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# Tropical Forestry and Biodiversity (FAA 118 & 119) Assessment Report Nepal

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## Disclaimer

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## Abbreviations and Acronyms

ACAP	Annapurna Conservation Area Project
ACOFUN	Association of Collaborative Forest Users in Nepal
ANSAB	Asia Network for Sustainable Agriculture and Bioresources
BCN	Bird Conservation Nepal
CA	Conservation Area
CBD	Convention on Biological Diversity
CBO	Community-Based Organization
CER	Certified Emission Reduction
CF	Community Forestry
CFD	Community Forestry Division
CFDP	Community Forestry Development Project
CFM	Collaborative Forest Management
CITES	Convention on International Trade in Endangered Species
CNP	Chitwan National Park
CO <sub>2</sub>	Carbon Dioxide
COP	Conference of Party
CPA	Comprehensive Peace Agreement
CSP	Country Strategic Plan
DDC	District Development Committee
DFID	Department for International Development (UK Government)
DFO	District Forest Officer
DNPWC	Department of National Parks and Wildlife Reserves
DSCWM	Department of Soil Conservation and Watershed Management
FAA	Foreign Assistance Act
FCPF	Forest Carbon Partnership Facility
FECONFUN	Federation of Community Forest Users Nepal
Gg	Gigagram
GLOF	Glacial Lake Outburst Flood
ICIMOD	International Center for Integrated Mountain Development
IFAD	International Fund for Agriculture Development
ILO	International Labor Organization
INGO	International Non-Governmental Organization
IPCC	International Panel on Climate Change
IPR	Intellectual Property Rights
ITTA	International Tropical Timber Agreement
ITTO	International Tropical Timber Organization
IUCN	World Conservation Union
KGV	Kali Gandaki Valley
Km	Kilometer
LFP	Livelihoods and Forestry Program
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
MAP	Medicinal and Aromatic Plant
MIS	Management Information System
MOEST	Ministry of Environment, Science and Technology
MOU	Memorandum of Understanding
MW	Megawatt
NBS	Nepal Biodiversity Strategy
NCSA	National Capacity Needs Self-Assessment
NEFEJ	Nepal Forum of Environmental Journalists
NEFUG	Nepal Federation of Forest User Group
NFA	Nepal Foresters Association
NGO	Non-Governmental Organization
NTFP	Non-Timber Forest Product
NTNC	National Trust for Nature Conservation
PES	Payment for Environmental Service
REDD	Reducing Emissions on Deforestation and Forest Degradation
R-PIN	Readiness Plan Idea Note
SAGUN	Strengthened Actions for Governance in Utilization of Natural Resources
SHL	Sacred Himalayan Landscape
SPA	Seven Party Agreements

TAL	Terai Arc Landscape
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNFCCC	United National Framework Convention on Climate Change
USAID	United States Agency for International Development
VDC	Village Development Committee
WECS	Water Energy Commission Secretariat
WTLCF	Western Terai Landscape Complex Project
WTO	World Trade Organization
WWF	World Wildlife Fund

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## Executive Summary

The objectives of this assessment are to assess and determine: (i) the actions necessary to conserve and sustainably manage Nepal's tropical forests; (ii) the extent to which the actions proposed for support by USAID meet the identified needs; (iii) the actions necessary to conserve biological diversity in Nepal; and (iv) the extent to which the actions proposed for support by USAID meet the identified needs. The assessment was conducted during June and August 2009. The current Country Strategic Plan (CSP) and FAA 118 & 119 form the basis for this update. As agreed with USAID, the format of the Tropical Forestry and Biodiversity (FAA 118 & 119) Assessment Report 2006 was used to inform this 2009-2014 report along with "An Assessment of Climate Change, Forests and Biodiversity in Nepal" (USAID, 2009). A myriad of relevant documents were reviewed during the preparation of this report, including the USAID Country Assistance Strategy (2009-13), the FAA 118 & 119 Tropical Forestry and Biodiversity report of 2006, the Assessment Report of Tropical Forestry and Biodiversity (2009) and other USAID documents. Similarly, relevant policies, strategies, laws and study reports were reviewed. Meetings with USAID officials and consultations with government and non-government agencies also took place. The report has been presented ecozone-wise in review, and makes recommendations about the action USAID needs to take to locate problems and threats within each ecozone.

Although forest policy and strategies exist to help the Nepal government and its partners to halt deforestation and forest encroachment, forestry administrations do not have full control over forest resources due to lack of good governance. Forest encroachment continues to be supported by political parties and is made worse by the ongoing political instability and presence of land mafias. There continues to be a gap between policy and implementation. On one hand, the government states that it is working to maintain at least 40% of the country as forested land, while on the other hand the same government allocates forest areas for other land use such as the resettlement of freed-bonded laborers, river-affected households and campsites for the armed forces. Silvicultural (scientific) forest management has not been applied due to lack of institutional commitment. There is a big gap between potential forest land productivity and present productivity per unit area of forest. As a result, the high productivity capacity of the plain-lands has not been harnessed. All the long-term, medium-term and short-term forestry plans and programs talk of sustainable forest management but not a single forest has been scientifically or silviculturally managed so far. All the forestry sector policies including National Conservation Strategy (1988), Master Plan for the Forestry Sector (1989) and others, explicitly state that the Churia Hills contain fragile ecosystems and should be the focus of conservation efforts. In reality, the Churia Hills (outside the protected areas) are becoming rapidly denuded; this has massive negative impacts on the Terai. There is a lack of awareness about the ecological services that the Churia Hills and Bhabar zones provide in terms of recharging the underground water in the Terai, as well as a lack of policy and strategy on upstream-downstream links between the Churia Hills and the plains. Similarly, there is a lack of skills and knowledge, policy and strategy for payment for environmental services (PES) schemes in terms of carbon sequestration/carbon trading in international markets, biodiversity valuation, and landscape/watershed services.

There are increasing numbers of hydro-electricity dams in the country but the contribution of watershed management to their success is not well-recognized as an integral design component. Forests (including community forests) are not managed from a watershed perspective (maintaining dense undergrowth and trees). There are high levels of anthropogenic disturbance in the watersheds of nationally and internationally known wetlands, and, as a result, there are high rates of siltation that is shortening their life (Phewa Lake, Mai Pokhari etc.). Despite Nepal's hilly and mountainous terrain, there is lack of national policy governing soil and watershed management. The Soil and Watershed Conservation Act 1982 (SWCA) and its Regulations (1985) were promulgated but never implemented. Mid-hill forests are highly important for watershed PES schemes, biodiversity and carbon sequestration but this is not recognized in policy, strategy and long-term planning. There is no north-south system of linking two or more protected areas. The high mountains are natural stores of high value non-timber forest products (NTFP) and medicinal and aromatic plants (MAP), but the massive unchecked collection of these from forests and pasture lands is unsustainable. NTFPs/MAPs are the principal export items from the high mountain districts and one of the main sources of additional income for poor households. However, a lack of clarity on the tenure of pasture lands means that collection takes place on a first come first served basis. The conservation, plantation and management of high value NTFPs/MAPs have not yet started at a commercial scale even in community and leasehold forests. Local processing and value addition is very expensive due to a lack of appropriate technology and skills; transportation costs also remain high. In addition, those transporting NTFPs/MAPs from the high mountains to the Terai and India are routinely harassed by DDC officers, the police, the forestry administration and other unauthorized organized forces. Although the high mountains are rich in natural resources they are permanent food deficit zones and witness some of the worst poverty in Nepal. Forests are not scientifically managed in the high mountains and there is a lack of alternative energy sources; this has led to a continued high demand for firewood. The illegal trading of timber and high value NTFPs/MAPs to Tibet through the northern passes continues unabated. Local communities are experiencing the effects and impacts of climate in terms of agriculture, water stress and changes in vegetation, but there is no climate change adaptation plan for local communities. There is a general lack of awareness about what can be done to address climate change issues.

There is no effective biodiversity conservation program outside the protected areas in the Terai. This is particularly so in the wetlands. In the Terai and Churia Hills, many important plant species (e.g. Bijay Sal, Semal, Satisal, Khair, Cycas and tree ferns) are rapidly disappearing. Similarly, indigenous varieties of crops and vegetables including Basmati rice, wild species of rice and local mango varieties are vanishing; this is compounded by a lack of long-term planning and programming for their conservation. Birds such as the crane, vulture and Thulo Dhanesh, wetland species such as the dolphin, crocodile, Sahar fish, and reptiles such as the python are not safe outside the protected areas.

The Terai and Churia Hill corridor links 29 of Nepal's districts and is home to about 60% of the country's population. Although the fragile ecosystems of the Churia Hills (e.g. Chulachuli of Jhapa district) are important habitats for many rare species, no conservation efforts are currently taking place, and the rampant excavation of rocks, sand and gravel is having negative impacts on the hills themselves and in the Bhabar and Terai zones. This demonstrates the dichotomy between ecosystem sensitivity and conservation efforts. In general mid-hill ecosystems are under-represented in the country's protected areas when compared to the Terai and high mountains, and many biodiversity issues in the Mid-hills have yet to be highlighted. The Mid-hills form a natural corridor for many Terai and Himalayan migratory species, but no effective corridor management system is in place. This is in part due to a lack of policy for creating links between protected areas in the north and south. Examples of important north-south biodiversity corridors are Chitwan-Barandabhar-Daman, Simbhanjyang-Chandragiri-Nagarjun, and Shivpuri-Gosaikund-Langtang. The tropical biology of the Mid-hills, including the conservation and commercial exploitation of indigenous crops, livestock and epiphytic orchids, are other neglected areas. Another cause for concern is the lack of thorough environmental impact assessments which should be informing the design of hydroelectric projects in the mid-hill region. Such projects affect the upstream/downstream mobility of aquatic animals and pose a threat to biodiversity.

Large swathes of Nepal's rangelands hold great ecological and economic significance, especially for the biodiversity of livestock and medicinal herbs. Tenure arrangements governing rangelands are generally vague in the high mountains, as is the monitoring and regulation of the use of rangeland resources. Another issue in the high mountains is the unsustainable and unregulated collection of natural stocks of high value NTFPs/MAPs. No commercial cultivation of such species exists and the absence of coherent policy means that local collectors are routinely harassed when transporting the high value NTFPs/MAPs from mountain to market. A 'one door permission system' should be adopted in the transportation of these plants to eliminate opportunities for corruption. Global warming and human pressure are causing disturbances in ecosystems along the tree line, but no mitigation plans are in place, nor is any research being carried out to determine what interventions are needed. High mountain glacial lakes are highly vulnerable to climate change but there is a general lack of site specific data/information. Outside protected areas, protected wildlife such as the musk deer and snow leopard are killed for their skins, meat, bones and body parts. This practice continues due to a lack of governance and community awareness. There is a decline in yak breeding as a career choice due to shifting livelihood opportunities in other attractive sectors such as tourism, which can provide better incomes. The absence of incentives means that indigenous knowledge of yak breeding is gradually disappearing. Patterns of transhumance are changing and the whole practice is declining due to the formation of community forests and bans on en-route grazing. Community forestry has not respected the traditional use rights of transhumant grazers who come with herds of animals to road heads and towns in order to fetch food grains.

The conversion of forest for other land use poses the greatest threat as it destroys forestlands forever. This is happening as a result of policy decisions regarding infrastructure development, resettlement (ex-army, free-bonded labor, flood victims etc.), and the location of government offices. Forest land is also encroached by both organized and unorganized land mafias, especially in the tropical forests of the Terai, Inner-Terai and Churia Hills. There is little political will to stop forest conversion and the forest administration lacks the means to deter or evict encroachers.

Although the forest lands situated on the plains of the Terai and Inner-Terai are potentially highly productive, they lack scientific management systems. Many forest management plans have been prepared for the region but have not been implemented due to a lack of government commitment. Although the forestry administration is trying to protect these forests from the illegal poaching of forest products, it has so far failed to do so. Heavy grazing and frequent fires are other key factors that hinder the natural regeneration of trees and significantly contribute to forest deterioration and degradation. This is compounded by the presence of timber mafias and weak forest governance. Due to the heavy loss of forest cover in the Churia hills, riverian forests (Sissoo, Khair, and Semal) have almost disappeared due to heavy siltation and river-bank widening. About 4-6 decades ago, the river banks of the Churia Hill and Bhabar zones had dense and well-stocked riverian forests of Khair and Sissoo species that served as filters, allowing only clean water to enter rivers and creeks. Due to forest deterioration, some of these important species are now threatened with extinction. Sand and gravel collection from sensitive areas and river bank widening are other

significant threats to forests and to the habitats of individual species. In the Mid-hills, government forests on steep slopes are at threat from slash and burn cultivation practices for the production of food grains. Acute poverty is often cited as the reason for this type of cultivation, which poses a huge threat to both forests and biodiversity. The rotation period for slash and burn cultivation is roughly two to three years (as opposed to the more usual 10 – 15 years) which is not long enough for the regeneration of secondary forests.

Threats to biodiversity should be understood at three levels: (i) threats to ecosystems that provide living space to living species; (ii) threats to living species whose existence on this planet is not safeguarded; and (iii) threats to the genetic resources that provide a base for the life and livelihoods of the human population. The threats to ecosystems emanate from the conversion of natural habitats (forestland, grassland, wetlands, mountain slopes) to man-made or man-manipulated areas such as farmlands, residential/industrial areas, and development infrastructure. The threat to species loss largely results from habitat loss and also from over-exploitation/over-harvesting, environmental pollution and also climate change. The threats to genetic resources largely come from replacement or displacement by introduced species, destruction by diseases and loss of relevance to human needs.

The proposed strategies for the forestry sector are as follows: (i) Maintain at least 40% of the country as forest land in the new federal set-up; (ii) Increase productivity per unit area in all of the country's forests; (iii) Conserve fragile ecosystems to protect the fertile lands of the Terai from siltation and river-cutting by creating upstream and downstream links between the Churia Hills and the Terai from the perspective of environmental services; (iv) Conserve the fragile steep slope ecosystems of the Mid-hills from the perspective of environmental services; (v) Reduce pressure on forests in the high mountains; (v) Conserve high value NTFPs/MAPs in the high mountains.

The proposed strategies for biodiversity conservation are as follows: (i) Establish the intellectual property rights (IPR) of indigenous peoples and local communities over indigenous knowledge/practices for biodiversity conservation; (ii) Conserve wetland biodiversity and fragile ecosystems outside protected areas; (iii) Conserve flagship wildlife species in the Terai; (iv) Adopt a river corridor approach, linking protected areas in the Terai and the high mountains; (v) Establish PES schemes for tropical forestry management and biodiversity development; (vi) Conserve biodiversity in the high mountain rangelands that are located outside the protected areas.

## **TROPICAL FORESTRY AND BIODIVERSITY (FAA 118 & 119) REPORT, 2009**

### **1.0 INTRODUCTION**

#### **1.1 Purpose**

The purpose of this assessment, as mandated by the Foreign Assistance Act, Section 118 and 119 (FAA 118, Tropical Forests, and FAA 119, Biological Diversity), is to assess and determine:

1. Action that needs to be taken in Nepal to achieve the conservation and sustainable management of tropical forests; and the extent to which the actions that USAID proposes to support meet with identified needs; and
2. Action that needs to be taken in Nepal to conserve biological diversity; and the extent to which the actions that USAID proposes to support meet with identified needs.

These requirements are detailed in USAID's Automated Directives System (ADS), Section 201.3.4.11.b, on mandatory environmental analyses for strategic plans, and state that:

1. Environmental factors and values should be integrated into USAID decision-making processes;
2. The environmental effects of USAID's actions must be independently assessed; and
3. USAID programs must meet the criteria stated in the National Environmental Policy Act (NEPA).

This assessment was commissioned, and this report drafted, to comply with these requirements. The assessment was conducted between June and August 2009. The current Country Strategic Plan (CSP) and FAA 118 & 119 provide a base-line for this update. As agreed with USAID, this report follows the same format as the Tropical Forestry and Biodiversity (FAA 118 & 119) Assessment Report 2006. In order to take into account major changes in Nepal's social and political context since 2006, the "Assessment of Climate Change, Forests and Biodiversity in Nepal" (USAID, 2009) was also used to inform the writing of this document. This report has been prepared for the period of 2009-14.

#### **1.2 Methodology**

The report authors reviewed a wide range of USAID documents, including the USAID Country Assistance Strategy (2009-13), the FAA 118 & 119 Tropical Forestry and Biodiversity report of (2006), and the Assessment Report on Tropical Forestry and Biodiversity (2009). The authors also referred to documents detailing relevant government policies, strategies and laws, along with a broad range of study reports. They also held meetings with USAID officials, and consulted with governmental and non-governmental agencies.

The report presents a review of each of Nepal's eco-zones (the Terai, the Mid-hills and the high mountains), along with recommendations for action to address the specific problems and threats that each eco-zone faces.

#### **1.3 Organization of the Report**

The first section of the report gives the reader an introduction to the study and its purpose, and presents the methodology used by the consultants. The second section reviews in detail the current status of tropical forests and biodiversity and includes sections on ecosystem diversity, Nepal's forests, wetland, lake and river biodiversity, species biodiversity, agro-biodiversity, and livestock/genetic resources. The report also deals with the effects and impacts of climate change on tropical forests and biodiversity. The third section presents the social, economic and political scenarios in Nepal, and the impact this is having on forests and biodiversity. The fourth section discusses the activity of relevant government and non-government agencies in the sector. The fifth section details threats to tropical forests and biodiversity, while section six focuses on the action necessary to conserve tropical forests and biodiversity in Nepal. Section seven features a series of recommendations to inform USAID/Nepal's country strategy and program planning.

### **2.0 STATUS OF TROPICAL FORESTS AND BIODIVERSITY**

## Introductory Note

This report details the problems and threats facing Nepal's tropical forests and biodiversity along with actions that need to be taken and recommendations for USAID/Nepal intervention. Findings are organized by eco-zone. In order to delineate these two overlapping but clearly separate areas of study, each chapter contains a tropical forest section and a biodiversity section.

The term "biodiversity" refers to the richness and variety of life found in *inter alia*, terrestrial, marine and freshwater ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems (CBD, 1992). This report examines the biodiversity of Nepal's rangelands, wetlands, agriculture, livestock, and forests.

According to Troll and Paffen, the subtropics are the geographical zones of the Earth immediately north and south of the tropic zones, which are bounded by the Tropic of Cancer and the Tropic of Capricorn, at latitude 23.5° north and south. The term "subtropical" describes the climatic region found adjacent to the tropics, usually between 20 and 35 degrees latitude in both hemispheres (<http://en.wikipedia.org/wiki/Subtropics>). As Nepal is located at a latitude of between 26°22' and 30°27' (CBS, 1991), all of the country's forests are technically classed as sub-tropical, despite the fact that some are located at altitudes of up to 2000 meters (Dobremej, 1996).

## 2.1 Ecosystem Diversity

Ecosystem diversity describes the variety of existing habitats, the dynamic complexes of plant/animal/micro-organism communities which populate these habitats, and their non-living environment. It also describes how these three elements interact as a functional unit and change over time. The exact number of ecosystems that have been defined in Nepal varies from source to source; the Government of Nepal has recognized 118 ecosystems in the country, ranging from tropical monsoon forests to alpine pastures (NBS, 2002). In broad terms, Nepal's ecosystem diversity can be concisely described within the framework of the five physiographic zones shown on the next page. To date, formal conservation efforts have focused predominantly on the Terai and the High Mountains. These efforts have targeted the conservation of rare and endangered mega fauna and the unique high mountain environment of the Himalayas, both of which hold high tourism potential. Examples of ecosystem conservation in the Terai can be seen in five protected areas (Koshi Tappu Wildlife Reserve, Parsa Wildlife Reserve, Chitwan National Park, Bardia National Park and Suklaphanta Wildlife Reserve) and also in the Terai Arc Landscape Program (TAL). In the High Mountains, there are numerous ecosystem conservation efforts going on in Rara National Park, Shey-Phoksundo National Park, the Annapurna Conservation Area, the Manaslu Conservation Area, Langtang National Park, Sagarmatha National Park, Makalu-Barun National Park and Kanchenjunga Conservation Area.

