Adaptation to Climate Change

9

It seems, in response to anthropogenic climate warming, upward migration of species is imminent for the species that are found in foothills. Other species especially in the highlands may be in danger as they may have nowhere to move to. Even then such species may find favorable microhabitats due to ruggedness of the terrain. In this context climate refugia become critical to sustain species and ecosystems from the adverse effects of climate change. Climate refugia are the areas "that are less affected by climate change than other areas as sources for recovery or as destinations for climate-sensitive migrants..." (Spehn 2011: 43).

Although a separate listing of climate refugia could not be made due to time and logistic constraints in the field, many of the identified Biodiversity Areas, especially those falling in the corridor, can be considered as climate refugia. The protected areas have altitudinal variations within themselves, creating climate refugia. For example, in Chitwan National Park the hills within the park and Barandabhar Forest to the north can act as climate refugia. In ACA, the altitudinal variation of 1,000-8,000 m and deep valleys and gorges provide a number of areas for climate refugia.

In general, it seems, in-depth field studies would be required to understand the effects of climate change on biodiversity in CHAL. The projected 2°C of average global temperature rise by 2050 could mean more than 3°C rise in temperature in the mountains, higher for taller mountains. This would change the complex ecological web in the mountains resulting in changes in weather patterns, hydrological processes, and water availability for drinking and for irrigation. Some observations reported in literature in the context of Nepal are equally applicable to the CHAL area: increased temperatures over decades has meant upward movements of vegetation, encroachment of invasive species, spread of new diseases and pests, increased incidence of dryness and fires, changed grass composition in the rangelands, and loss of local crop varieties (Ministry of Environment (MoE) 2012, NVST 2009). Upward migration of species would affect the composition of plant communities and vulnerable species may decrease in abundance as environmental factors such as soil and moisture become limiting factors. For animals the new areas may not have adequate food or cover.

Community-based forest management systems, including community forests, pro-poor leasehold forests, BZ community forests, sub-watershed management user communities, and forests conserved through conservation area management committees provide opportunities for implementing adaptation and mitigation measures to address the adverse impacts of climate change in CHAL, as elsewhere in Nepal. These measures are equally important to reduce poverty and provide new opportunities for livelihoods. The National Adaptation Program of Action (NAPA) of Nepal (MoE 2010) rightly recommends putting more focus on sustainable forest management, and improved governance and capacity at the local level, including improved access and equitable benefit sharing, among other things, as the measures to deal with the impacts of climate change on forests and biodiversity. The effects of climate change will tend to aggravate the complex mountain poverty situation, which is affected by the fragility of ecosystems, remoteness, poor accessibility and marginalization of mountain communities from the mainstream. Further, it is complicated by lack of equity in terms of access to basic facilities, lack of employment opportunities and proneness to natural disaster (ICIMOD 2010). In this context of climate change, potential livelihood options, especially for marginalized communities, should be explored and implemented in CHAL. Some opportunities that can be further explored include utilization of abandoned agriculture land, production and marketing of mountain niche products, and promotion of community-based tourism. These issues are discussed in more detail by other experts in the main report.

10 Recommendations

10.1 Policy and Legislative Environment

The conservation of biodiversity at the landscape level is given high priority by the government: as a result, three important landscape level conservation initiatives are under implementation or at the last stage of planning: Terai Arc Landscape, Sacred Himalayan Landscape and the Kailash Sacred Himalayan Landscape. The Chitwan-Annapurna Landscape would fill an important gap and would provide the landscape with north-south connectivity. The government should formulate specific policy for identified biological corridors in the country. The Ministry of Forests and Soil Conservation (MoFSC), which has currently proposed draft bills for amendment of the National Parks and Wildlife Conservation Act and Forest Act, should consider including this aspect of biodiversity conservation in its draft bills. With the policy and legislative environment in place, it would be easy to provide specific attention to the declared corridors and biodiversity areas in CHAL.

In the meantime, MoFSC should work with community and NGO partners to protect these sites for landscape level conservation by declaring the potential corridors and biodiversity areas for more focused conservation.

10.2 Documentation

Data available in the Himalayan region is sporadic. Documentation of biodiversity in CHAL is essential to improve the understanding of status, conservation and management issues, including the effects of climate change on biodiversity.