This report focuses on the conservation of biodiversity in the Mid-hills and Churia Hills which have, to this point, witnessed only limited ecosystem conservation efforts. It examines biodiversity in both the river and mountain corridors that link the Terai in the south with the Himal in the north. It also looks at biodiversity along the fragile Churia Hill corridor which runs from east to west.

### Ecosystems in Nepal's Five Physiographic Zones

Physiographic zone	Elevation (m)	Climate	Major ecosystems
<b>High Himal</b>	>5000	Tundra/Arctic	Tundra Arctic
<b>High Mountains</b>	4000-5000	Alpine	Upper Caragana Steppe Lower Caragana Steppe High Alpine Vegetation Upper Alpine Meadows Dry Alpine Scrub Moist Alpine Scrub
	3000-4000	Sub-Alpine	Fir/Blue Pine Forest Birch/Rhododendron Forest Fir Forest Larch Forest Fir/Oak/Rhododendron Forest Fir/Hemlock/Oak Forest Oak Forest
<b>Mid-hills</b>	1000-3000	Cool Temperate Monsoon (2000m - 3000m) Warm Temperate Monsoon (1000m - 2000m)	Upper Temperate Blue Pine Forest Temperate Juniper Forest Spruce Forest West Himalayan Fir/Hemlock Forest Temperate Mountain Oak Forest Lithocarpus Forest, Rhododendron Forest Oak/Rhododendron Forest Maple/Magnolia/Sorbus Forest Rhododendron/Maple Forest, Cedar Forest Cypress Forest Blue Pine/Oak Forest Lower Temperate Oak Forest Walnut/Maple/Alder Forest Oak/Laurel Forest Olea Forest
<b>Churia Hills</b>	1000-2000	Hot Monsoon Sub-Tropical	Chirpine Forest Chirpine/Broad-leafed Forest Schima/Castanopsis Forest Eugenia Forest
	<1000	Hot Monsoon Tropical	Sal Forest Terminalia Forest
<b>Terai</b>	<1000	Hot Monsoon Tropical	Sal forest, Terminalia Forest Tropical Evergreen Forest Riverian Forest Khair/Sissoo Forest Savannah/Grasslands

## 2.2 Nepal's Forests

In Nepal, as in much of the developing world, forests are an extremely valuable source of natural resources. Covering approximately 30 percent of Nepal's total land area (with approximately 10% forest shrubland), forests supply a large majority of the country's household fuel, and more than 50 percent of the fodder needed for livestock. Forests also supply Nepali people (especially in rural areas) with food, medicine, construction materials, and other products. In addition to this, forest catchments represent the main source of water for domestic/household consumption, and hydroelectric power and irrigation. Forests are also a major source of the leaf litter which, when mixed with animal dung, plays an important role in traditional farming systems.

### CHARACTERISTICS OF THE 10 RECOGNIZED FOREST GROUPS IN NEPAL

**Alpine Scrub Forest** (above 4100m): *Juniper-Rhododendron* associations include *Juniperus recurva*, *J. indica*, *J. communis*, *Rhododendron anthopogon*, and *R. lepidotum*, also associated with *Ephedra gerardiana*, and *Hippophae tibetana* in inner-valleys. *Caragana versicolor*, *Lonicera spinosa*, *Rosa sericea*, and *Sophora mocroftiana*, among others, occur north of the Dhaulagiri-Annapurna massif. Alpine meadows, locally called 'Kharka', are used for grazing during the summer and rainy seasons. Perpetual snow occurs above 5,200 m, and mosses and lichens are found in scattered locations. *Stellaria decumbens* and *Parrya lanuginosa* have been recorded at an elevation of about 6,100 m, but beyond 6,000 m, in the Arctic desert/nival zone, even mosses cannot survive.

**Sub-Alpine Forest** (3000m - 4100m): *Abies spectabilis*, *Betula utilis*, and *Rhododendron* forests occur in sub-alpine zones, the latter in very wet areas.

**Temperate Coniferous Forest** (2000m - 3000m): The species *Pinus wallichiana*, *Cedrus deodara*, *Cupressus torulosa*, *Tsuga dumosa*, and *Abies pindrow* characterize temperate coniferous forests. However, many of the above species also thrive above 3000m. *Pinus wallichiana* in particular is an aggressive colonizer and can be found in temperate parts of Nepal at an altitude of up to 3700m. *Cedrus deodara*, *Picea smithiana*, *Juniperus indica*, and *Abies pindrow* forests occur in the western Himalayas. The valley of the upper Bheri River demarcates the eastern boundary for *Cedrus deodara*. *Larix himalaica* forests only occur in the moraine habitats of the Langtang and Buri Gandaki valleys. *Larix griffithiana* is an eastern Himalayan larch species which can be found as high as 3940m. Both *Cupressus torulosa* forests and *Tsuga dumosa* forests are widespread throughout Nepal at altitudes of between 2130m and 3340m.

**Upper Temperate Mixed Broad-Leaved Forest** (2500m - 3500m): This forest type occurs in central and eastern Nepal, mainly on north and west-facing slopes. Although *Acer* and *Rhododendron* species are prominent throughout this altitude range. *Aesculus*, *Juglans* and *Acer* forests are largely confined to western Nepal.

**Upper Temperate Broad-Leaved Forest** (2200m - 3000m): *Quercus semecarpifolia* forests are widespread on south-facing slopes in central and eastern Nepal but are absent in heavy rainfall areas such as the Upper Arun and Tamur valleys and the hills lying north of Pokhara.

**Lower temperate Mixed Broad-Leaved Forest** (1700m - 2200m): This type of forest is confined to north and west-facing slopes. In many places, the most prominent tree species found in this forest type belong to the *Lauraceae* family.

**Lower Temperate Broad-Leaved Forest:** This forest type occurs between 2000m and 2700m in the west, and between 1700m and 2400m in the east. *Alnus nitida*, *Castanopsis tribuloides*/*C. hystrix*, *Lithocarpus pachyphylla*, and several species of *Quercus* thrive in the Mid-hills. Among them, *Alnus nitida* forests can be found on the banks of the Mugu Karnali river at between 2130m and 2440m. *Quercus leucotrichophora*/*Q. lanuginosa* forests along with *Q. floribunda* forests occur mostly in western Nepal, whereas *Q. lamellosa* forests are widespread in central and eastern Nepal. *Lithocarpus pachyphylla* forests can be found in eastern Nepal.

**Subtropical Conifer (Pine) Forest** (1000m - 2200m): *Pinus roxburghii* forests occur particularly on south-facing slopes in the Mid-hills and Siwalik Hills in western and central Nepal.

**Subtropical Broad-Leaved Forest** (1000m - 2000m): *Schima wallichii*/*Castanopsis indica* forests are found in central and eastern Nepal. Riverine forests of *Cedrela*/*Albizia* occur along large rivers such as the Arun, on the subtropical foothills. *Alnus nepalensis* forests are widespread along streams and in moist areas.

**Tropical Forest** (below 1000m): This forest type is found in the southern parts of Nepal and is predominantly composed of *Shorea robusta*. *Acacia catechu*/*Dalbergia sissoo* forests replace *Shorea robusta* forests along streams and rivers. There are other riverine forests which mainly contain evergreen species such as *Michelia champaca* or deciduous species such as *Bombax ceiba*. *Shorea robusta* forests are replaced by *Terminalia*/*Anogeissus* forests in the foothills of western Nepal.

## 2.2.1 Natural Forests

The Ministry of Forests and Soil Conservation has recognized 35 natural forest types, which have been categorized into the 10 major groups shown above. The habitats and characteristics of these 10 major forest groups were defined in the National Conservation Strategy (2002).

More than 99% of Nepal's forests are naturally regenerated. According to a 1999 DFRS report, forest area as of 1994/95 was estimated to be around 4268.8 thousand hectares, which is about 29% of the total territory of the country. The forest cover in 1978/79 was about 5593 thousand hectares, covering about 39% of total territory (LRMP, 1986). This difference can be attributed to deforestation<sup>1</sup>, which affected 1.7% of total forest area between 1978/79 and 1994/95 (Table 1). A total of 1325 thousand square hectares of forest land, (i.e. more than 9% of the total forest cover), was converted to other land-use/land cover categories during this period. In the same time frame, shrubland doubled from 689.9 thousand hectares (4.7%) to 1559.2 thousand hectares (10.6%). The rate of conversion of forest and shrubland (woody vegetation) into areas of non-woody vegetation during the same period was approximately 29 thousand hectares per annum. This is a clear indication that forest resources have been subjected to exploitation beyond their sustainable growth.

**Table 1: Forest Areas in Nepal**

Category	Land cover in 000 hectare			Rate of change between 1978/79 & 1994/95
	LRMP 1978/89	MPFS 1985/86	NFI 1994	
Forest <sup>2</sup>	5,616.8	5,504	4,268.8	- 1.7%
Shrub <sup>3</sup>	689.9	706	1,559.2	+ 5.2%
Total	6,306.7	6210	5,828.0	- 0.5%

Source: *Forest Resources of Nepal (1987-1998)*, Publication No. 74, 1999 and LRM 1986.

NB: Eco-region differentiated data is not available for comparison.

The National Forest Inventory (NFI, 1999) shows that in 1995, Nepal had a forested area of 5.8 million hectares (40%) that consisted of 4.2 million hectares (29%) of forest and 1.8 million hectares (10.8%) of shrubland. About 48% of the forested area was in the Mid-hills, 25% in the plains (Terai), with the remaining 27% in the High Mountains.

## 2.2.2 Plantation Forests

In order to improve the condition of degraded forests and grasslands in the Terai and Mid-hills, the Nepal Government with support from a variety of aid organizations has established a forest plantation program. This initially involved planting eucalyptus and chirpine (*Pinus roxburghii*) species on the denuded hills around the Kathmandu valley but was later expanded to other hilly areas. As a result, a number of districts now have substantial areas of plantation forest comprising both indigenous and exotic species. *Dalbergia sissoo*, *Eucalyptus* species, and *Tectona grandis* were planted in Terai districts and *Pinus roxburghii*, *P. wallichiana*, *P. patula*, and *Alnus nepalensis* were planted in the Mid-hills (NBS, 2002). However, the use of *Dalbergia sissoo*, *Eucalyptus* species and *Tectona grandis* to replace naturally occurring Sal (*Shorea robusta*) forests has had negative impacts on wildlife conservation due to the lack of accompanying undergrowth vegetation. People from local communities have complained that the species used to replace the Sal forests do not cater to their needs for construction quality timber and rope (lack of *Bauhinia* species). They also bemoaned the current lack of medicinal and aromatic plants, wild fruits, and vegetables growing in plantation forests.

During the implementation of the 7<sup>th</sup> Five Year Plan (1985-90), the government and its partners planted a total of 63,053 hectares of forest (DOF, 1994). The government claims that another 26,456 hectares were planted during the implementation of the 8<sup>th</sup> Five Year Plan (NPC, 1998) and a further 15,316 hectares by the mid-point of the 9<sup>th</sup> Five Year Plan (DoF, 2002) totaling 41,772 hectares. However, the survival rate of plantations and the progress made towards the formal establishment of these plantations as forests areas have yet to be assessed. The Department of Forests ceased its plantation policy with the advent of the 10<sup>th</sup> Five Year Plan, shifting its focus to the protection, promotion, invigoration management, and natural regeneration of Nepal's forests.

<sup>1</sup> Deforestation is the conversion of forest to other land use, or the long-term reduction of the tree canopy cover below the minimum 10 percent threshold (FAO, 2004).

<sup>2</sup> Forest is considered all lands with a forest cover, i.e. with trees whose crowns cover is more than 10% of the area, and not used primarily for purposes other than forest (FAO, 2009).

<sup>3</sup> Shrubland is the same as forest but lacks well-defined tree stems (FAO, 2009).

### 2.2.3 Non-Timber Forest Products

Non-Timber Forest Products (NTFP)<sup>4</sup> provide crucial sources of income and livelihood for many people in Nepal. Edwards (1996) estimates that 10-15 thousand tons of NTFPs are harvested annually from the middle and high mountains of Nepal and that the value of these NTFPs, (almost all of which are sold to India), is US\$ 8.6 million. Kanel (1999) puts this figure at US\$ 19 million. According to Subedi (1997), in 1995, more than 100 entrepreneurs along the East-West Highway traded in more than 100 different NTFPs generating total sales of 1.5 billion Nepali rupees (equivalent to approximately 26 billion rupees today).

Subedi (2006) has also grouped the 161 commercial NTFP species found in Nepal according to ecological zone, and according to where they can be found along the country's east-west axis. His findings show that 71% of commercial NTFP species are found in the Mid-hills, 17% in the high mountains and 12% in the Terai. Many of these commercial species can also be found at different altitudes. Only 2% are found in all three ecological zones. While there are a considerable number of NTFPs in tropical and mid-hill regions, the Himalayan and trans-Himalayan regions are rich in high value NTFPs. Along the east-west axis, western Nepal is richer in commercially harvested species than the east. The annual commercial growth rate for NTFPs is 36% for herbs, 30% for trees and 22% for shrubs. The number of fungi, orchids and climbers that are used commercially is relatively small but many of these species are important due to the high prices they command in the market. Examples of this latter category are *Yarsagumba (Cordyceps sinensis)* and *Guchi Chiyau (Morchella esculenta)*. In terms of primary use category, 50% of NTFPs are employed primarily for medicinal purposes, 17% for food, 7% for essential oil production, 6% for plant fiber, 5% for wooden and craft products 4% for spices and flavoring agents, and 4% for dye products. The remaining 7% are used to produce tonics, gums and resins, edible oils, brooms and brushes, incense, soaps and so on.

Forests and high altitude range/pasture lands are the main sources of NTFPs in Nepal, with people from local communities collecting primarily from naturally occurring forest stocks. Plantations of essential oil yielding NTFPs have started to become popular in the Terai, with the current focus on exotic species such as citronella, lemon grass, menthol and others. Similarly, the cultivation of *Asparagus racemosus* and other edible species has started in several Terai districts; cultivation takes place both in community forests and on private land. Dabur Nepal, working in collaboration with local communities, is currently the only private company cultivating high altitude NTFP species in Mustang and Manang districts in addition to the Terai. The medicinal and aromatic plants (MAPs) it harvests are used to produce health tonics and ayurvedic medicines. In addition to Dabur Nepal, the Gorkha Ayurved Company cultivates a number of MAP species for Ayurvedic medicine production. *Yarsagumba (Cordyceps sinensis)*, *Guchi Chiyau (Morchella esculenta)* are examples of high altitude NTFPs found in the western Himalayan regions; these are collected from natural stocks and have a high market value, but as yet, the technology to cultivate such species in forestlands and on private farms does not exist.

### 2.2.4 Forest Management

Forest management is the process of planning and implementing practices for the stewardship and use of forests and other wooded areas. It aims to achieve specific environmental, economic and/or cultural objectives (FAO, 2004). Forest resources in Nepal are categorized into two management regimes: community-managed forests and government-managed forests. These are described below:

#### Community-Managed Forest Resources

Community-managed forest resources can be defined as both forested and non-forested land, the use rights for which have been transferred from the government to another entity. Officially, the Government of Nepal recognizes five types of community-managed forest resource: community forests, leasehold forests, religious forests, collaborative forests, and private forests. Each of these is described briefly below.

#### Community forestry

A community forest is defined as a "national forest handed over to a user group for development, conservation and utilization for the collective benefit of the community" (Forest Act, 1993). As of 2009, a total of 14,439 forest user groups were managing 12, 29,669 hectares of forest, benefiting 16,59,775 households (CFD, 2009). 18% of Nepal's forest user groups can be found in the high mountains, 73% in the Mid-hills and 9% in the Terai. 19% of the country's community forests are located in the high mountains, 67% in the Mid-hills and 14% in the Terai. Table 2 summarizes this data.

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<sup>4</sup> NTFPs or Non-Timber Forest Products are defined as any product derived from forest species, both plant and animal, other than timber or fungi. A narrower definition of NTFPs appropriate for Nepal, includes all biological materials, other than timber, fodder or fungi (Hammett, 1993).

**Table 2: The Distribution of Community Forests in Nepal by Eco-region**

Eco-region	#. of Community Forests	Area in hectares	Total # of Households	# of districts
High mountains	2,586 (17.91%)	238,403 (19.39%)	263,665 (15.89%)	15 (20.27%)
Mid-hills	10,512 (72.80%)	821,717 (66.82%)	1, 109, 49 (66.85%)	39 (52.70%)
Terai/Inner Terai	1,341 (9.29%)	169,549 (13.79%)	286,620 (17.27%)	20 (27.03%)
<b>Total</b>	<b>14,439 (100%)</b>	<b>1,229,669 (100%)</b>	<b>1,659,775 (100%)</b>	<b>74</b>

Source: MIS Community Forestry Division, Department of Forests (12 June 2009)

Community forests in Nepal's mountain regions are rich in high value NTFPs and/or MAPs. The potential for NTFPs/MAPs has only been harnessed in a few community forests. The forests also provide local communities with firewood for cooking and winter heating. Community forestry is the primary forestry program in the Mid-hills. It focuses on protection and regeneration and has proved to be successful. Most of the existing community-accessible forests in the Mid-hills would benefit from the community forest approach. In order to increase production and benefits per unit area, horizontal and vertical space management systems need to be introduced. In addition, all forests would benefit from tree and dense undergrowth maintenance in order to promote soil conservation.

There is scope for forests in the high mountains and Mid-hills to be divided into watershed or sub-watershed basin areas which would enable communities to sell watershed protection services (a type of Payment for Ecosystem Services or PES) particularly in areas upstream from hydropower dams. Services include irrigation and drinking water provision for VDCs/DDCs. This would bring additional economic benefits to community forest users.

Community forests in the Terai have enormous potential for productivity due to the fertile soil in the area, but this has yet to be fully harnessed. As a result, almost all of the community forests in the Terai are under stocked. Although some silvicultural activities like singling, thinning, and weeding have started in small areas, horizontal and vertical space management are needed to increase forest production per unit area. Such space management would help communities to optimize the benefits from both timber and non-timber forest products.

Community forestry in the Terai is often controversial. Unlike the Mid-hills where a relatively small number of users are managing a relatively small area of forest, most of the forests in the Terai are large. The government would prefer these areas to be managed as blocks. In addition to this, communities that depend on forest resources are many in number, and may live close to or far away from the forest itself. This means that the type of community forestry practiced in the hills, although successful in some parts of the Terai, needs to be reviewed and perhaps modified before being applied to large areas of forest. Many non-community forests administered by District Forest Offices have become degraded due to open public access ("the tragedy of the commons" - Hardin, 1968).

Community forestry has contributed to the *in-situ* and *ex-situ* conservation and management of economically viable NTFP species in all three eco-regions. CARE/SAGUN has also initiated a program of biodiversity registration in community forests. In Kailali district, the Bijay Sal (*Pterocarpus marsupium*) has been conserved very successfully. Table 3 shows that there is a 3% to 20% increase in plant species biodiversity in the buffer zone community forests of Banke district.

**Table 3: Increased biodiversity in the buffer zone community forest of Banke district**

	Name of buffer zone CF	No. of Species in 2002 (Baseline)	No. of Species in 2006 (Assessment)	Difference	
				Number	Percent
1	Rampur	185	191	6	3.24
2	Khaireni	155	174	19	12.26
3	Amohiya	134	149	15	11.19
4	Ranjha Bich Tole	134	162	28	20.90

Source: CARE Nepal (SAGUN). 2008

### Collaborative Forest Management

Collaborative forest management (CFM) is only practiced in the Terai districts to manage large chunks of forest. There are five CFMs in the Terai covering 10,676 hectares and 115,300 households in five districts (Table 4). The difference between CFM and community forestry is that CFM users come from both nearby and far distant households. Also CFM covers larger chunks of forest than community forestry. There is no CFM in the Mid-hills or high mountains.

**Table 4: Collaborative Forest Management in Nepal**

Eco-region	No. of CFM	Area in Ha	Total Households	No. of districts
Terai/Inner Terai	5	10,676	115,300	5

Source: BISEP-ST, 2009

The CFM model is being used for large areas of forest in the Terai, and, as with community forestry, these areas are protected but not managed. The use of horizontal and vertical space management systems could more than double the production and benefits per unit area for both timber and NTFPs. The size of these areas means that there are large numbers of households, a huge quantity of forest products and hefty CFM budgets to be managed. This presents a number of challenges relating to good governance and the equitable distribution of forest products and benefits to forest users.

### Leasehold Forests

The term 'leasehold forest' refers to areas of national forest that have been leased to a legally established institution, to a community, or to an industry, and that are used for the production of forest products, agro-forestry, eco-tourism or the farming of insects/wildlife in a manner conducive to the conservation and development of the forest (Forest Act, 1993). The Leasehold Forest Policy (2002) permits the leasing out of forest land to groups of poor households, eco-tourism organizations or local communities. Since leasehold forestry programs for poor households are currently a priority area for the forestry sector, the Department of Forests' leashing efforts have, to this point, focused mainly on programs for the poor. Table 5 shows that in 2009, 4,194 leasehold groups (including 36,478 poor households) were managing 23,423 hectares of forest land across the country. The majority of this is concentrated in the Mid-hills.

**Table 5: Leasehold Forestry for Poor Households**

Eco-region	# of leasehold groups	Area in Ha	Households	# of districts
High mountain	375 (9%)	6,708 (29%)	5,881 (16%)	6 (19%)
Mid-hills	3,772 (90%)	16,394 (70%)	30,134 (83%)	23 (72%)
Terai	47 (1%)	321 (1%)	463 (1%)	3 (9%)
<b>Total</b>	<b>4,194</b>	<b>23,423</b>	<b>36,478</b>	<b>32</b>

Source: MIS, Leasehold Forestry and Livestock Program, 12 July 2009

Leasehold forestry programs for the poor have been set up with the financial support of the International Fund for Agriculture Development (IFAD). The lead implementing agency in the high mountains is the Ministry of Local Development (MLD) while the Department of Forests implements programs in the Mid-hills. Both work with partner organizations including the Department of Livestock Services, the Department of Agriculture, and the Department of Women's Development. In the high mountains, the focus is on income generation through NTFPs/MAPs; the mid-hill initiatives focus on forage development and the raising of livestock. Participation in leasehold forestry programs is open only to people living below the poverty line. Poor households are leased small areas (up to one hectare) of forest for a maximum of 40 years. Leasehold forestry programs have so far been launched in 11 high mountain districts, 22 mid-hill districts and three Terai districts.

Leasehold forestry in the mid-hill and high mountain eco-regions has been effective in promoting the regeneration, re-vegetation and management of degraded forest land. This in turn, has had a direct positive impact on biodiversity and environmental conservation. Analysis of two leasehold forest sites of Chitrepani in Makwanpur and Bhagwatisthan in Kavre district between 1994/95 and again in 2000 showed significant increases in biodiversity. In Chitrepani forest, there was a 57% increase in species diversity, going up from 37 species in 1994 to 58 species in 2000. In Bhagwatisthan, there was an 86% increase, jumping from 70 species in 1995 to 130 species in 2000 (Ohler, 2000).

The Ministry of Forests and Soil Conservation and the Department of Forests do not seem to be interested in leasing areas of forest to the timber industry or to poor households in the Terai. As a result, very few forest areas in the Terai have been leased to local communities. All leasehold forestry programs can qualify for Reducing Emissions on Deforestation and Forest Degradation funding as they are able to establish new forest areas in a relatively short period of time.

### Government Managed Forest Resources

The term 'government managed forests' refers to areas of national forest that are managed by the Government of Nepal with the main objective of production. Of Nepal's 5,828,000 hectares of forest, 1,263,768 ha (21.68%) is managed with the active participation of local communities, while the remaining of 4,564,232 ha (78.3%) is administered by the Department of Forests and the Department of National Parks and Wildlife Conservation, the latter managing forests in protected areas. Forests which are directly administered by the Department of Forests are becoming degraded due to the lack of proper protection and management systems.

### Protected Areas

Nepal has a total of nine national parks, five of which are located in the high mountains, two in the Mid-hills and two in the Terai. There are also three wildlife reserves in the Terai, one hunting reserve in the Mid-hills and three conservation areas in the high mountains. In addition to these, there are six buffer zones in the high mountains and five in the Terai. At the time of writing, no buffer zones have been created in the Mid-hills.

**Table 6: Distribution of protected areas in different ecozones**

Characteristics	High mountains		Mid-hills		Terai		Total	
	No.	Area (km <sup>2</sup> )	No.	Area (km <sup>2</sup> )	No.	Area (km <sup>2</sup> )	No.	Area (km <sup>2</sup> )
National Parks	5	8,019	2	369	2	1,900	9	10,288
Wildlife Reserves	-	-	-	-	3	979	3	979
Hunting Reserves	-	-	1	1,325	-	-	1	1,325
Conservation Areas	3	11,327	-	-	-	-	3	11,327
Buffer zones	6	3,288	-	-	5	1,792.67	11	5,080.67

Source: DNPWC, Annual Report, 2007/08.

### Private Forests

There are very few private forest areas in the Mid-hills, although the number of fodder-producing trees on private land outside forest areas is relatively high. Although only a few small patches of forest are managed privately in the Terai, the number of trees on private land increased substantially when the Terai Community Forestry Development Project was launched (1984 -1989). For the duration of the project, tree seedlings were distributed free of cost; after its completion Terai residents continued to plant seedlings purchased from private nurseries. Tree planting has maintained momentum in many Terai districts due to the growing demands for fuel wood and timber for furniture. Private plantations have contributed to the *ex-situ* conservation of economically viable tree species.

### High Altitude Rangelands and Pasture lands

Large areas of land (including swamp) in the high Himal are used as rangeland/pasture land during the rainy season. In the winter season, most of these rangelands are covered in snow. The high mountain rangelands are home to a number of high value medicinal and aromatic plants including Yarsagumba, which fetches NRs 200,000 to 300,000 per kilo in the market. Most of these rangelands are a one to three day walk from the nearest settlement. The rights of use for such areas are not currently clear. They are managed neither by the government nor a private agency.

### Watershed and Soil Conservation Status

A watershed is a topographically delineated area that is drained by a stream system (Brooks, 1986). In the planning and management of resources, watersheds are often described as physical-biological /socio-economic political units. Nepal's watersheds range in size from large river basins to small confluences of streams. The watersheds of the country's four major river systems (Koshi, Gandaki, Karnali and Mahakali) and over 6,000 medium and small sized rivers contain the natural resources (soil, water and natural vegetation) that are vital for the livelihoods of millions of Nepali people. However, many of the country's watersheds are in a state of deterioration due to geological fragility, rugged topography and intense monsoon rainfall. Increased population pressure and anthropogenic activities like the improper use of land and the construction of environmentally inappropriate infrastructure, have further aggravated the problem. The deterioration of watershed resources has resulted in the decline of soil fertility, water yield, farm productivity, and forestry production. This in turn has led to increasing levels of poverty amongst those dependent on watershed resources for their livelihoods.

According to the Department of Soil Conservation and Watershed Management (DSCWM), the degree of land degradation varies from district to district. About 10% of land is badly degraded, around 3% is in poor condition, about 19% is in a marginal condition, 35% is in good condition and the remaining 33% is in very good condition (DSCWM, 1983). In the high Himal, the watersheds of Manang, Mustang, and Dolpa districts vary from very poor to marginal while the remaining watersheds in the Himalayan districts are in good condition. The watersheds of the Terai districts

are categorized as being in very good condition but are badly affected by siltation from the Churia hills. The condition of the watersheds of the mid-hill districts is mostly very poor, poor, and marginal, although watersheds in a few districts are in good condition.

The DSCWM has worked successfully for the conservation of Phewa Lake (Kaski) and Kulekhani (Makwanpur) and has managed to reduce siltation by using a participatory integrated watershed management approach. However, dealing with the massive siltation coming from the Churia Hills to the Terai is a challenging task, and suitable policies, approaches and programs have not yet been devised to address the ongoing desertification. Watershed/sub-watershed is an appropriate unit for the sustainable management of natural (forest, water, and land), social, human, animal, and mineral resources. However, since results are only visible indirectly and in the long-term, the soil and watershed sectors do not attract large-scale investment from either the government or from donor agencies.

### 2.3 Wetland, Lake and River Biodiversity

The Ramsar Convention (1971) defines wetlands as “areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine waters, the depth of which at low tide does not exceed six meters” and which may include “riparian and coastal zones adjacent to the wetland, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands”. Nepal's National Wetlands Policy (2003) describes wetlands as swampy areas, marshy lands, riverine flood plains, ponds, lakes, water storage areas and agricultural lands. These can be natural or artificially created areas. Wetlands and water bodies occupy approximately 5% (743,563 ha) of Nepal's total territory (Department of Agriculture, DOAD 1992). The most extensive and visible water bodies are the rivers and streams of which there are around 6,000. Most of them are snow fed and perennial. Seasonal rivers originate from the Siwaliks (Churia Hills). The conservation of wetlands is crucial for biodiversity conservation, and for sustaining the livelihoods of local communities. They also represent a significant resource for fresh water and hydropower projects.

According to an inventory carried out by the IUCN (Bhandari, 1998) there are 163 wetland sites in the Terai. These include flood plains, canals, reservoirs, lakes, ponds, and marshes. Although a systematic inventory of the wetlands of the Mid-hills has not yet been carried out, a number of secondary data sources list a total of 78 wetland sites in the region. These include the lakes of Kaski district (Phewa, Roopa, Begnas, *et al*) and Mai Pokhari of Ilam district. The inventory carried out by ICIMOD/UNEP (Mool *et al* 2001) identified 2,323 glacial lakes situated at above 3,500 m. Of these, 20 are thought to be vulnerable to GLOF (Glacial Lake Outburst Flood) and are particularly sensitive to global warming and climate change.

Wetland habitats, especially the flood plains of Nepal's big rivers (Koshi, Narayani (Gandaki), Karnali and Mahakali) are critically important for a large number of endangered wildlife including the One-Horned Rhinoceros, the Bengal Tiger, the Gangetic Dolphin, the Gharial Crocodile and a large number of migratory birds and resident fish. Other wetland habitats in the Terai and the Doon Valley (oxbow lakes, waterlogged bogs and Bhabar lakes like Ghodaghodi Tal and Beeshazari Tal) are critical for over 190 species of birds (22% of the total bird species found in Nepal) including the world's highest flying bird, the Bar-headed goose, the Demoiselle Crane and the Brahmin Duck. Nepal is home to over two percent (182 species) of the world's freshwater fish species (8,411 species). These are also dependent on rivers and wetlands. Nepal is host to 14 different types of riverine vegetation ranging from moraine to riverine khair/sisso forests and savannah grasslands (TISC Doc. Series 105, page 43, 2002).

Nepal has been a signatory of the Ramsar Convention since 1988, and has responsibilities to formulate and implement planning measures to promote the conservation of Ramsar Sites. A total of nine Ramsar Sites of international significance are located in Nepal; four are in the Terai, four are in the high mountains and one is in the Mid-hills. The Koshi Tappu site is the lowest (75-81 m above sea level) while Gokyo Lake is the highest (4710-4950 m). These Ramsar Sites, especially those in the Terai and the Mid-hills, are important habitats for a large number of birds, amphibians, reptiles, aquatic animals and floral species. Six of the Ramsar Sites (Rara Lake, Phoksundo Lake, Gosainkund and associated lakes, Beeshazari and associated lakes, Gokyo and associated lakes and Koshi Tappu) fall within the protected area system, while the remaining three sites (Ghodaghodi Lake, Jagdishpur Reservoir and Mai Pokhari) do not. Due, in part, to the absence of a recognized management authority, these Ramsar Sites are prone to many on-going threats and encroachments. The three sites located outside the protected areas are facing many anthropogenic threats and need special attention.

### 2.4 Species Diversity

Species diversity refers to the frequency and variety of species (wild or domesticated) within a geographical area (NBS, 2002). The bio-geographic location of Nepal and its complex mountain systems has given rise to a high level of

biodiversity within the small territory area of 147,181 sq. km. Although Nepal represents only 0.1 percent of the global terrestrial surface (148.4 million km<sup>2</sup>), it is host to 0.3 percent of global species. This includes 4.5% of the planet's mammalian species, 4.2% of butterfly species, 2.7% of flowering plant species, 2.2% of freshwater fish species, 1.6% of reptiles and 1% of amphibians (Nepal Country Report on Biological Diversity, IUCN Nepal 1999; Nepal Biodiversity Strategy 2002; Nepal's Illustrated Biodiversity Primer 2005; Nepal Fourth National Report to CBD, Govt. Nepal 2009). The geography of Nepal's Himalaya has created six 'life zones' within the country, namely tropical, sub-tropical, warm temperate, cool temperate, sub-alpine, alpine and arctic. As a result, the habitats of the tropical tiger (Royal Bengal Tiger) and the arctic leopard (Snow Leopard) are separated by a distance of less than 200 km. Similarly, the tropical *Dipterocarpus* forests of the Terai are juxtaposed with the temperate oak forests of the Mid-hills and the rhododendron and conifer forests ranging from above 1,000m up to 3,000m along the vertical slopes of the mountains. Temperate forests give way to sub-alpine forests of birch, juniper and rhododendron until they reach the tree line at about 4,000m. Alpine species flourish at 4,000m to 5,000m. A Nival zone is found at 5,000m and above. It is the diversity of these 'life-zones' that has made Nepal so rich in species diversity. A summary of the highlights of Nepal's species diversity is given below.

## **SPECIES DIVERSITY IN NEPAL: SOME HIGHLIGHTS**

### **Platy helminthes**

Helminthes are invertebrate animals with bilateral symmetry but no appendages. Most species are parasitic. They occur in the wild as well as in domestic plants and animals. Helminthes have not been systematically studied in Nepal, with research efforts confined mainly to the Kathmandu Valley. A checklist of 168 species of helminth parasites has been compiled, with 33 species belonging to the trematode grouping, 67 to the nematode grouping, 36 to the cestode grouping, and 32 to the plant nematode grouping (Gupta 1997). Some common plant helminth parasites include *Melioidogyne incognita*, *M. arenaria*, and *M. javanica*, all of which cause damage to vegetables. *Ascaris lumbricoides*, *Ancylostoma duodenale*, and *Taenia* are common human parasites.

### **Spiders**

Thapa (1995) reported that Nepal is host to 144 different species of spider, which can be categorized into 17 families. 109 species are endemic, including 33 species that are rare and three that are threatened. Most of the documented spider species in Nepal were collected from the high mountains and Mid-hills; the far-western region of the country, the lowlands of the Terai and the Siwalik Hills still need further study.

### **Insects**

An inventory made by Thapa in 1997 details approximately 5,052 species of insect, 1,131 of which were previously unknown and were thus described for the first time using Nepali specimens. *Apis laboriosa*, the world's largest honey bee, *Attacus atlas*, the world's largest atlas moth, and the dragonfly *Epiophlebia laidlawi*, are three of the best known insect species that are unique to Nepal.

### **Butterflies and Moths**

Butterflies are perhaps the best studied grouping of Nepal's fauna (Smith 1994; 1997), with 640 documented species across the three eco-zones. The Red Data Book of the Fauna of Nepal (BPP, 1995b) lists 142 species, of which 12 are endangered, 43 are vulnerable, and 87 are susceptible to threats. There are four species and 25 subspecies which are possibly endemic (Smith 1997, pers. comm.). There are 557 species living in the Mid-hills, 325 in the Terai, and 82 in the high mountains (BPP 1995h). 2,253 species of moth (excluding Microlepidoptera) have been recorded in the country (Smith 1997, pers. comm.).

### **Fish**

The fish fauna of Nepal has been fairly well documented. Shrestha (2001) made many taxonomic changes in the classification of genera and species, leading to a final list of 182 species belonging to 11 orders, 31 families, and 93 genera. A total of 34 species are threatened. Eight fish species are endemic to Nepal.

### **Amphibians and Reptiles**

Shah (1995) documented 143 reptile and amphibian species in Nepal. Of these, 43 are amphibians (one salamander, four toads, and 38 frogs) and the remaining 100 are reptiles (24 lizards, 14 turtles, two crocodiles, and 60 snakes). Studies of amphibians and reptiles have been carried out in a number of areas of the country including the Arun Valley in eastern Nepal, the Chitwan National Park in central Nepal, and the Annapurna-Dhaulagiri region in western Nepal.

### **Birds**

Nepal's bird life has been relatively well documented with Grimmet *et al* listing 852 species belonging to 18 orders (Grimmet *et al* 2000). Eleven species have become extinct over the last century. 691 bird species have been recorded in the Mid-hills, 648 in the Terai and Siwalik Hills, and 413 in the high mountains. Of these, 111 species are confined to the Terai and Siwalik Hills, 29 species are confined to the Mid-hills, and 24 to mountainous areas (BPP 1995f). The

richest area for bird species is the lowland tropical forest (below 300m) in the Terai, where over 500 species have been recorded (Inskipp & Inskipp 1991).

### **Mammals**

A comprehensive account of Nepal's mammalian fauna was produced by Suwal and Verheugt (1995), who listed a total of 181 mammal species belonging to 12 orders and 39 families. Mammals are well represented in the protected areas of Nepal.

(adapted from Ministry of Forests and Soil Conservation, Nepal Biodiversity Strategy, 2002. (pp 25 -28)

Nepal's indigenous species of fauna and flora present researchers with many interesting phenomena related to biodiversity. Some highlights are listed below:

- The bacterium *Geodermatophilus obscurus everesti* is found at altitudes of up to 8306m – higher than any other organism on the planet.
- The Bar-headed goose, which can be seen flying across Himalayan ranges, is the highest flying of all flying bird species.
- The *Stellara decumbens*, found at altitudes of up to 6135m is the world's highest flowering plant
- Jumli Marshi Rice grows at 2800m in the Jumla – higher than any other rice species.
- Nepal is home to both the world's largest (*Apis laboriosa*) and the world's smallest (*A. florea*) honey bees.
- Nepal is also home to the Atlas moth – the largest moth in the world
- Nepal plays host to Asia's largest bovine (Gauri Gai or *Bos gaurus*) as well as the largest horn bearing Arna or water buffalo
- The world's largest flying bird - the Sarus Crane - is also found in Nepal

Species richness in Nepal is best indicated by birds. The Koshi Tappu Wildlife Reserve, the Mai Valley, and the Phulchoki and ACAP regions are the best known areas that are rich in bird diversity. The Tamur Valley and the adjoining Singhalila Range are rich in flowering plants, especially rhododendron species, primrose species, and epiphytic orchids. The upper Bheri Valley in Dolpa district is particularly rich in endemic plant species.

Species richness in flora and fauna may be attributed to the meeting of six phyto-geographical provinces within Nepalese territory: (i) Sino-Japanese, (ii) South-East Asian, (iii) Indian, (iv) African-Asian, (v) Irano-Turanean, and (vi) Central Asiatic. The floras and faunas of the eastern and western Himalaya merge in central Nepal. This merging can clearly be seen in the Kali Gandaki valley.

### **Endemism**

Endemism refers to a type of natural species distribution where occurrences of a particular species are confined to the political boundaries of a particular country. The endemic species of small countries are of special biological interest due to their concentration within a limited area. Endemism in Nepal is more pronounced in plant than animal species. Shrestha and Joshi (1996) listed 246 species of flowering plant that are endemic to Nepal. Analysis of distribution patterns reveal that the highest concentration of endemic plants (some 118 species) occurs at altitudes of between 3000 and 4000m. Twenty-nine of these species are found in eastern Nepal, 91 in the central region and 61 in the west. Several species can be found in more than one region. The Annapurna Conservation area (which contains the Kali Ghandaki Valley or KGV) plays host to the highest number of endemic flowering plants in any of Nepal's protected areas. The KGV is an area of interpenetration, containing both the 'humid' fauna of the eastern Himalaya and the 'dry' fauna of the west..