10.3 Management

- The rapidly deteriorating conditions of Churia Hills in Makwanpur and Nawalparasi districts should be addressed.
- Three District Forest Offices should be supported to implement the Protected Forest Management Plans and revise the plans to make them more oriented for protecting species and ecosystems at the landscape level.
- Protected Areas, especially those situated on the northern parts of the country, should consider realigning their boundaries to include more/new areas with high biodiversity value.
- DFOs and PA agencies should collaborate with the Haryio Ban Program to identify locally occurring biodiversity areas of national importance. The expertise of the Department of Forest Research and Survey could be valuable.
- Conservation issues, especially management and governance related issues should be properly addressed, giving priority to the midhill forest areas. Issues include curbing illegal harvest of forest resources, promoting biodiversity-friendly hydropower projects, addressing human-wildlife conflicts, controlling poaching and illegal trade of wildlife and their parts, and controlling rapid spread of identified invasive alien species.
- Institutional capacity of government agencies, grassroots NGOs, and community based organizations should be increased. This includes providing field-based training, providing opportunities for higher education, making available necessary equipment, and providing access for electronic communications (e.g. internet).

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Annex A

Check List for Biodiversity and Corridors

What are the biodiversity hotspots in your district ?

Questions to ask at district level meetings

- Location
- Approximate area
- Key biodiversity found
- District level initiations to protect them
- Assess the awareness and perception about the need for biodiversity conservation in their areas and their willingness to support such activities. Assess with the help of gender specialist, different awareness of men and women, persons with disability and other socially disadvantaged groups on need for biodiversity conservation