There is only one mammal species endemic to Nepal - the Himalayan Field Mouse (*Apodemus gurkha*), which can be found at between 2200 and 3600m in the coniferous forests in the north of Gorkha district (Shrestha, T.B, 1999). Of Nepal's 863 bird species, The Spiny Babbler (*Pnoepyga immaculate*) is the only one known to be endemic (Nepal Fourth National Report CBD, 2009). Endemic species of herpetofauna (amphibians) include seven frogs, (e.g. *Rana nepalensis* and *Rana rara*). There are eight endemic species of fish, three of which can be found in Rara lake (*Schizothorax nepalensis*, *S. macrothalamus* and *S. rarensis*). The remaining five are river species (e.g. Jalkapoor (*Raimis guttatus*) and *Pseudo tropius murius batraensis*). Nepal is known to have 29 endemic butterfly species but other data on endemic insect life is incomplete.

**Table 7: Species richness and endemism in Nepalese Fauna**

Fauna	Number of Species			
	Global	Nepal	Percent	No. of endemic species
Mammals	4,327	181	4.2	1
Birds	9,883	844	8.5	2
Reptiles	6,500	100	1.5	0
Amphibians	4,500	43	1.1	9
Fresh water fish	8,500	185	2.2	8
Butterflies	15,000	656	4.2	29

Source: IUCN-Nepal 1999 and other reports

### Alien Invasive Species

Those alien species that become established in a new environment and then proliferate and spread in ways that are destructive to human interests and natural systems are considered “invasive alien species” (GISP, 2004). The history of human civilization demonstrates the spread of crops, livestock and pets across boundaries of natural distribution. Examples include potato, banana, maize, rice, millet, cows, buffaloes, horses, pigs, chickens, tea, coffee, rubber and so on. Plants such as rose, marigold, *Narcissus poinsettia* (Lalupate) and others can be found all over the world. These species are propagated by human efforts but there are also large numbers of species (e.g. weeds) which are able to propagate without human assistance. These tend to be confined to agricultural land.

Biologists are now focusing on species which are both invasive and which cause serious threats to biological diversity, such as the Water Hyacinth (*Eichornia crassipes*), which is a menace in the wetlands of the Terai and Mid-hills. Similarly, a prolific climber, *Mikania microcantha* (also known as the ‘mile-a-minute’ plant), is causing serious problems in Chitwan National Park by damaging forests as well as grasslands. *Lantana camara*, another invasive shrub is causing damage to the biodiversity of western Nepal in Bardia National Park, while biodiversity in the Mid-hills and mountain areas is threatened by a forest weed called Ban Mara (*Eupatorium adenophorum*). The introduction of the Tilapia fish has caused a decline in indigenous fish species. Biodiversity conservation may face serious threats from those introduced species which are invasive and difficult to control.

### Protected and Threatened Species

There are both policy and legal frameworks for the protection of certain species in Nepal. Through the National Parks and Wildlife Conservation Act (1973), the government has given protected legal status to 27 species of mammal, nine species of bird, and three species of reptile (see Appendix 1). The Forest Regulations Act (1995, Amended 2001) provides varying degrees of protection to 19 plant species and forest products (see Appendix 1). Threatened species are defined as any species (animal, plant, fungus, etc.) which is vulnerable to extinction in the near future. The World Conservation Union (IUCN) categorizes threatened species into three subsets: vulnerable, endangered, and critically endangered. Threatened species are also referred to as ‘red-listed’ as they appear on the IUCN Red List of Threatened Species. ([http://en.wikipedia.org/wiki/Threatened\\_species](http://en.wikipedia.org/wiki/Threatened_species)).

## 2.5 Agro-biodiversity

### 2.5.1 Agricultural Biodiversity

Nepal’s wide variety of farming cultures and agro-climates helps to conserve a very high degree of genetic diversity in agro-crops. This diversity is also found in the country’s livestock. Nepal has over 1,800 varieties of indigenous land crops, including Jumli Marshi - the highest altitude rice in the world. Other wild rice varieties such as *Oryza rufipogon*, *O. nivara*, and *O. officinalis* can be found in Nepal’s wetlands. The variety of pulses, beans, barley and other oil seeds differ from one agro-ecological zone to another. The introduction of improved cultivars and high yielding strains has resulted in the loss of many indigenous varieties of agro-crop. This poses a huge threat to the sustainability of genetic diversity. In several parts of Nepal, farmers are not capable of producing their own seeds.

Approximately 22% (3.2 million hectares) of the total land area of Nepal is under cultivation, with the principal crops being rice (45%), maize (20%), wheat (18%), millet (5%), and potatoes (3%). These are followed by sugarcane, jute, cotton, tea, barley, legumes, other vegetables, and fruits. Given the ecological and climatic variation, a high degree of agro-ecological diversity has evolved in Nepal. More than 634 species/sub-species of food crop are documented, out of which 257 species/sub-species are cultivated. This variability in crop species has been maintained through traditional farming systems and through reliance on local cultivars. To date, very few genetic-level studies of biodiversity have been undertaken for cultivated species in Nepal. The potential of agro-biodiversity conservation for both local and global food security and as an important source of genetic crop resources has not yet been recognized or understood (Pratap and Sthapit, 1998).

### 2.5.2 Livestock Genetic Resources

Livestock are an important component of the Nepalese farming system, providing food for humans, manure for plants, muscle power for farms, and cash incomes for farming communities. Cattle, buffalo, sheep, goats, pigs, and poultry are reared across the country's different agro-ecological zones. Nepal is estimated to have 27.7 million domestic animals, which provide 31 percent of the total agricultural output of the country. The total number of livestock and their contribution to overall agricultural output is expected to increase by 45% over the next 20 year period (APP, 1995). As the cereal deficit continues to worsen, the conservation of animal genetic resources may become an increasing priority for livestock production systems. At the time of writing, twenty-five breeds of cattle, buffalo, sheep, goats, pigs, and poultry are officially recognized:

- Cattle breeds: Lulu, Achhami, Khaila, Terai Pahari, Yak
- Buffalo breeds: Lime, Parkote, Gaddi
- Goat breeds: Khari, Terai, Sinhal, Chyangra
- Sheep breeds: Lampuchhre, Kage, Baruwal, Bhyanglung
- Pig breeds: Hurrah, Chwanche, Bampudke
- Chicken breeds: Sakini, Ghanti Khuile, Puwankh Ulte
- Horse breeds: Jumli

All of the above breeds have been identified at a phenotypic level, while a few are characterized at chromosomal level and one at DNA level. The strains within each breed have yet to be adequately identified. Other breeds/strains of domesticated animals living in different ecological belts that have not been identified and characterized as endemic breeds are vanishing.

Current government policy focuses on upgrading and replacing local breeds with improved stock. This has had only limited success due to lack of funding, inconsistent long-term objectives, and an inability to pursue programs in traditional farming systems. The purity of native breeds is being lost in some areas due to informal programs conducted by the farmers themselves. With the exception of one breed of goat, there are no conservation programs for native breeds. The wild relatives of livestock, including arnee (*Bubalus arnee*), gaur (*Bibos gaurus*), wild boar (*Sus scrofa*), jungle fowl (*Gallus gallus*) and rock dove (*Columba livia*), are seeing their populations infiltrated by the genes of domestic animals. Little has been done to systematically characterize Nepal's livestock resources, yet continuous attempts have been made to replace them.

### 2.6 Ecosystem/Environmental Services

The Millennium Ecosystem Assessment (2005) defines ecosystem services as the benefits that people can obtain from ecosystems. They are categorized into four groups:

- **Provisioning services:** Products obtained from ecosystems e.g. food, fresh water, fuel wood, fiber, biochemical and genetic resources.
- **Regulating services:** Benefits obtained from the regulation of ecosystem processes e.g. climate regulation, the regulation of floods, water regulation, water purification, and the regulation of drought, land degradation and disease and detoxification.
- **Cultural services:** Non-material benefits obtained from ecosystems e.g. recreational, spiritual, religious, symbolic, educational, and others.
- **Supporting services:** Services necessary for the production of all other ecosystem services e.g. soil formation, nutrient cycling, and primary production.

Environmental services are the qualitative functions of the natural (non-produced) assets of land, water and air. There are three basic types of environmental service:

- **Disposal services** which reflect the functions of the natural environment e.g. an absorbent sink for residuals.
- **Productive services** which reflect the economic functions of providing natural resource inputs and space for production and consumption.
- **Consumer or Consumption services** which provide for the physiological, recreational and other related needs of human beings. (UN, 1997)

According to Wunder (2005) payment for environmental services (PES) can be defined as (a) *voluntary transactions* where (b) *well-defined environmental services (ES) or land uses* are likely to ensure that services are being bought by an (c) *environmental*

buyer (minimum of one), from an (d) *environmental service provider* (minimum of one); and when the environmental service provider (e) *conditionally secures environmental service provision*.

Forests can play an important role in regulating hydrological flows and reducing sedimentation. Changes in forest cover can affect the quantity, quality and timing of water that flows downstream (Pagiola et.al, 2004). Forests are commonly associated with a range of environmental services delivered at watershed level, including the regulation of water flow (i.e. the maintenance of dry season flow and flooding control), the maintenance of water quality (i.e. the minimization of sediment load, nutrient load, chemical load and salinity), the control of soil erosion and sedimentation, and the reduction of land salinization and/or regulation of ground water level (Bishop et. al., 2004).

Nepal has over 6,000 rivers and streams which have the potential to generate about 83,000 megawatts of electricity through hydropower systems (WECS, 1995). In order to fulfill the growing demand for electricity, hydropower production is one of the priority areas for the Government of Nepal. The conservation of forests with dense undergrowth in watershed areas for the provision of ecosystem services is the minimum water regulation requirement for hydroelectric production. A PES mechanism for watershed conservation was devised for the Kulekhani hydroelectric project (Makwanpur DDC, 2005). This can be replicated in hydroelectric projects in other watershed areas. Changes in forest land use and high rates of siltation are the major long-term threats that hydropower projects pose to watershed conservation.

The demand for water for irrigation is growing due to an increase in agricultural productivity in the Mid-hills and the Terai. In order to simultaneously conserve watershed areas, ecosystem services to reduce silt loads and protect irrigation canals from landslides are crucially important.

In order to meet the growing demand for drinking water in urban areas, ecosystem services can play an important role. In the Kathmandu valley for example, the Shivapuri hill forest produces 33.3 million m<sup>3</sup> of water per year from the Sundarijal sub-catchment area, which is then distributed to residents of the capital (IUCN, undated). Other hill forests around the Kathmandu valley also provide major sources of water that are distributed by tanker truck to help mitigate the water deficit. This type of PES setup can be gradually introduced into towns and municipalities in the hills and mountains where there is a growing demand for drinking water. The success of such systems relies on the formulation of appropriate policies, strategies and laws for enforcement.

The fragile Churia and Bhabar zones – found in the outermost Himalayan regions stretching from east to west - play an important role in recharging the underground water of the Terai. However, shifting cultivation patterns, deforestation and forest degradation in the Churia Hills and Bhabar zones, and rapid, silt-heavy water flow during annual floods, pose an enormous threat to the recharging of ground water in Terai (IUCN, CARE Nepal & WWF, 2007).

Eco-tourism is one of Nepal's major sources of revenue generation. In the early to mid-1990s, biodiversity prospecting (bio-prospecting) was expected to provide an important new source of financing for forest conservation (Farnsworth and Soejarto, 1985; Pearce and Puroshothaman, 1992). Eco-tourism is a medium for generating income from biodiversity, and thus encouraging its conservation (Brandon, 1996; Gosling, 1999). There were about 291,040 visitors to the protected areas of Nepal in 2007/08, 244,510 in 2006/07 and 165,304 in 2005/06 (Table 8). One-horned rhinos and Bengal tigers continue to be the central attractions in Chitwan National Park. Each year, Chitwan National Park receives about 36% of the total tourists who visit the 16 protected areas of Nepal. Despite these high numbers, the biggest threat to the survival of rhinos and tigers is illegal poaching. Biodiversity and landscape conservation for eco-tourism are defined as cultural ecosystem services.

Table 8: No. of tourists/revenue earned in the protected areas of Nepal

Fiscal year	# of tourists	Generated Revenue (in 000s of Nepali rupees)
2007/08	291,040	117,898.99
2006/07	245,910	94,557.17
2005/06	165,304	64,581.87

Source: DNPWC, 2008.

Pokhara is another of Nepal's tourist hubs which boasts Phewa Lake as one of its main attractions. The life of Phewa Lake depends on the conservation of its watershed and ecosystem services. Higher rates of siltation in the lake's watershed will reduce its life span dramatically. The landscapes of Mustang and Manang, along with other areas that are of interest to tourists, have the potential to provide a wide range of ecosystem services.

## Carbon trade

There is now a scientific consensus that human activities, including fossil fuel combustion, industrial processes, and land use change, have led to rising levels of greenhouse gases, most notably carbon dioxide, in the atmosphere. The increased rate and magnitude of these gases have manipulated the "greenhouse effect", a natural system that regulates the earth's temperature regime, to warm the earth. (ITTO, 2004).

Forests play an important role in the carbon cycle by absorbing carbon dioxide and releasing oxygen into the atmosphere. Carbon dioxide is converted to carbon (sequestered) and stored in the woody tissue (biomass) of plant. It is estimated that tropical deforestation, forest fires, and land use change contribute approximately 20% of global carbon dioxide emissions.

Carbon sequestration and trading is one of the components of the PES system. Forestry-based carbon sequestration is based on two main approaches: (a) active absorption in new vegetation, and (b) avoiding emissions from existing vegetation. The first approach includes any activity that involves planting new trees (such as afforestation, reforestation or agro-forestry) or increasing the growth rate of existing forest stands (such as improved silvicultural practices). It also includes the substitution of fossil fuels with sustainably produced biomass fuels to reduce the carbon emissions arising from energy production. The second approach involves the prevention or reduction of deforestation and land use change, or the reduction of damage caused to existing forests. The value of sequestered carbon is the same everywhere. A ton of carbon sequestered in one place makes much the same contribution to the mitigation of climate change as a ton sequestered anywhere else. Estimates of the costs of carbon sequestration through forestry, suggest that it is much cheaper than most other methods of tackling climate change, in particular the reduction of emissions from burning fossil fuels.

Deforestation is the second leading cause of greenhouse gas emissions after energy production, and is responsible for about one quarter of all anthropogenic greenhouse gas emissions. The 13th Conference of Parties (COP) to the UNFCCC (Bali, Indonesia, December 2007) put forward the Reducing Emissions on Deforestation and Forest Degradation (REDD) concept, under which developing countries would be provided with financial incentives for reducing emissions from deforestation and forest degradation. This has created an opportunity for Nepal to work on a carbon credit mechanism for the forestry sector. Deforestation and forest degradation are major issues for both Nepal and for the planet. In the 1960s, forest cover in Nepal was at about 60%. This declined to 42.7% in 1978 and 39.6% in the 1990s. Although community-based forest management in Nepal is fairly wide-spread, a few outstanding issues continue to prevent full acceptance of the REDD mechanism. There is a shortage of data on forest cover, growing stock, and biomass stock in the country, while data on carbon stock is not available. Nepal's capacity to estimate and monitor deforestation and to implement schemes to reduce CO<sub>2</sub> emissions needs urgently to be developed (Oli, 2008).

Carbon credit schemes are a new concept for the forestry sector in Nepal, and the institutional and human resource capacity necessary to prepare documents on REDD does not currently exist, making it difficult to obtain international funding. In April 2008, the Ministry of Forest and Soil Conservation (MFSC) prepared the Forest Carbon Partnership Facility (FCPF) Readiness Plan Idea Note (R-PIN) Template and submitted it to the World Bank for funding. The MFSC has so far received a US\$ 200,000 grant from the World Bank's Forest Carbon Partnership Facility to fund the preparation of a detailed proposal for funding support for REDD initiatives. For this purpose, the MFSC established a REDD/Forestry and Climate Change Cell on 7 May 2009. The MFSC has also allocated NRs 1.2 million to the cell for the fiscal year 2009/10. The names of twelve people to staff the cell have already been proposed, although the six government nominees are currently on temporary secondment. There are currently nine major components (i) Forest governance and land use assessment, (ii) Management of Readiness (i.e. institutional mechanisms and outreach/consultation plans), (iii) REDD strategy, (iv) REDD implementation framework, (v) Social and environmental impact analysis of REDD, (vi) Assessment of inventories and capacity building, (vii) Development of deforestation and forest degradation scenarios (baselines), (viii) Monitoring, reporting and verification of REDD and (ix) Overall monitoring of REDD program components (with indicators).

## **2.7 Tropical Forest Management, Biodiversity and Climate Change**

Climate change refers to shifts in the mean state of the world's climate or in its variability, persisting for an extended period (decades or longer). Climate change may be due to natural changes or to persistent anthropogenic changes in the composition of the atmosphere or in land use (USAID, 2007). Nepal, along with 150 other nations, signed the United Nations Framework Convention on Climate Change (UNFCCC) at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil in June 1992. Nepal ratified the convention on 2 May 1994; it subsequently came into force on 31 July 1994 (MoEST, 2004).

Nepal experiences heavy rain from June to September from the south-easterly monsoon, which accounts for 80% of total annual rainfall. Winter rains from November to January and pre-monsoon rains from April to May account for the remainder. Average annual rainfall in the country is about 1,530 mm although there are sharp spatial and temporal

variations. A total average annual runoff of about 225 billion m<sup>3</sup> comes from Nepal's 6,000 rivers and streams. Current estimates show that only around 15 billion m<sup>3</sup> is being utilized for economic and social development (NCSA, 2008).

**Table 9: Summary of Climatic Conditions in Nepal**

Ecological belt	Climate	Average annual precipitation (mm)	Mean annual temperature (°C)
Mountains	Arctic/Alpine	snow/150-120	<10
Hills	Temperate	275-2300	10-20
Terai	Sub-tropical	1100-3000	20-25

Source: WECS, 2005

Temperature records from the last 30 years show that the average maximum temperature is increasing at an alarming rate. Shrestha *et al* (1999) took data from 49 weather stations across Nepal and found that the temperature increased by an average of 0.06 °C per year between 1977 and 2000. Increases are more pronounced in the higher altitude regions of the country with smaller or zero increases documented in the plains. The highest levels of increase can be seen during the winter. The average temperature is rising by an average of 0.41 °C per decade, while seasonal temperatures during the pre-monsoon, monsoon and winter seasons have risen by 0.43 °C, 0.43 °C and 0.37 °C per decade respectively.

Nepal's Initial National Communication Report to the COP of the United National Framework Convention on Climate Change (UNFCCC) (2004) states that global warming may cause ecosystem damage as species composition changes due to migration and die-off. The consequences of this situation could directly affect not only the environment of Nepal but also the lives of huge numbers of people. The report goes on to say that under existing (CO<sub>2</sub>) conditions, Nepal has 15 out of the 39 different types of vegetation zone categorized by the Holdrege model.

#### **Glacial lake outburst flood (GLOF)**

There are 2,315 glacial lakes of various sizes in the country, with a total area of 75 km<sup>2</sup> (ICIMOD/UNEP, 2001). The formation and growth of glacial lakes is a phenomenon closely related to de-glaciation in the mountains. GLOFs are characterized by the sudden release of a huge amount of lake water, which rushes downstream in the form of dangerous flood waves. These flood waves devastate downstream communities, hydropower stations and other infrastructure. Nepal has experienced at least 25 GLOF events in the recent past (NCSA Stocktaking Climate Change, 2008). The Government of Nepal sees GLOFs as a threat to the development of water resources in the country.

#### **CO<sub>2</sub> emissions from forest and grassland conversion**

There is no reliable estimate for CO<sub>2</sub> emissions caused by deforestation and forest degradation in Nepal. However, the Initial National Communication Report to the COP of UNFCCC (2004) estimates that the total CO<sub>2</sub> emissions from land-use change and forestry in the base year 1994/95 were about 22,895 Gg out of which 14,372 Gg of carbon dioxide was sequestered due to biomass growth.

Biomass stock per hectare in Nepal's forests varies from 115 to 178 tons (WECS, 2001). In total, tree cutting accounts for about 14,006 kilotons of the biomass removed from forests and non-forest land. There is no commercial harvest. Forest land is generally changed into land suitable for cultivation by a two step process. First the forest is converted into shrubland, and then the shrubland is converted into agricultural land. The biomass found in shrubland after conversion is thought to be 16.1 tons per hectare (WECS, 2001) whereas the average biomass for cultivated land is thought to be 10 tons per hectare (IPCC, 1996).

Not all of the biomass removed from the forest is consumed as fuel wood. The cutting of timber for local construction and development and the illegal cross-border trading of timber also account for 20% of the total biomass removed from forests (DFRS, 1993). During the period of 1978/79-1994/95, a total of 1.3 million hectares of forest was cleared (74 thousand hectares per year). In total, 14 million tons of wood have been removed from forests, releasing more than 18,547 Gg of CO<sub>2</sub> into the atmosphere.

#### **The legal and institutional framework for climate change**

The Ministry of Environment, Science and Technology is designated as the UNFCCC focal point for climate change, despite its very limited capacity to coordinate, formulate and implement climate change related policies and programs. Although there is no specific policy, strategy or law directly relating to climate change, several important policies, strategies and laws have been enacted to govern the overall management of natural resources and to address the environmental problems facing the country. The major national environmental policies include the National Conservation Strategies (1988), the Nepal Environmental Policy and Action Plan (1993), the Sustainable Development Agenda (2003), the Tenth Five-Year Plan (2002-2007) and the Three Year Interim Plan (2007-2010). The Interim Plan is the first to give priority to the implementation of the multilateral environmental agreements to which Nepal is a party,

and to recognize the benefits that clean development mechanism projects, renewable energy projects and community forestry projects will bring. The Plan also gives priority to maintaining the current 39.6% of forest cover in the country, and modernizing the departments of hydrology and meteorology to make them better able to carry out quantitative assessments of climate change, and better equipped to conduct research and development.

In the absence of a specific national policy, strategy and legal framework for climate change, Nepal is far behind in the fulfillment of its international commitments. In the absence of national and sectoral policies, climate change does not figure in law and strategy documents, and is effectively limited to a national dialogue in which only a few participate. Despite the fact that many communities are being directly affected by climate change, studies of its impact on local communities and ecosystems have not been carried out.

### **3.0 SOCIAL, ECONOMIC AND POLITICAL CONTEXT**

#### **3.1 Social and Economic Environment**

After one decade of armed insurgency (from 13 February 1996 to 21 November 2006) which disrupted development activities, government functioning, economic processes, and the peace and security of the Nepali people, a fragile peace and democracy have come to Nepal. As described in USAID/Nepal's Democracy and Governance Report (2008), "Beginning in late 2005 the Seven Party Alliance, led by Nepali Congress and the Communist Party of Nepal-Maoist (CPN-M) formed a fragile but ultimately successful alliance against King Gyanendra and the monarchy. In April 2006, a 19-day "people's movement" (*Jana Andolan II 6-24 April 2006*) generated widespread mobilization against royal rule and for the return to democracy. This was followed by the eruption of discontent in the Terai, which symbolized the growing importance of Madheshi political actors in Nepalese politics."

On 22 November 2006 the Comprehensive Peace Agreement (CPA) between the Seven Party Alliance and the Maoists was signed in Delhi. This formed the basis for an interim power sharing agreement which brought the Maoists into the government and gave them seats in the interim legislature. It also formally concluded the armed struggle between the Maoists and the government. The CPA also provided the roadmap for a political process, including the election of a Constituent Assembly (CA), charged with writing a new national constitution. The election for the CA was successfully held on 10 April 2008 with the CPN-M becoming the largest party, winning about 38% of a total of 601 seats, but failing to secure the 51% needed to form a government. On 28 May 2008 (the elected parliament's first day of business) the CA declared Nepal a Federal Democratic Republic, changing its status from that of a Kingdom. A Maoist-led coalition was formed on 15 August 2008 with the Communist Party of Nepal – Unified Marxist-Leninist (CPN-UML) and a number of smaller parties. Nepali Congress became the main opposition. At the end of 2008, the Maoist-led government formed a three-member panel to start dialogue with the armed groups of the central and eastern Terai. Nine months later on 3 May 2009, the Maoist-led government resigned over the issue of the sacking of the Nepal Army Chief by the Prime Minister and his subsequent reinstatement by the President. On 25 May 2009, the CPN-UML with support from 22 other parties formed a new coalition government. The renamed Unified Communist Party of Nepal-Maoist became the main opposition.

The CA was mandated to prepare the Constitution of Nepal by 28 May 2010, i.e. within two years of its formation, but it failed to do so due to disagreement and distrust among the three main political parties, namely Maoist, Nepali Congress and CNP-UML. Political parties are still divided on many key issues, including the restructuring of the state along federal lines, and the integration of former combatants into the national army. Intra-party conflict and party splits are common phenomena in Nepali politics. Natural resources allocation in a federal setup and cooperation between federal units in natural resource sharing are major issues in natural resource management.

Although the political and social situation in the Mid-hills, the high mountains and far-eastern/far-western Terai has improved considerably since 2005, about three dozen groups in the eastern and central Terai districts have continued their armed struggle despite the Constituent Assembly election. As a result, levels of social security in these districts have fallen dramatically. Extortion, abduction, and killings are problems not only in the Terai and Eastern hills, but also in the capital. Highway and road blockades, strikes and civil disturbances are common phenomena in Nepal's towns and cities.

The high rate of remittance collection from Nepali migrant workers is one of the main sources of income for both the country and for Nepalese households. In July 1991, remittances formed only 1.74% of GNP. This increased to 9.38% by July 1999. As of July 2005, remittances accounted for 12.03% of GNP – a total of NRs.65.42 billion per year. The reason for this increase is the growing trend of Nepali workers seeking employment in Malaysia and the Arabian Gulf (MOF 2006). There are currently more than 1.2 million Nepalis working overseas, most of whom are male. This migration of the male population has decreased the availability of agriculture laborers in rural areas which, in turn, has increased the workload of rural women.

Massive migration to the Terai has caused forest areas to retreat farther and farther from indigenous communities, creating human barriers to easy forest access. There are several recorded instances of traditional forest users being unable to access or benefit from the buffer zone forests in protected areas.

The migration of laborers from the Mid-hills has caused system failure in farm management practices, with terrace farming being particularly badly affected. This has led to slope failures in the hills and subsequently to landslides. It has also led to an increase in infection rates for sexually transmitted diseases, particularly in the far-western region of the Mid-hills. Recent epidemics of diarrhea and cholera in the far western hills have also been attributed to the lack of active labor forces in the villages. Bonds between the forest and local communities have been weakened, as there are fewer resident youths to whom indigenous knowledge can be imparted. There has been a drastic decline in the number of local healers, not only in the Terai (Guruas) and the Mid-hills (Dhamis, Jhankis, Lamas and Fedamnas) but also in the Himalayan regions (Yamchis). Increased incidence of mushroom poisoning is an indicator of the loss of indigenous knowledge about wild food plants. It can be said that indigenous knowledge and culture in some regions of the country is declining faster than biodiversity itself. The youths of the Mt. Everest and Annapurna regions have found that learning about tourism is likely to provide them with more attractive job opportunities than acquiring indigenous knowledge. Yak breeding, for example, is no longer an attractive job prospect for Sherpa youth in the Solukhumbu region. Despite this drop in interest, practices such as the collection of valuable NTFPs (e.g. Yarsagumba - *Cordyceps sinensis*) demonstrate that indigenous knowledge and biodiversity conservation have the potential to become a major source of income for poor rural communities.

The Government of Nepal, along with environmental campaigners, is pushing to maintain the current 40% forest cover in the new federal set-up in order to shore up the fragile ecological condition of the country's hills. One of the biggest challenges here is to maintain biodiversity. Deforestation and forest degradation in the Churia Hills combined with the collection of massive amounts of stone and gravel for export to India presents a grave threat to the productive plains of the Terai, rapidly converting them into unproductive river-beds. In any federal set-up, close cooperation between states will be essential in order to ensure the effective conservation, management and benefit sharing of natural resources. This is particularly important in terms of rivers, water usage, hydropower projects, and national parks and other protected areas.

Although the use of biotechnology to control and manage biological resources is growing rapidly across the globe, it is not without problems. The most complex of these arise in the area of intellectual property rights (IPR) under the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) which calls for signatories to 'respect and recognize the rights of indigenous peoples as stated by ILO 169, and CBD 8(j)'. There is a great deal of scope for bio-prospecting in Nepal, especially for new drugs and new sources of genetic material for agriculture, livestock and fisheries. These IPRs should play a key role in regulating access to and benefit sharing from genetic resources and other associated traditional knowledge.

The variation of snowlines and tree lines in Eastern and Western Nepal can be clearly seen in the winter, when snow falls at lower altitudes in the west. Different altitudes demand different farming patterns and forest management, and climate change will affect these parts of the country in various ways. For example, in Western Nepal (and especially in the Karnali zone), farmers are dependent on snow melt irrigation; if the melt occurs sooner or faster than usual, the impact on farms will be severe.

### **3.2 Institutions, Policies and Laws Affecting Conservation**

The Government of Nepal has made significant progress over the past three and a half decades in the establishment of institutional, legal, and policy frameworks that are supportive of forestry and biodiversity conservation. This evolution is deeply rooted in the recognition of a direct link between the country's diverse biological resources, the livelihoods of the Nepali people, and the economic development of the nation.

#### **3.2.1 Institutions, Policies and Laws in Forest Management**

The Ministry of Forest and Soil Conservation is the government entity for policy formulation in the forestry sector. However, the Department of Forests and its district and local agencies are responsible for the conservation and management of forests outside protected areas. There are a total of 74 District Forest Offices and 84 Local Forest Offices throughout the country (except in Mustang district). These are supported by over 500 range-posts which are stationed at field offices and fall under the direct supervision of District Forest Officers. Community, leasehold and collaborative forests are managed by the local communities, as stipulated by Nepal's forestry laws.

At present, community forestry programs are receiving funding and technical support from DFID/LFP in 15 mid-hill districts and from the Swiss Development Cooperation in another three mid-hill districts. IFAD is providing funding

support to implement leasehold forestry programs in 22 mid-hill districts and 11 high mountain districts through two separate projects. Similarly, the Government of the Netherlands is providing technical and funding support for collaborative forest management projects in eight Terai and inner-Terai districts through the BISEP-ST Project. A list of government and non-government agencies involved in forestry management is given in Appendices 2 & 3 respectively.

The Master Plan for the Forestry Sector (1989), the Revised Forestry Policy (2000), the Leasehold Forestry Policy (2002) and the Collaborative Forest Management Guidelines form the basis for forest management systems in Nepal. In addition, the Forest Act (1993) and Forest Regulations (1995) are the laws governing the enforcement of forestry policies. The forest policies related to forest management in Nepal are listed in Appendix 4, while Forestry Laws can be found in Appendix 5. Community and leasehold forestry are successful examples of Nepal's forestry policies, but despite strict laws, sound policies and strategies, and the involvement of many agencies in the forestry sector, deforestation has not been controlled, and forest deterioration continues in government administered forests.

### **International Tropical Timber Organization**

Nepal has consumer country member status of the International Tropical Timber Organization (ITTO). The ITTO was created in 1983 by the International Tropical Timber Agreement (ITTA) and currently operates under the ITTA 1994 which will soon make way for the ITTA 2006. Its secretariat is based in Yokohama, Japan. ITTO objectives are to promote the sustainable management of tropical timber-producing forests, and to promote the expansion and diversification of international trade in tropical timber from sustainably managed and legally harvested forests. Membership of ITTO brings together tropical timber producers and consumers as equal partners in decision-making. There are currently 60 member countries. The ITTO oversees more than 90% of the world's tropical timber trade from over 80% of the world's tropical forests.

### **United Nations Forum on Forests**

As a member of the United Nations, Nepal is also a member of the United Nations Forum on Forests (UNFF). The Minister of Forest and Soil Conservation, Mr. Kiran Gurung, attended the Plenary Session of UNFF8 and addressed the opening session on 20 April 2009. Nepal also organized a side event at UNFF8. UNFF is a subsidiary body of the Economic and Social Committee and has universal membership. As such, it is composed of all member states of the United Nations each of which is entitled to full and equal participation, including voting rights. Member States of the UNFF have designated a UNFF National Focal Point within their respective governments; the MFSC handles this role in Nepal. Member States contribute to the UNFF process through dialogue, culminating in the annual session of the UNFF. Member States also are invited to provide voluntary reports to each UNFF session. Nepal has not submitted any voluntary reports at the time of writing. The Seventh Session of the Forum adopted the landmark, non-legally binding agreement on all types of forest on 28 April 2007. The instrument is considered a milestone, as it is the first time all member states have agreed to an international instrument for sustainable forest management. The instrument is expected to have a major impact on international cooperation and national action to reduce deforestation, and will be helpful in preventing forest degradation, promoting sustainable livelihoods, and reducing poverty for all forest-dependent communities.

### **3.2.2 Institutions, Policies and Laws in Biodiversity Conservation**

The Department of National Parks and Wildlife Conservation (DNPWC) and its agencies are responsible for the conservation, management and administration of Nepal's protected areas. The country's nine national parks, three wildlife reserves, and one hunting reserve are directly administered by DNPWC wardens while the three conservation areas are managed by local committees. Buffer zone forest resources are protected and managed by the buffer zone council with the participation of local communities. The overall monitoring and supervision of forest conservation and management is carried out by five regional directors at the MFSC, while District Forest Offices take care of soil and watershed conservation and plant resource management at district and field level.

A biodiversity conservation and management program for the Terai Arc Landscape is supported by WWF Nepal in 14 Terai districts from the Bagmati River in the east to the Mahakali River in the west. A similar program is run by the Western Terai Landscape Complex Project (WTLCP) in the Terai districts of Bardia, Kailali and Kanchanpur. Although WWF and WTLCP are operating in some of the same districts, their efforts are focused on different VDCs in those districts with overlap. WWF Nepal is also supporting the Sacred Himalayan Landscape program, linking Langtang National Park in the west to Kanchenjunga Conservation Area in the east. This landscape program covers 18 districts in the Mid-hills and high mountains. Two Conservation Areas (Annapurna CA and Manaslu CA) are managed by the National Trust for Nature Conservation (NTNC) while the Kanchenjunga CA is managed by a number of local committees with the support of WWF Nepal. The main agencies involved in biodiversity conservation in Nepal are listed in Appendix 6.

The following documents define Nepal's biodiversity strategy:

- Nepal Biodiversity Strategy (2002)
- Master Plan for the Forestry Sector (1989)
- Nepal Environmental Policy and Action Plan (1993 and 1998)
- Nepal Wetland Policy (2003)
- Domestic Elephant Management Policy (2003)
- Wildlife Farming, Reproduction and Research Strategy (2003)
- Herbs and NTFP Development Policy (2004)
- Terai Arc Landscape Nepal Strategic Plan (2004-14)
- Greater One-horned Rhino Conservation Action Plan (2006)
- Sacred Himalayan Landscape Nepal Strategic Plan (2006)

The National Park and Wildlife Conservation Act (1973), the Forest Act (1993), the Environmental Act (1996) and associated regulations represent the main legal framework for the enforcement of the government policy and strategy that directly and indirectly contribute to biodiversity conservation. Other relevant policies, acts and regulations are listed in Appendices 7 and 8.

Despite the existence of legislation, the illegal poaching of threatened and rare wildlife - including the killing of rhinos and tigers and the trading of restricted plant species - still goes on in Nepal's protected areas. In addition, in spite of the paradigm shift from species conservation to ecosystem and trans-boundary conservation, Nepal lacks agreements with India and China for dealing with trans-boundary conservation issues.

### 3.3 Participation in International Treaties

Nepal is signatory to the following international conventions related to biodiversity conservation:

#### **Convention on Wetlands of International Importance (1971)**

Nepal signed the Convention on Wetlands of International Importance on 17 April 1988. The main obligation of signatory countries is the designation of wetlands as having national and international importance, the conservation and management of those wetlands, and the wise use of migratory stocks of waterfowl and their habitats. Nepal has designated Beeshazari and its associated lakes in Chitwan district as a Ramsar site under the convention. This has directly contributed to the conservation of rhino habitats.

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

Nepal joined the Convention for the Protection of the World Cultural and Natural Heritage on 20 September 1978. The main obligation of signatories to this convention is the adoption of effective measures for the protection of cultural and natural heritage through national and international cooperation. In 1984, Chitwan National Park was declared the 284th World Heritage Site, which has also directly contributed to the conservation of rhino habitats.

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

Nepal became a signatory to the Convention on International Trade in Endangered Species (CITES) on 16 September 1975. The main obligations of signatories are the protection of natural ecosystems (including wild fauna and flora) and the regulation of the trade, import, and export of species listed in the appendices. Appendix I documents items prohibited for trade in local, national and international markets and includes the organs and body parts of rhinos and other species. The DNPWC is designated for ensuring Nepal's compliance with CITES in terms of wild fauna management.

#### **Convention on Biological Diversity (1992)**

Nepal joined Convention on Biological Diversity (CBD) on 21 February 1994. The main obligations under the convention are:

- the conservation and sustainable use of biological diversity and the equitable sharing of benefits;
- the preparation of national strategies, plans or programs for the conservation and sustainable use of biodiversity;
- conservation in *in-situ* and *ex-situ* conditions;
- the promotion of biotechnology and genetic research.

The CBD has directly informed the Nepal Biodiversity Strategy (2002) and the Nepal Biodiversity Strategy Implementation Plan (2006).

#### **The World Trade Organization (1995)**

Nepal joined the World Trade Organization (WTO) on 23 April 2004 as its 147<sup>th</sup> member. Through its TRIPS agreement, the WTO urges member states to register and patent biological diversity and associated intellectual property rights in order to benefit from these resources in the future.

#### **The World Conservation Union (IUCN) (1948)**

IUCN Nepal opened its Country Office on 23 February 1995. The IUCN Red List of Threatened Species lists three protected areas of Nepal as rhino habitat and categorizes them as follows:

##### *Chitwan National Park*

- National Park II
- Buffer Zone VI

##### *Bardia National Park*

- National Park II
- Buffer Zone VI

##### *Suklaphanta Wildlife Reserve*

- Wildlife Reserve IV
- Buffer Zone VI

## **4.0 RELEVANT GOVERNMENT, NGO AND DONOR PROGRAMMING**

### **4.1 Government Institutions**

The Ministry of Forest and Soil Conservation, the Ministry of Agriculture and Cooperatives, the Ministry of Environment, Science and Technology, the Department of National Parks and Wildlife Conservation, the Department of Forests, the Department of Agriculture, the Department of Livestock Services, the Nepal Agricultural Research Council and the Nepal Academy of Science and Technology are the government institutions responsible for biodiversity conservation in Nepal. The agencies and their respective roles are summarized in Table 10.

**Table 10: Government institutions responsible for biodiversity conservation**

	<b>Agency</b>	<b>Role in biodiversity conservation</b>
1	Ministry of Forest and Soil Conservation	Focal point for the Convention on Biological Diversity in Nepal
2	Ministry of Agriculture and Cooperatives	Responsible for the conservation of agricultural and livestock diversity
3	Ministry of Environment, Science and Technology	Responsible for preserving Nepal's natural and cultural environments
4	Department of National Parks and Wildlife Conservation	Responsible for the conservation of biodiversity in protected areas
5	Department of Forests	Responsible for protecting biodiversity in forests which fall outside the protected areas
6	Department of Agriculture	Responsible for the conservation of agricultural biodiversity
7	Department of Livestock Services	Responsible for the conservation of livestock biodiversity
8	Nepal Agricultural Research Council	Carries out agricultural and livestock research
9	Nepal Academy of Science and Technology	Carries out chemical screening (bio-prospecting) of some medicinal plants, mostly conifers

### **4.2. INGOs, NGOs and Educational Institutions**

WWF, IUCN, CARE Nepal, Winrock International, TMI and ANSAB are the INGOs involved in biodiversity conservation in Nepal. NTNC - a national NGO promoted by the government – has contributed to biodiversity conservation in protected areas. LI-BIRD, NEFEJ, and BCN are other national NGOs regularly involved in biodiversity conservation. Tribhuvan and Kathmandu universities are active in the field of biodiversity and conservation studies. The Nepal Foresters Association works to conserve biodiversity in Nepal's forests. The Buffer Zone Council, Federation of Community Forest Users Nepal (FECOFUN), Association of Collaborative Forest Users in Nepal (ACOFUN), and Nepal Federation of Forest User Group (NEFUG) are federations of forestry related groups and forest user groups, including leasehold groups, collaborative forest management committees, buffer zone committees, and soil conservation groups. All of these are community based organizations. All of these organizations have played an important role in biodiversity conservation in Nepal, particularly in community-based programming and in interventions in remote areas.