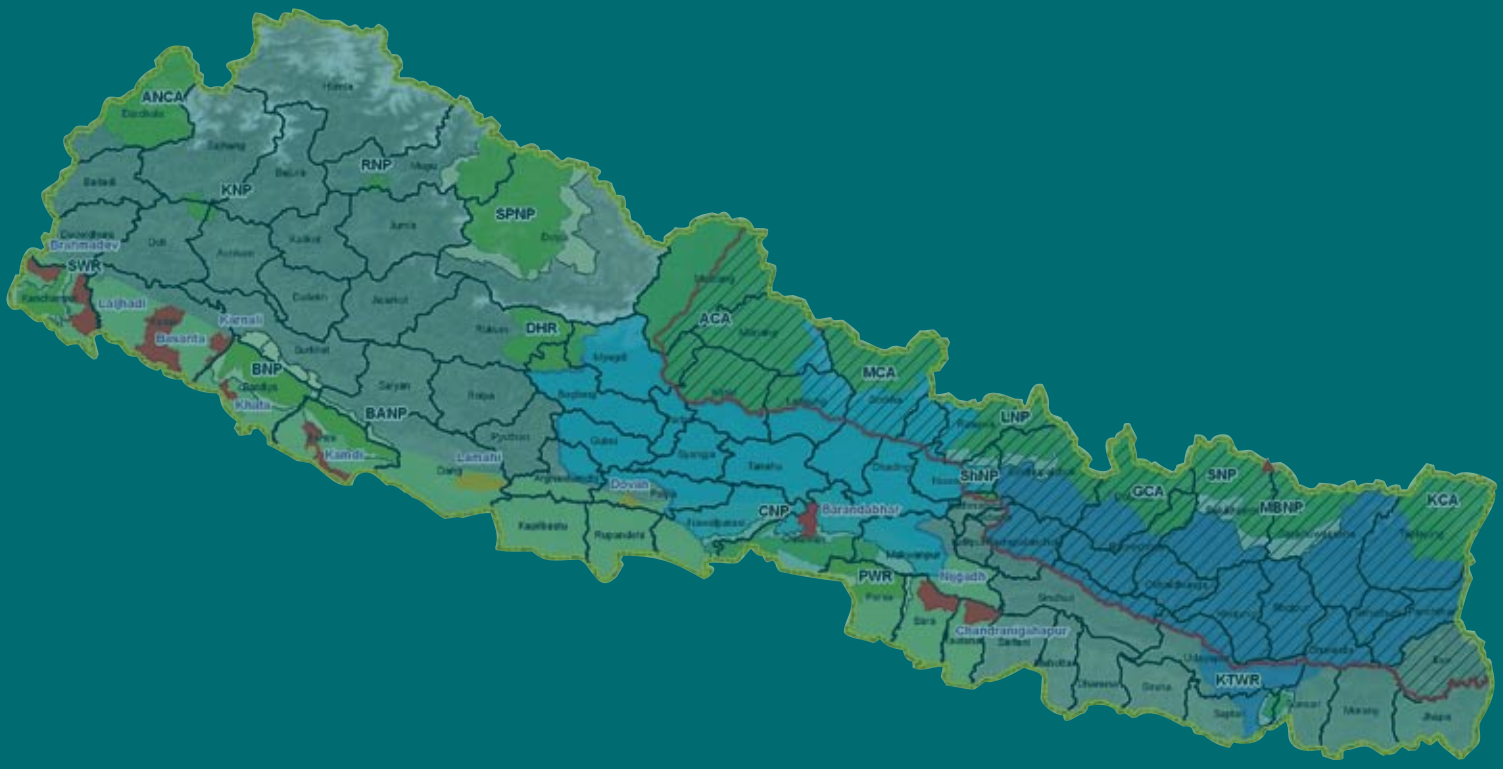
Questions for community level meetings

- Inputs on the conditions of forests/waterways in the identified potential corridors and existing ones. [Relevant for both levels of meetings]
- Invasive alien species in natural areas
- Take stock reported
- Controlling methods adopted
- Forest Encroachment [Relevant for both level meetings]
  - In the government-managed forest in the district
  - In the community forests in the district
  - Initiations taken to evict them or other mechanisms to manage them
- Grazing of livestock [Relevant for both level meetings]
- Grazing practices: totally stall-fed, partially stall-fed, free-ranging, seasonal migration
- Types of stock
- Increase/decrease of dominant types of stock over the past years
- Poaching of wild animals [Relevant for both level meetings]
- Which wild animals/birds killed?
  - Killed for self-consumption of meat or for sale in the market
  - Killed for valuable trophies
- Number of cases of poachers tried and jailed/fined in the district
- Any reported case of wildlife trophy movement from south to north, or vice versa
- Identify threats to biodiversity: To be assessed based on the interactions with the community members, villagers, and local agency officials. [Relevant for both level meetings]
- Human wildlife conflict [Questions to community level meetings]
- Major species of livestock depredated by wildlife
- Major crops reported to have been lost to wildlife
- Who are the most affected in community by the wildlife conflict?
- Local harassment: attacks, injuries, deaths and property damage
- Retaliatory killing of depredating wildlife

- Local measures taken to protect their crops and livestock against depredation
- Any livestock insurance practices prevailing?
- How compensation, if any, is claimed from the government?
- Any special program targeted to key species in implementation from the government?

Questions for district level meetings

- Any wildlife crime control bureau formed under DFO/Park Warden?
- Any of the following support the crime control activities in your district/park: National Tiger Conservation Committee (NTCC), Wildlife Crime Control Bureau (WCCB), South Asia Wildlife Enforcement Network (SAWEN)? If yes, elaborate.
- Inquire about any measures against forest fires, landslides and high flood incidents in the district in last and current years. [Relevant for both level meetings]
- How fires are put out and other incidents are mitigated? Who bears the costs of such operations? [Relevant for both level meetings]
- What are the indigenous varieties of beans, cereals, fruits, vegetables, oilseeds used? Is their use same as before or is it gradually being replaced by new/improved varieties?
- Forest management practices [Relevant for both level meetings]
- Community forests: number, total area in the district, problems reported
- Government-managed forests: activities and problems
- Leasehold forests: number, area in the district, problems reported
- Religious forests: number, area in the district, problems reported
- Private forests
- Protected forests



The Hariyo Ban Program is named after the famous Nepali saying 'Hariyo Ban Nepal ko Dhan' (Healthy green forests are the wealth of Nepal). It is a USAID funded initiative that aims to reduce the adverse impacts of climate change and threats to biodiversity in Nepal. This will be accomplished by working with the government, communities, civil society and private sector. In particular, the Hariyo Ban Program works to empower Nepal's local communities in safeguarding the country's living heritage and adapting to climate change through sound conservation and livelihood approaches. Thus the Program emphasizes the links between people and forests and is designed to benefit nature and people in Nepal. At the heart of Hariyo Ban lie three interwoven components – biodiversity conservation, payments for ecosystem services including REDD+ and climate change adaptation. These are supported by livelihoods, governance, and gender and social inclusion as cross-cutting themes. A consortium of four non-governmental organizations is implementing the Hariyo Ban Program with WWF Nepal leading the consortium alongside CARE Nepal, FECOFUN and NTNC.

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