### **4.3 Bilateral and Multilateral Donors**

In the forestry sector, DFID is providing funding and technical assistance for community forestry in 12 mid-hill and

three Terai districts. Similarly, SDC is providing funding and technical support for community forestry in three districts of the Mid-hills. IFAD is a single funding agency that is providing funding support for leasehold forestry in 33 mid-hill and high mountain districts. SNV is providing funding and technical support for collaborative forest management in eight Terai and inner-Terai districts. The Government of Nepal has signed an agreement with the Finnish Embassy to undertake a national inventory of forests. The World Bank has provided funds to the Ministry of Forest and Soil Conservation to prepare a proposal on REDD.

#### **4.4 Donors in Biodiversity Conservation**

WWF Nepal provides funding to the Terai Arc Landscape (TAL) program and the Sacred Himalaya Landscape (SHL) program. WTLCP and many others support biodiversity conservation in protected areas. WTLCP is funded by UNDP, WWF, SNV and other agencies, and is tasked with implementing a landscape level program in three far-western Terai districts. Similarly, UNDP, DFID, and the Danish Embassy have provided funds for the preparation of a climate change adaptation plan. CARE Nepal has launched wetland projects in two Ramsar International Sites: Koshi Tappu in Sunsari district and Ghodaghodi Lake in Kailali district.

#### **4.5 Gaps and/or inconsistencies in tropical forest management**

##### **Gaps in forest management in the Terai/Inner-Terai and Churia Hills**

Forest policy and forest strategies exist to stop deforestation and prevent forest encroachment. However, due to a lack of good governance, forestry administrations do not have full control over the forest resources they are there to protect. Forest encroachment backed by political parties and fuelled by land mafias and political instability continues unabated. There is therefore a huge gap between what forest policy says on paper and its implementation in the field. Despite professing a policy of maintaining a forest cover level of 40% in the country, the government routinely allocates forest land for the resettlement of freed bonded laborers, the resettlement of victims of flooding and other natural disasters, and camping grounds for the armed forces. This can be attributed to both a lack of political will and gaps in national forestry policy.

A large gap currently exists between potential forest productivity and present productivity levels per unit area of forest. The high productivity capacity of the plains has yet to be harnessed. Although Nepal's long-term, medium-term and short-term forestry plans and programs talk of sustainable forest management, at the time of writing, none of Nepal's forests were using silvicultural management techniques.

All of Nepal's forestry sector policies including the National Conservation Strategy (1988) and the Master Plan for the Forestry Sector (1989) explicitly state that the Churia Hills have an extremely fragile ecosystem which should be one of the focus points of national conservation efforts. In practice, however, most of the Churia Hill areas (except for those parts which fall under protected areas) are rapidly denuding, causing severe negative impacts in parts of the Terai. The Churia Hill forests are also under threat from over-grazing and forest fires. The gap between forestry policy and its enforcement in the Churia Hills is enormous.

There is a lack of awareness about the ecological and environmental services that Churia and Bhabar zones provide for the Terai in terms of recharging underground water. There is also a lack of policy and strategy regarding upstream-downstream links between the Churia Hills and the plains. There is a lack of skills and knowledge and policy/strategy for PES initiatives in terms of carbon sequestration /carbon trading, biodiversity valuation, and landscape/watershed services.

##### **Gaps in tropical forest management in the Mid-hills**

Forest (including community forest) management does not systematically take watershed issues (such as maintaining dense undergrowth and trees) into account during planning processes. There are many anthropogenic disturbances facing Nepal's watersheds and wetlands. As a result, there are high rates of siltation that are shortening their life cycles. This is particularly visible at sites such as Phewa Lake and Mai Pokhari and hydro-electric dams. There is no national policy, strategy or long-term plan to regulate land use. Despite Nepal's hilly and mountainous topography, there is currently no specific national policy governing soil and watershed management. Although the Soil and Watershed Conservation Act (1982) and its associated Regulations (1985) were promulgated, neither has been implemented. Nepal's Mid-hill forests have huge potential for watershed PES initiatives, biodiversity initiatives and carbon sequestration but these are not mentioned in policy, strategy or long-term plan documents. In addition, there is currently no north-south system for linking two or more protected areas.

##### **Gaps in tropical forest management in the high mountains**

Although the high mountains are rich in natural resources (forests, scenic views, NTFPs, rivers etc.) they are also permanent food deficit zones which experience perennial poverty. A lack of scientific forest management prevents local communities from deriving reasonable benefits from NTFPs/MAPS. Similarly, the lack of alternative energy services in the high mountains means that there is a high demand for fuel wood. Illegal timber and NTFP/MAP trading through the northern passes to Tibet puts additional pressure on the regions' forests.

Although local communities in the high mountains are experiencing a range of negative climate change impacts, no climate change adaptation plan exists for the region and there is a general lack of awareness amongst local communities as to what to do about climate change.

#### **4.6 Gaps and/or inconsistencies in biodiversity conservation**

##### **Gaps in biodiversity conservation in the Terai**

In the Terai, there is no effective biodiversity conservation program outside the protected areas.

##### **Gaps in biodiversity conservation in the Mid-hills**

There are fewer mid-hill ecosystems in protected areas than there are in the Terai and the high mountains, and biodiversity issues in Mid-hills have not received adequate attention. The Mid-hills form a corridor for migratory species in the Terai and the Himalayas but there is no effective corridor management system to link them. There is also a lack of policy/ implementation plan for linking north-south protected areas. Chitwan-Barandabhar-Daman, Simbhanjyang-Chandragiri-Nagarjun, and Shivapuri-Gosainkund-Langtang are all important biodiversity corridors and habitats for a number of valuable species.

Many hydro-electric dams have been planned or constructed in the Mid-hills. These may affect the mobility of aquatic animals from upstream to downstream areas – an issue that should be highlighted when carrying out environmental impact assessments before the construction of such dams.

##### **Gaps in tropical forest management in the high mountains**

The ecosystems on the tree line are coming under intense pressure from human activity and from global warming. Research and mitigation plans do not exist. Although high mountain glacial lakes are highly vulnerable to climate change there are currently large gaps in site specific data and information.

Transhumant livelihoods are declining due to the creation of community forests and a ban on en-route grazing. Community forestry does not respect the traditional use rights of transhumant grazers who come with herds of animals to road-heads or towns to fetch food grains.

### **5.0 THREATS TO TROPICAL FORESTS AND BIODIVERSITY**

#### **5.1 Threats to Tropical Forests**

##### **Threats to forests in the Terai, Inner-Terai and Churia hills**

###### **Changes in land use**

The conversion of forest land into land used for other purposes poses the greatest threat to forests in the region. These changes in the use of forest lands have come about due to the government's infrastructure development policy, the resettlement of freed bonded laborers, flood victims and others, and forest encroachment by organized and unorganized land mafias. There is also a general lack of political will to prevent forest conversion in the region. The forest administration is too weak to prevent encroachment and there is a lack of governance in Terai and Inner-Terai forests. Encroachers are often backed by political parties (as a vote-winning tactic), which makes it very difficult for local forestry administrations to remove them. In addition to this, when a new community moves into a forest area, it is common for development agencies and other non-government organizations to set up drinking water, road, and school facilities without taking into consideration the legality of the settlement. These factors have resulted in the rapid loss of forested land in the region.

###### **Changes in forest cover in the Terai**

**Table 11: Annual rate of change in forest cover (1990/91 - 2000/01)**

District	Forest cover 1990/91 (hectare)	Forest cover 2000/2001 (hectare)	Changes in Forest cover (hectare)	Rate of change (%)
20 Terai districts	1,158,545	1,149,494	- 9,051	- 0.08

Source: DOF, 2005

If we compare the Churia Hill zones and plain zones in the same 20 districts, we can see an increase in forest cover in the Churia Hills, but a decrease in forest cover in the plains.

**Table 12: Forest cover change (1990/91-2000/01) in the Churia hills and Terai**

District	Forest cover 1990/91 (hectare)		Forest cover 2000/2001 (hectare)		Changes in Forest cover (hectare)		Rate of change (%)	
	Hill	Plain	Hill	Plain	Hill	Plain	Hill	Plain
20 Terai districts	651,888	506,657	656,115	493,379	4,227	- 13,278	0.06	- 0.27

Source: DOF, 2005

### Forest deterioration and degradation

Most of the forests in the Terai, Inner-Terai and Churia Hills are regarded as common property ("the tragedy of the commons" - Hardin, 1968). Although forests in the plain lands are potentially highly productive, none are scientifically managed. Many forest management plans have been prepared for these forests, but none have been implemented due to a lack of government commitment. The forestry administration has been trying to protect these areas from illegal poaching but has failed to do so. Heavy grazing and frequent brush fires are other key factors that hinder the natural regeneration of trees and contribute significantly to forest deterioration and degradation. Due to the rapid decline of forested areas in the Churia Hills, riverian forests (Sissoo, Khair, and Semal) have been virtually destroyed by heavy siltation and river-bank widening. Four to six decades ago, the river banks of Churia and Bhabar zones had dense and well-stocked Khair and Sissoo forests which served as natural filters, allowing only clean water to reach rivers and creeks. Several important species such as Bijay Sal, Satisal, Semal and Khair have now become threatened species in the Terai and Churia Hill forests. Table 13 illustrates the quality of forests in 20 Terai districts.

**Table 13: Forest/degraded forest (2000/01) by district**

District	Forest cover (hectare)			Cover Percent (%)		
	Good Forest	Degraded forest	Total	Good forest	Degraded forest	Total
20 Terai districts	1,011,362	138,132	1,149,494	88.00	12.00	100

Source: DOF, 2005

### Traditional users denied access to forest resources

In the past, the people of the Terai enjoyed easy access to the region's forests. Forest products were collected through the *purji system* (government permission to collect forest products for home use), but when this was stopped by the Department of Forests and replaced with the community forestry system, many traditional forest users were denied access. Community forestry programs in the Terai give access only to the communities settled along the east-west highway. Although community forest groups protect their own forests reasonably effectively, they are known to go to adjoining forest areas for the collection of forest products and to graze their livestock. This has led to the rapid degradation of forest areas adjoining community forests in the Terai and Churia Hills. Non-community forests are administered by the District Forest Office. The current scenario represents a dangerous future threat to the region's forests.

### Sand and gravel collection/export from sensitive areas and river bank widening

Along Nepal's border with India, there is a high demand for sand, gravel and stone, with much of this being collected from sensitive forest and river areas in the Churia Hills. The high number of stone crushing plants in river areas has increased local pollution levels. This situation can be attributed to the ongoing confusion over the jurisdiction of DFOs and DDCs, leading to often ineffective regulation of excavation. Excessive excavation poses a major threat to forests and leads to habitat loss.

### Threats to forests in the Mid-hills

#### Slash and burn cultivation

Although community forestry has proved successful in the Mid-hills, government administered forests on the steep slopes in the region have fallen prey to slash and burn cultivation practices. Pressure to produce food grains in order to alleviate acute poverty poses a serious threat to forests and biodiversity in the Mid-hills. The lack of alternative livelihood options for many living in the region has led to the rotation period for slash and burn cultivation being shortened from 10-15 years to 2-3 years – not nearly long enough for secondary forest regeneration.

### Excessive extraction of pine tree resin

In the far western hills, people have devised a resin tapping technique to increase the amount of resin they can obtain from pine trees – a practice which is killing many trees in the region’s pine forests..

### Cardamom forest deforestation in the eastern hills

Until 2008/09, many areas in the eastern hills were used for cardamom cultivation, both in community forests and on private land. When cardamom yields decreased due to prolonged drought, these areas were deforested for the cultivation of food grains.

### Loss of riverian forests along river banks

Due to heavy siltation and river-bank widening, many of the riverian forests in the Mid-hills have been lost in the last four decades.

### Threats to forests in High Mountains

#### Slash and burn cultivation

Due to permanent food shortages in the high mountain region, temperate and alpine forests found on southern slopes and hill tops are often cleared for the production of food grains.

#### No alternative to firewood:

Firewood is the principal source of cooking and heating fuel for rural communities in the region. Better-off households stockpile huge amounts of firewood for the winter, putting pressure on forest resources. A rapid increase in the region’s population and an increase in the number of tourists means that viable alternatives to firewood will become increasingly important in the drive to conserve high mountain forests.

#### Illegal trade of timber to Tibet

Along the northern borders, timber is illegally exported to Tibet to provide a source of income for local populations. As there are no forestry check-points, this illegal trade is carried out freely and openly.

## 5.2 Threats to Biodiversity

Threats to biodiversity can be described at three different levels:

1. Threats to ecosystems that provide living space for living species;
2. Threats to living species whose continued existence is not safeguarded; and
3. Threats to genetic resources that provide a basis for the life and livelihoods of the human population.

Threats to ecosystems emanate from the conversion of natural habitats (forest lands, grasslands, wetlands, mountain slopes etc.) into man-made or man-manipulated areas such as farmlands, residential/industrial areas, infrastructure projects and so on. Threats to species loss largely result from habitat loss, and also from the over-exploitation or over-harvesting of land, environmental pollution and climate change. The threats to genetic resources largely come from replacement or displacement of indigenous species by introduced species, the destruction of species by disease and the loss of a species’ relevance to human needs.

### Threats to biodiversity by eco-region

S/N	Eco-region	Threats to Biodiversity
1	Terai and Churia hills	<ul style="list-style-type: none"><li>• High rate of organized forest encroachment by the landless, freed bonded laborers and hill-migrants</li><li>• Over-exploitation of forest resources</li><li>• Increasing populations/prevailing poverty in forest areas</li><li>• Wetlands are neither conserved nor managed</li><li>• Unchecked poaching of large mammals including rhinos and tigers</li><li>• Illegal activities are safeguarded by political parties/bureaucratic power</li><li>• Pressure from tourism in certain areas (e.g. Sauraha in Chitwan National Park)</li><li>• Increasing market demand for natural resources and related products across the border</li><li>• Land reclamation in and around wetland sites</li><li>• Invasion of alien species</li><li>• Replacement of local varieties/ breeds by exotic varieties/breeds</li></ul>

		<ul style="list-style-type: none"> <li>• An increasingly fragile Churia ecosystem caused by the excessive excavation of rocks, boulders and sand/the felling of trees</li> <li>• Unpredictable flooding</li> </ul>
2	Mid-hills	<ul style="list-style-type: none"> <li>• Increasing populations and prevailing poverty in forest areas</li> <li>• Limited diversity of ecosystems in protected areas</li> <li>• Threats to ecosystems/valuable species outside protected areas</li> <li>• The biodiversity of the connecting river corridors between the protected areas in the high mountains and the Terai is neither protected nor managed</li> <li>• Increasing frequency of floods, landslides and forest fires</li> <li>• Migration of a large percentage of the active labor force</li> <li>• Over-exploitation of NTFPs/MAPs</li> <li>• Slash and burn cultivation on steep slopes</li> <li>• Invasion of alien species in numerous habitats</li> <li>• Loss of local crop varieties and breeds of livestock</li> </ul>
3	High mountains	<ul style="list-style-type: none"> <li>• Over-exploitation of forest resources including high value NTFPs/MAPs outside protected areas</li> <li>• Illegal timber trade with Tibet</li> <li>• Direct export of high value medicinal plants to Tibet</li> <li>• Poaching of endangered species including snow leopard and musk deer</li> <li>• Over-crowded base camps in popular mountaineering destinations</li> <li>• Climate change causing changes in the water regime and snow dynamics</li> <li>• Forest fires</li> <li>• Over-grazing</li> <li>• Threats posed by glacial lake outburst floods</li> </ul>

### Threats to Forests: The Root Causes

#### Terai, Inner-Terai and Churia Hills

- Increased population due to the large scale migration from the hills
- High levels of poverty/disparity of wealth
- Political instability/political rivalry in the eastern and central Terai
- Timber production/firewood collection
- Gravel/boulder/sand excavation
- Government condoned changes in forest land use
- Weak governance in forest conservation

#### Mid-hills

- Deteriorating livelihood base
- The lack of job opportunities encourages poor households to encroach forests – even on steep slopes
- Issues of tenure in non-community/leasehold forests and non-protected areas

#### High Mountains

- Huge demand for firewood for cooking/heating
- Lack of alternatives to firewood
- Weak governance/law enforcement in markets along the Tibetan border
- Wealth disparity between Nepal and Tibet border communities

### Threats to Biodiversity: The Root Causes

#### Terai, Inner-Terai and Churia Hills

There are a number of major threats to biodiversity in the region. The depletion of natural forests and the conversion of natural wetlands into farm lands (for example in Kailali district) causes habitat loss for many endangered species including Pater plants, Khair, Sissoo and Semal trees. Frequent forest fires and over grazing threatens the biodiversity of

several forest plant species, reptiles and other wildlife. The illegal wildlife trade puts rhinos, tigers, owls and other species at risk. The introduction of hybrid species and the lack of incentives to conserve local varieties of crops and animals is another reason for the loss of biodiversity in the Terai. In the Koshi Tappu Wildlife Reserve, the transmission of disease from domestic to wild species is having a negative impact on the numbers of wild buffalo. Flash flooding from large rivers such as the Koshi and the Narayani decimates wildlife in protected areas. Mono-culture plantations of Sissoo, and/or Eucalyptus are replacing natural Sal forests in Sagarnath, Nepalgunj and Jhapa. Human-wildlife conflict on the borders of protected areas is another reason for biodiversity loss. High dams hinder the free movement of aquatic animals such as dolphin, fish and reptiles while the decline in the vulture population can be attributed to the use of Diclofenac (a non-steroidal anti-inflammatory drug), residues of which can be found in the carcasses on which the vultures feed. The rapid increase in exotic invasive species such as *Mikania microcantha* (the 'minute-a-mile plant') and Ban Mara (*Eupatorium adenophorum*) also threaten biodiversity in protected areas.

### **Mid-hills**

The reasons behind the decline in the number of Rhododendron and Quercus species in the region are mainly anthropogenic. The excessive use of pesticides and chemical fertilizers in farmlands (for example in Panchkhal and Palung) also pose a threat. Unsustainable fishing practices such as poisoning, blasting, electrification and the use of loop nets in the mid-hill rivers are depleting the number of fish species. Ban Mara (*Eupatorium adenophorum*) and other invasive species have replaced native species in open and denuded hill areas. Frequent forest fires and rampant over-grazing in government forests also contribute to the problem. The lack of incentives to promote local crop varieties and animal breeds is causing many species to disappear from the Mid-hills.

### **High Mountains**

The unsustainable *ad hoc* collection of NTFPs/MAPs from forests and rangelands is one of the main threats to biodiversity in the high mountains. In the rangelands, problems with land tenure and ownership are also threatening the region's biodiversity. There is increasing evidence that climate change is one of the reasons for the decline in the wildlife and plant species which have a short-range habitat.

## **6.0 ACTION NEEDED TO CONSERVE TROPICAL FORESTS AND BIODIVERSITY**

### **6.1 Action Needed to Conserve Tropical Forests**

#### **Terai, Inner-Terai and Churia Hills**

##### **Political commitment**

In order to maintain an ecological balance between mountains, hills, and plains, conservation efforts are needed to maintain at least the current 40% of forest land in the country. During state restructuring, political commitments to this end need to be forged and then implemented.

##### **Stop policy decisions which endorse changes in land use in forest areas**

There is a pressing need for the government to declare a national policy prohibiting the clearing and conversion of forest areas. If a non-forestry program must take priority, the area of forest converted should be replaced in another location in order to maintain a minimum of 40% of forest land in the country.

##### **Removal of forest encroachers**

Land mafias and land encroachers have illegally grabbed much of Nepal's forest land. Such encroachers should be removed and plantations established as soon as possible. This will require a high level of commitment from both the government and the political parties.

##### **Scientific forest management**

The Terai's forests have not been managed at all; some areas are densely forested while others lie vacant or are covered in pernicious weeds. The introduction of scientific space management systems would help communities to make the best use of forest space and increase the production of forest products.

##### **Access of traditional and far-distant users**

Traditional and far-distant forest users must be given access to forest management systems and forest products. This type of benefit sharing is essential for sustainability.

##### **National policy/strict enforcement of policy for Churia Hill forest conservation**

Forests in the Churia Hills are rapidly becoming denuded due to the over-exploitation of forest resources and to forest encroachment. The disturbance of this fragile Churia ecology along with the flow of heavy sediment to the plains is leading to desertification in several areas. It is imperative for the government to declare the whole of the Churia Hill range a "conservation corridor" and that input for the area's conservation comes from a wide range of stakeholders. At present the existing "conservation area" is administered solely by the Department of National Parks and Wildlife Conservation.

#### **Provincial resource management plan**

After the restructuring of the state, provincial resource management plans should be prepared and enforced by each of the new government entities. "Provincial protected areas" should be created and managed by local communities.

#### **Choice of species/site**

Urban greenery programs are needed in district headquarters, cities, towns, and along highways across the nation. Choices of species will differ from region to region.

#### **Riverbank stabilization and restoration of riverian forests**

There are large areas of land in the Churia Hills and Bhabar plains which have been converted into unproductive riverbeds. With the conservation of the Churia hills, these large dry areas should be restored and rehabilitated into riverian communities or leasehold forests, with the active participation of local communities. This is, no doubt, a challenging task but it is not impossible if open grazing can be controlled. The seeding of Khair species and the plantation of hardy species such as Sajiwan (Jatropha) and bamboo are processes that can be owned by local communities.

#### **Ban the commercial collection of sand, gravel and stones from sensitive Churia Hill and river areas**

Environmental impact assessments need to be carried out before any excavation takes place. Commercial enterprises wishing to excavate must submit detailed plans based on the assessment to the appropriate authority before any excavation is allowed to take place.

#### **Good governance**

Through its projects and programming, USAID has learned a great deal about good governance in community forestry and forest administration. These lessons learned should be used to inform forestry administration systems, especially when large amounts of money are involved.

#### **Mid-hills and High Mountains**

##### **Replace slash and burn methodologies with permanent agro-forestry systems with long-term land ownership**

Areas where slash and burn cultivation is practiced must be identified and replaced with community and/or leasehold forestry systems to encourage a feeling of local ownership. In leasehold forestry, technologies and processes to convert shifting cultivation areas into permanent agro-forestry farms already exist and can provide many financial and material benefits to local communities.

#### **High mountains**

##### **Alternative energy**

Nepal's high mountain areas are in desperate need of cheap and readily available alternative energy sources to replace the use of firewood. This would significantly reduce pressure on forests and contribute immensely to forest conservation.

##### **Management of forests yielding NTFPs/MAPs**

Since the high mountains play host to a large number of high value NTFPs and MAPs, their conservation, management and cultivation should be integrated into standard forest management systems.

## **6.2 Action Needed to Conserve Biodiversity**

### **All Eco-Regions**

#### **Protected Areas in a Federal Set-Up**

After state restructuring, new government entities must confirm the boundaries and management bodies for all national parks and protected areas. The new constitution must ensure that federal government carries the responsibility for identifying, categorizing and managing World Heritage Sites, Ramsar Sites and National Parks. Protected areas that fall into two or more federal entities should also be administered by the federal government.

#### **Plan and program based on internal/community resources:**

Species conservation action plans tend mainly to be funded from external sources. As a result, many highly ambitious plans are prepared but few are implemented. To address this, species/ecosystem conservation plans should rely on local resources, local communities and national government funds for implementation. Management plans should be prepared both in Nepali (or the local language) and English. At present most plans are prepared in English and cannot be understood by local communities.

#### **Conserve the wild relatives of agricultural animals and plants**

Genetic resource conservation is, by and large, driven by species which have relevance to the livelihoods of local populations (e.g. cultivars of crops, local breeds of livestock and poultry and local species of fish). 'Gene pool centers' of relevant species should be set up for all three eco-regions. Wild relatives of agricultural plants and animals must be identified and conserved.

#### **Biodiversity registration**

Biodiversity registration should be implemented at local, state and federal level. For this purpose, a legal framework, a process of registration, details of human resource requirements and an institutional mechanism should be prepared.

#### **New destinations for tourists**

The Annapurna Conservation Area, Chitwan National Park, and Sagarmatha National Park have seen a rapid increase in the number of tourists that visit annually. New destinations with suitable infrastructure and facilities are needed to reduce the pressure on biodiversity in national parks and other protected areas popular with tourists.

#### **Sacred forests, ponds and wetlands**

Sights of particular religious significance require protection under existing management regimes.

#### **Promote under-utilized species**

Under-utilized species should be identified and their use promoted for the conservation of biodiversity. These include Amaranthus, Dale Chuk (seabuckthorn), Wild Yam, Wild Millet, Junelo and Fapar.

#### **Policy and strategy for indigenous species**

The Government needs to devise policy and strategy documents for the conservation of indigenous species; particularly those used by indigenous peoples and communities (see Article 8(j) of the CBD). Through its policy and strategy, the government should be assisting indigenous peoples in the preservation of such species. Methodologies used by CARE Nepal in its JIWAN Project could be usefully adapted for this purpose.

#### **Incentive packages to encourage the rearing of local livestock breeds and crop varieties**

An *in-situ* conservation program providing incentive packages to encourage communities to rear local livestock breeds and grow local plant varieties should be implemented by the government. To complement this effort, the study of local biodiversity should be included in both formal and informal education systems. There are currently very few institutions operating in this sector.

#### **Terai, Inner-Terai and Churia hills**

##### **Trans-boundary national policy and MOUs/Agreements with India and China**

Nepal is using a landscape approach in both TAL and WTLCP, with regular meetings between Indian and Nepali communities/local authorities taking place. However, there is no formal MOU or agreement between the governments of Nepal and India related to such trans-boundary issues. Trans-boundary policy agreements between Nepal and India and Nepal and China are urgently needed in order to conserve the habitats of mega-mammals and ensure their protection.

##### **Conservation of wetlands outside protected areas**

Studies of the natural wetlands outside protected areas need to be carried out and action plans formulated to protect wetland biodiversity in the region.

##### **Conserve the biodiversity in the Churia Hill corridor**

The fragile Churia Hill ecosystems provide an important corridor of biodiversity which is in desperate need of conservation efforts.

##### **Promote the TAL conservation strategy and action plan**

The Terai Arc Landscape exemplifies a functioning, sustainable conservation strategy for flagship species in the Terai. It therefore should be continued and further refined.

#### **Himalayan tropicity**

Many low altitude plant and tree species can also be found in the Mid-hills and high mountains along river corridors. Sal and many other tropical species can be seen along river corridors in the Arun, Karnali and Narayani river valleys. The conservation of such tropical species in the Mid-hills and Himalayas would allow researchers to study different characteristics within the same species which could be exploited to benefit local communities.

#### **Alternative energy**

Forest resources in the Churia Hills are a major source of firewood by communities living in the Churia and Bhabar areas. In order to reduce pressure on forest resources, cheap and readily available alternative energy sources should be promoted in both the Churia Hill and Bhabar zones.

#### **Mid-hills**

##### **River-corridor links between protected areas**

River corridors and mid-hill landscapes are rich in biodiversity and have excellent potential for conservation efforts.

##### **Payment for environmental services (PES)**

Watershed areas, white-water rafting routes and areas rich in biodiversity/landscape diversity have huge potential for PES initiatives which can contribute significantly to biodiversity conservation.

##### **Link conservation to the livelihoods of poor households**

In a developing country like Nepal, the conservation of biodiversity should be directly linked to the livelihoods of poor and marginalized households who are largely dependent on natural resources for their survival.

##### **Conservation of hotspots outside protected areas**

According to Wikipedia, 'a biodiversity hotspot is a biogeographic region with a significant reservoir of biodiversity that is threatened with destruction'. Mai Pokhari in Ilam district and Phulchoki Hill in Lalitpur are rich biodiversity hotspots crying out for conservation. Long term plans/programs for these areas should be prepared with the participation of local communities.

#### **High Mountains**

##### **Conserve landscapes in collaboration and cooperation with China and India**

In addition to being attractive tourist destinations, Nepal's high mountains contain a number of important habitats for biodiversity conservation. Most of these areas have already been designated as protected areas, a practice which should continue with the cooperation of the Indian and Chinese authorities.

##### **Conservation outside protected areas**

Highland rangelands are important biodiversity spots. Those rangelands which fall outside the protected areas do not currently benefit from biodiversity conservation efforts.

##### **Establish environmental monitoring centers**

Centers to collect time series data on climate change, glaciers and indicative species need to be established. An elevation baseline (minimum/maximum elevation) should be agreed on in order to monitor indicative species of both flora and fauna.

##### **Control the illegal trade of valuable medicinal plants and wildlife**

The illegal trade of valuable medicinal plants and wildlife can be controlled by establishing check points at the Tibetan and Indian borders. For this purpose, the forestry administration should coordinate with the police and customs services.

#### **Alternative energy**

The collection of fuel wood for cooking and heating puts tremendous pressure on the forest resources in the region. Cheaper and more readily available alternative energy such as solar and improved cooking stoves should be aggressively promoted.

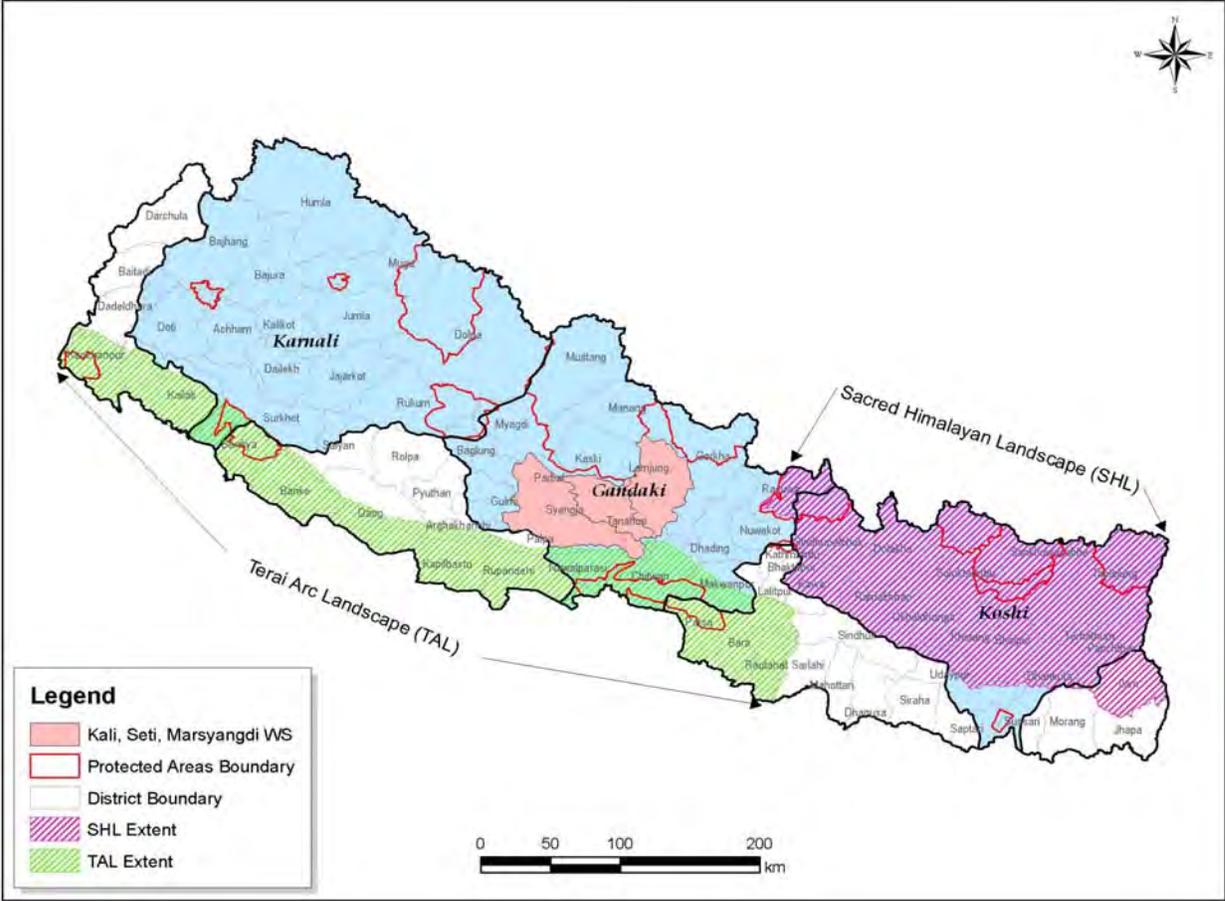
#### **Yak breeds conservation**

In order to conserve yak breeds, community-based or household-based incentive mechanisms should be introduced.

##### **Commercial plantations of high value NTFPs/MAPs**

In order to conserve high value NTFPs/MAPs, *in-situ* and *ex-situ* conservation and management should be adopted. For this purpose, community or household-based commercial plantations of high value NTFPs/MAPs (of at least selected species) should be promoted. Such plantations can provide valuable income to local communities.

6.3 **Priority Landscapes/River Corridors in Nepal:** A map showing the location of priority landscapes/river corridors for tropical forest and biodiversity conservation in Nepal can be found below. A series of tables follow, which attempt to summarize the key tropical forest/biodiversity characteristics of these landscapes/river corridors.



Summary of the characteristics of the priority landscapes/river corridors of Nepal:

Characteristics	Terai Arc Landscape (TAL)	Sacred Himalaya Landscape (SHL)	Kali Gandaki Corridor	Koshi River Corridor	Karnali river corridor
Introduction	<p>Runs from the Bagmati river in the east to the Yamuna river in the west</p> <p>Total Area: 49,500 km<sup>2</sup> (23,199 km<sup>2</sup>. in Nepal)</p> <p>Covers 11 protected areas (four in Nepal)</p> <p>Covers 75% of all forests in the Terai</p>	<p>Total area: 39,021 km<sup>2</sup> (73.5% in Nepal, 24.4% in Sikkim and Darjeeling (India) and 2.1% in Bhutan)</p> <p>Covers 18 districts in Nepal</p>	<p>The river is older than mountains</p> <p>Contains the deepest gorge on the planet between the Annapurna and Dhaulagiri peaks (river valley deepens to 5000m)</p> <p>Covers 245,567 hectares of land with 41.5% forest cover between the Annapurna Conservation area and Chitwan National Park</p>	<p>A trans-boundary river between Nepal and India</p> <p>One of the largest tributaries of the River Ganges</p> <p>Drains a total area of 69,000km<sup>2</sup> (29,400 km<sup>2</sup> in China, 30,700 km<sup>2</sup> in Nepal &amp; 9,200 km<sup>2</sup> in India)</p> <p>Over a period of 250 years, the river has shifted 120km to the west</p> <p>Called the ‘Saptakoshi’ as it has seven tributaries (Sunkoshi, Tamakoshi, Dudhkoshi, Indravati, Likhu, Arun and Tamur)</p> <p>729km from its source to the Ganges</p>	<p>A turbulent perennial, fast flowing river</p> <p>One of the four major rivers of Nepal</p> <p>Originates from Lake Mansarovar in Tibet</p> <p>Covers an area of 1740 km<sup>2</sup></p> <p>The longest river in Nepal at about 507 km</p> <p>Converges with the Seti and Bheri rivers</p> <p>Flows through many gorges in the hills and mountains</p> <p>Fans out and changes course in the Terai</p>

Characteristics	Terai Arc Landscape (TAL)	Sacred Himalaya Landscape (SHL)	Kali Gandaki Corridor	Koshi River Corridor	Karnali river corridor
Significance	<p>Highly productive alluvial grasslands and sub-tropical forests support flagship species (One-horned Rhinoceros, Royal Bengal Tiger and Asian Elephants)</p> <p>Comprises of two the WWF's Global 200 Eco-regions (Terai: Savanna and Grassland/Himalaya: Subtropical Broadleaf Forest)</p> <p>Home to 85 species of mammal, 550 species of bird, 47 species of reptile and amphibian and 125 species of fish</p> <p>Contains three wetlands of international significance (Ghodaghodi Lake, Jagadishpur Tal, Beeshazari Lakes) and one world heritage site (Chitwan National Park)</p>	<p>Runs from Langtang National Park in Nepal through Kanchenjunga in India to Toorsa Strict Nature Reserve in Western Bhutan</p> <p>Contains intact alpine, temperate and subtropical forests</p> <p>Home to Mount Everest</p> <p>Contains two globally important contiguous eco-regions: Eastern Himalayan Alpine Scrub and Meadows/ Eastern Himalayan Broadleaf and Conifer Forests</p> <p>Important habitat for many threatened species such as snow leopard, musk deer, red panda and several pheasants</p> <p>Supports ecological services, snow caps, glaciers, water towers and Himalayan rivers</p>	<p>Kali Gandaki valley (KGV) hosts a rich diversity of species</p> <p>Serves as natural boundary for some flora and fauna (16 Primula species do not cross from west to east: Horse chestnut (<i>Aesculus indica</i>), <i>Abies pindraws</i>, <i>Cedrus deodara</i>, <i>Cupressus torulossa</i>, and <i>Picea smithiana</i> do not cross from west to east; the eastern mid-hill Schima-Castanopsis forests of do not extend west of the KGV; Oak-Laurel forests found in eastern Nepal do not extend west of the KGV)</p> <p>East Himalayan pheasants and Chyakhura birds from the west are found only in the KGV</p>	<p>Two famous protected areas are located in the river basin (Sagarmatha National Park in the north and the Koshi Tappu Wildlife Reserve in the flood plains of the Saptakoshi river in eastern Nepal)</p> <p>Extends from the plains of the Terai to the highest mountain in the world</p> <p>Contains subtropical to temperate and alpine climate zones and a huge amount of flora and fauna</p>	<p>About 14% of the total river basin area is protected</p> <p>The basin spans four national parks, one wildlife reserve and one hunting reserve</p> <p>Extends from the mountains through the mid- hills to the Terai and is rich in flora and fauna</p> <p>The whole of the Karnali zone is a rain-shadow area and is rich in high value NTFPs/MAPs including Yarsagumba</p> <p>Meadows, rangelands and pasturelands are rich in Himalayan biodiversity</p>

Characteristics	Terai Arc Landscape (TAL)	Sacred Himalaya Landscape (SHL)	Kali Gandaki Corridor	Koshi River Corridor	Karnali river corridor
Threats	<p>Human population growth has caused wildlife habitats to become highly fragmented</p> <p>Deforestation rate is high (1.3% per annum)</p> <p>Degradation has forced wildlife into small, insular refuges - it is difficult to support so many species within protected areas</p> <p>Poaching and illegal timber extraction</p> <p>Frequent forest fires and heavy grazing in forests</p> <p>High levels of deforestation and forest degradation in the western Terai</p> <p>Rapid expansion of exotic invasive species in protected areas</p> <p>Over-fishing/construction of high dams threatens crocodile and dolphin populations</p>	<p>Rapid degradation of large tracts of agriculture, forest and pasture land</p> <p>Short rotation periods for slash and burn cultivation poses a threat to ecosystems</p> <p>Landslides, slope failure and erosion, sediment deposits, mass wasting, flash floods, and declining fertility are the main threats in the SHL</p> <p>Rapid change from forest to shrubland to rangeland</p> <p>Wetlands outside protected areas are threatened by over-exploitation of resources</p> <p>Prone to natural disasters due to geology and extreme climatic conditions</p>	<p>Slash and burn cultivation is a major threat to biodiversity</p> <p>The river carries heavy amounts of silt which gives it a black color</p> <p>Illegal poaching of wildlife and smuggling of valuable Sal timber from natural forests</p>	<p>Rapid degradation of large tracts of agriculture, forest and pasture land</p> <p>Short rotation periods for slash and burn cultivation pose a threat to ecosystems</p> <p>Landslides, slope failure and erosion, sediment deposits, mass wasting, flash floods, and declining fertility are the main threats in the corridor</p> <p>Rapid change from forest to shrubland to rangeland</p> <p>Wetlands outside protected areas are threatened by over-exploitation of resources</p> <p>Prone to natural disasters due to geology and extreme climatic conditions</p> <p>Heavy siltation in the Terai (Nepal &amp; India) during the rainy season</p>	<p>Rich in NTFPs/MAPs</p> <p>Perennial poverty/food shortages</p> <p>Poor socio-economic indicators/lowest development index in the country</p> <p>Rapid rate of deforestation in Kailali district</p> <p>Slash and burn cultivation is widespread</p> <p>Remoteness and inaccessibility leading to high levels of illegal poaching of threatened wildlife</p> <p>Two species of crocodile and Gangetic dolphin are at risk in the Terai area of the corridor</p> <p>Construction of high dams</p>
Opportunities	<p>Restoration and maintenance of landscape corridor and connectivity between protected areas in Nepal and India</p> <p>Conservation of flagship and threatened species (flora and fauna)</p> <p>Opportunity for PES schemes</p>	<p>PES schemes for ecotourism, hydrological services, landscape aesthetics and carbon sink utilities</p> <p>White water rafting</p> <p>Conservation of biodiversity hotspots outside protected areas</p>	<p>Annapurna Conservation Area and Mustang popular with trekkers and tourists</p> <p>The World Heritage Site, Chitwan National Park and Ramsar Site, Beeshazari Tal are internationally significant areas</p>	<p>The Koshi has the potential to generate 22,350 Mw of hydro-electricity (10,860 Mw could be exploited for economic purposes)</p> <p>White water rafting</p> <p>Fish production (the <i>mahaseer</i> is particularly popular and</p>	<p>High value NTFPs/MAPs in Karnali zone</p> <p>PES schemes including watershed services and hydro-electricity generation</p> <p>White water rafting</p>

Characteristics	Terai Arc Landscape (TAL)	Sacred Himalaya Landscape (SHL)	Kali Gandaki Corridor	Koshi River Corridor	Karnali river corridor
	<p>(wetland &amp; terrestrial), REDD and watershed services, river sports, cultural ecotourism etc.</p> <p>Poverty alleviation through income generating programs for the conservation of species</p> <p>Retardation of deforestation /degradation of sub-tropical forests</p>	<p>Conservation of high mountain rangeland/ pasture ecosystems</p> <p><i>In-situ</i> &amp; <i>ex-situ</i> conservation of high value NTFPs/MAPs</p>	<p>Chitwan National Park is the breeding ground for the largest number of one-horned rhinoceros, royal Bengal tigers and elephants on the planet</p> <p>Natural habitat of two species of crocodile</p>	<p>delicious)</p> <p>Great potential for ecotourism</p>	<p>Meadows and rangelands rich in Himalayan biodiversity</p> <p>Unexplored potential for ecotourism in Rara and Shrey-Phoksundo National Parks</p>
Way forward	<p>Protect flagship species and other threatened species</p> <p>Conserve wetland biodiversity in the Basanta (Kailali), and Khata (Bardia &amp; Kailali) corridors and three critical bottlenecks (Mahdevipuri in Banke, Lamahi in Dang and Dobhan in Palpa)</p> <p>Protect sub-tropical forests from encroachment</p>	<p>Conserve the biodiversity hotspots which are located outside protected areas (e.g. Mai Pokhari)</p> <p>Conserve the rich biodiversity in the Arun valley</p> <p>Provide watershed services/hydrological services for electricity production in the Saptakoshi river system</p>	<p>More research/exploration of the area's biodiversity</p> <p>Create PES schemes for hydropower development/watershed services</p> <p>Start up white water rafting ventures</p>	<p>Conserve biodiversity in the Arun valley</p> <p>Provide watershed services for hydro-electricity generation</p>	<p>Enable the cultivation of high value NTFPs/MAPs in the Karnali zone</p> <p>Create PES schemes for watershed services/hydro-electricity generation</p>

## 7.0 USAID STRATEGY REVIEW AND RECOMMENDATIONS

### 7.1 Review of Current Strategy

The United States Government's (USG) overall foreign policy goal in Nepal is identical to the U.S. State Department's Transformational Diplomacy Goal: to help build and sustain a democratic, well-governed state that responds to the needs of its people, reduces wide-spread poverty and conducts itself responsibly on the international stage.

The USG's strategic vision for Nepal for the period 2009-13 is: measurable progress in expanding and deepening democracy, strengthening public and private institutions, and supporting policies to promote economic growth and poverty reduction.

The USG has fixed five Assistance Priority Goals (USG Country Assistance Strategy 2009-13) which are shown below:

- Goal 1:** Complete the successful transition towards an effective, responsive and democratic constitutional government.
- Goal 2:** Establish the key elements of an enabling environment for inclusive, private-sector led economic growth.
- Goal 3:** Improve and sustain the health and well-being of Nepali people.
- Goal 4:** Assist the Nepal government in effectively securing national territory, providing public safety, enforcing the law and fulfilling its international commitments, with full respect for human rights and subordination to civilian authority.
- Goal 5:** Improve the national capacity to prevent, mitigate and respond to disasters and address the needs of vulnerable populations.

Nepal's tropical forestry and biodiversity sector issues should be addressed under Goals 2 and 5. Under Goal 2, one of the assistance approaches is a focus on the environment which states:

*"U.S. assistance to the environment will be two-pronged, consisting of community-based interventions in areas of significant biodiversity, and policy and legal reform activities focused on improving the enabling policy and legal environment. US AID will continue to build on its success in working with local communities that are dependent on the environment for their livelihoods, and to improve biodiversity conservation and sustainable forest management while also improving income. These communities are also specifically at risk from the effects of global climate change. Nepal currently has a policy environment and legal framework for the management of natural resources, although enforcement still needs improvement. With changes in the political and governance environment of the country, ensuring that there is continued progress in this direction will be paramount. U.S. policy and legal activities should engage at national and local levels to ensure that community rights to natural resources are included in the constitutional and federal process, as well as any new policies and regulations".*

Under Goal 5, one of the assistance approaches is a focus on mitigation which states:

*"The extensive and severe deforestation and over-grazing/over-cultivation of land (identified as key environmental threats in the Mission's 2006 Tropical Forest and Biodiversity Assessment) play a key role in vulnerability to flooding and landslides. The USG should continue to support community forestry, and buffer zone and conservation area groups to help build their internal capacity for sustainable forest management and biodiversity conservation. These activities currently fall under the democracy and governance section of the Mission".*

Within the US Mission, an Economic and Environment Working Group coordinates U.S. assistance in economic policy reform, enterprise development and environmental protection and resource management.

There are five major themes that cut across Nepal's development challenges. Of the five themes, two themes are directly linked to Nepal's tropical forestry and biodiversity. They are:

**Theme 1—Environment:** The degradation of Nepal's natural resources, including forests, arable land, wildlife, and water, is both a consequence and cause of poverty, limited economic opportunity, natural disasters, and absence of local government and the rule of law.

**Theme 2—Sustainability:** All sectors are hampered by a lack of adequate attention to the professional development of individuals and institutions. For lasting results, investments must be made in strengthening the capacity of stakeholders in a manner that promotes ownership.

Under the broader guidance of the Country Assistance Strategy (2009-13), the strategies and programs on tropical forestry and biodiversity listed in section 7.2 of this report have been recommended for Nepal.

## 7.2 Strategy Recommendation for Tropical Forestry and Biodiversity

### 7.2.1 Proposed strategy for Tropical Forestry

#### Terai, Inner-Terai and Churia Hills:

**Strategy:** Conserve fragile ecosystems to protect the Terai's fertile lands from siltation and river-cutting; create upstream/downstream links between the Churia Hills and the Terai. This is also a landscape management strategy for Churia hills corridor from east to west Nepal. This strategy is linked to USG Priority Assistance Goal 5.

The Churia Hill region is a watershed area that provides vital ecosystem goods and services; it supports both upland livelihoods and downstream populations in the Terai. The Churia Hills are the southern-most range of hills in Nepal lying between the plains of the Terai and the mountain ranges of the Himalayas with an elevation ranging from 120m to 2,000m. The region serves as a watershed for the downstream Terai plains where the bulk of the Nepalese population resides. For these people, delivered water resources for domestic and agricultural purposes are crucial. The Churia region is also important for safeguarding lives, livelihoods and properties in the plains, by regulating the water flow (reducing the flow in monsoon and ensuring supply in the dry season). The region also provides a range of ecosystem goods and services to upland households including important NTFPs for fuel, fodder and medicine. Downstream communities rely on the region for water supply and construction materials such as boulders, gravel and sand. The Churia Hills account for 13 per cent of the total land area of Nepal and accommodate about 13 per cent of the total population (NPC 2004).

The Churia Hill region (or Siwaliks) has 13 ecosystems, five of which can be found in protected areas (Koshi Tappu, Parsa and Suklaphanta wildlife reserves, Chitwan National Park and Bardia National Park - NBS, 2002). CITES listed species including varieties of *Cyathea*, *Cycas pectinata*, and *Rawolfia serpentina* are found in the Churia ecosystem (Pokharel & Tiwari, 2002).

The Churia, Bhabar and Terai areas are so closely interlinked that any changes in land and resource use in the upper watershed area affects its capacity to deliver ecosystem services both in the uplands and downstream. There is therefore an urgent need to demonstrate the economic value associated with conserving upland ecosystems, in order to provide goods and services downstream. This will help to convince planners and decision-makers that investing in watershed conservation and management can have huge positive impacts on socio-economic development. At the same time, it is necessary to find equitable, efficient and sustainable mechanisms by which to reward the upland land and resource managers for the downstream water services that they provide.

USAID can offer valuable assistance in devising an effective institutional mechanism for the conservation of the whole range of fragile Churia ecosystems. This in turn would contribute to the conservation of biodiversity and reduce deforestation/forest deterioration in the area. A mechanism for restoring critical riverine forest ecosystems in the Terai, the Churia Hills and the Mid-hills would help conservation efforts in the Terai and Bhabar zones. In order to conserve the fragile Churia ecosystems, especially those that fall outside protected areas, there is a pressing need for the establishment of functional upstream-downstream links between the upstream and downstream communities that are dependent on Churia Hill resources. This effort needs the support of a range of both government and non-government institutions.

**Strategy:** Maintain a minimum of 40% of forest land after state restructuring (or "save whatever is left of the country's natural forests").

Many lessons on good governance in community forestry can be learned from the USAID/Nepal funded SAGUN II program. These include: public audit practices, participatory wealth ranking, livelihood planning, and livelihoods support, which can be replicated in other forestry sector/non-forestry sector programs, particularly in the Terai. The learning can be applied by soil conservation groups, water user groups, irrigation groups, school management committees, cooperative societies, and others, to promote good governance in the target region. The SAGUN program, through its support for FECOFUN, helped communities to identify the issues they care about, and then encouraged political candidates to make commitments to address those issues in exchange for votes. This took

advocacy beyond the usual party political or ethnic/religious focus, towards a focus on common issues of concern to the people dependent on forests for their livelihoods.

**Strategy:** Increase productivity per unit area in forest lands

This strategy would help to create sustainable forest management models in community forests and set up space management systems in collaborative forests and leasehold forests. Roughly 29% of Nepal's territory is forested, while about 10% is shrubland area. There are 14,439 forest user groups managing 1,229,669 hectares of community forest. Despite these figures, there is not a single model community forest in the country which is scientifically managed; this includes those that fall under the jurisdiction of the Department of Forests, FECOFUN and other forestry organizations. A model forest is "a place where the best sustainable forest management practices are developed, tested and disseminated. It is an ideal 'natural' laboratory for conducting research on sustainable forest management". Technical assistance is urgently needed for the development of model forests in all three ecoregions.

#### **Mid-hills:**

**Strategy:** Conserve fragile ecosystems on steep slopes

This strategy would help to control slash and burn cultivation on steep slopes through community/leasehold forestry programs.

#### **High Mountains:**

**Strategy:** Reduce pressure on forests

This strategy would help to replace the excessive use of firewood with the use of alternative energy sources in market centers and along tourist routes.

**Strategy:** Conserve high value NTFPs/MAPs

*In-situ* conservation in community and leasehold forests/*ex-situ* conservation in community and leasehold forests, and on private land would create greater space for the conservation of high value NTFP/MAPs.

**Strategy:** Rangeland management

This strategy would help to fill gaps in formulating policy and strategy for the governance of rangelands.

### **7.2.2 Proposed Strategy for Biodiversity Conservation**

**Strategy:** Establish the intellectual property rights (IPR) of indigenous people and local communities for the protection of indigenous knowledge and biodiversity conservation practices

This strategy would help to launch community biodiversity registration programs to record details of traditional knowledge and practices.

#### **Terai**

**Strategy:** Conserve wetland biodiversity and fragile ecosystems outside protected areas

This strategy would help to prepare and implement a wetland biodiversity conservation plan for rich biodiversity areas in Nepal outside the protected areas such as for Kailali district (see Appendix 12).

**Strategy:** Conserve flagship wildlife species

This strategy would help to prepare national and bilateral strategies on trans-boundary biodiversity conservation issues between Nepal and India, and Nepal and China. USAID/Nepal is in a good position to provide technical assistance to the development of a national policy and strategy to ensure the maintenance of at least 40% of forest land in the country, and the equitable distribution of natural resources and benefits under a new federal setup.

#### **Mid-hills**

**Strategy:** Adopt a river corridor approach to link protected areas in the high mountains and the Terai

This strategy would help to launch a river corridor program in the Kali Gandaki region linking Chitwan National Park to the Annapurna Conservation Area (see Appendix 12). The aim of the program is to increase the representation of mid-hill ecosystems in conservation projects.

**Strategy:** Establish PES systems for tropical forestry management and biodiversity development

This strategy would help to establish pilot PES schemes in four key areas (i) carbon sequestration and trading, (ii) watershed services, (iii) biodiversity and (iv) landscape to inform the development of PES policy and strategy. There are opportunities for USAID/Nepal and its partner INGOs to launch pilot REDD initiatives in the country or to provide technical assistance for REDD schemes to the MFSC.

### **High mountains**

**Strategy:** Conserve rangeland biodiversity outside protected areas

This strategy would help to launch conserve high value species (e.g. Panch Aule (*Dactyloctenium aegyptium*) and others) that are found in the rangelands outside protected areas.

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## Appendix 1: Protected faunal species under the National Parks and Wildlife Conservation Act, 1973 CITES

### Mammals

Common Name	Scientific Name	IUCN Category*	CITES Appendix**
Red panda	<i>Ailurus fulgens</i>	VU	I
Black buck	<i>Antelope cervicapra</i>	VU	III
Gaur	<i>Bos gaurus</i>	VU	I
Wild yak	<i>Bos mutus</i>	EN	I
Wild water buffalo	<i>Bubalus arnee</i>	EN	III
Tibetan wolf	<i>Canis lupus</i>	VU	I
Hispid hare	<i>Caprolagus hispidus</i>	EN	I
Swamp deer	<i>Cervus duvauceli</i>	EN	I
Asiatic elephant	<i>Elephas maximus</i>	EN	I
Lynx	<i>Felis lynx</i>	EN	II
Striped hyaena	<i>Hyaena hyaena</i>		
Assamese monkey	<i>Macaca assamensis</i>		
Indian Pangolin	<i>Manis crassicaudata</i>		II
Chinese pangolin	<i>Manis pentadactyla</i>		II
Musk deer	<i>Moschus chrisogaster</i>	EN	I
Great Tibetan sheep	<i>Ovis ammon</i>		I
Bengal tiger	<i>Panthera tigris</i>	EN	I
Snow leopard	<i>Panthera uncia</i>	EN	I
Tibetan antelope	<i>Pantholops hodgsoni</i>		I
Clouded leopard	<i>Pardofelis nebulosa</i>	VU	I
Gangetic dolphin	<i>Platanista gangetica</i>	VU	I
Leopard cat	<i>Prionailurus bengalensis</i>		I
Spotted linsang	<i>Prionodon pardicolor</i>		I
Asian one-horned rhino	<i>Rhinoceros unicornis</i>	EN	I
Pigmy hog	<i>Sus salvanius</i>	EX(?)	I
Four-horned antelope	<i>Tetracerus quadricornis</i>	VU	III
Brown bear	<i>Ursus arctos</i>		I

### Birds

Common Name	Scientific Name	IUCN Category*	CITES Appendix **
Giant hornbill	<i>Buceros bicornis</i>		I
Cheer pheasant	<i>Catreus wallichii</i>	EN	I
White stork	<i>Ciconia ciconia</i>		
Black stork	<i>Ciconia nigra</i>		II
Bengal florican	<i>Eupodotis bengalensis</i>	EN	I
Common crane	<i>Grus grus</i>		II
Impeyan pheasant	<i>Lophophorus impejanus</i>		I
Lesser florican	<i>Syphotides indica</i>	EN	II
Crimson-horned pheasant	<i>Tragopan satyra</i>		III

## Reptiles

Common Name	Scientific Name	IUCN Category*	CITES Appendix **
Gharial	<i>Gavialis gangeticus</i>	EN	I
Asiatic rock python	<i>Python molurus</i>	VU	I
Golden monitor lizard	<i>Varanus flavescens</i>	VU?	I

## Plant Species/Forest Products

Scientific Name	Government Status***	IUCN Category*	CITES Appendix **
<i>Dactylorhiza hatagirea</i>	1		II
<i>Picrorhiza scrophulariiflora</i>	1		
<i>Juglans regia</i> (bark)	1		
<i>Abies spectabilis</i>	2		
<i>Cinnamomum glaucescens</i>	2		
<i>Cordyceps sinensis</i>	2		
<i>Lichen species</i>	2		
<i>Nardostachys grandiflora</i>	2	VU	
<i>Rauwolfia serpentina</i>	2	EN	II
<i>Asphaltum</i> (rock exudate)	2		
<i>Taxus buccata</i> subsp. <i>wallichiana</i>	2		II
<i>Valerina jatamansii</i>	2		
<i>Acacia catechu</i>	3	NT	
<i>Bombax ceiba</i>	3		
<i>Dalbergia latifolia</i>	3		
<i>Juglans regia</i>	3		
<i>Michelia champaca</i>	3	EN	
<i>Pterocarpus marsupium</i>	3		
<i>Shorea robusta</i>	3		

Adapted from Ministry of Forests and Soil Conservation, Nepal Biodiversity Strategy, 2002 (pp. 28-30)

### \*IUCN Categories:

EX=Extinct/EN=Endangered/VU=Vulnerable/NT=Near Threatened

### \*\*CITES STATUS:

**Appendix I** includes all species threatened with extinction which are, or may be affected by trade. Trade in specimens of these species must be subject to particularly strict regulation in order not to endanger further their survival and must only be authorized in exceptional circumstances.

**Appendix II** includes: i) all species which although not necessarily now threatened with extinction may become so unless trade in specimens of these species is subject to strict regulation in order to avoid utilization incompatible with their survival; and ii) other species which must be subject to regulation in order that trade in specimens of certain species referred to in subparagraph i) above may be brought under effective control [e.g. species that are similar in appearance to those included in Appendix I].

**Appendix III** includes all species which any party identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation, and as needing the cooperation of other Parties in the control of trade.

<http://www.cites.org/eng/resources/terms/glossary.shtml>

**\*\*\*Government Protection Status:**

1. Species banned for collection, use, sale, distribution, transportation, and export
2. Species banned for export
3. Timber trees banned for felling, transportation, and export

## Appendix 2: Agencies involved in forest management in Nepal

	<b>Government Agencies</b>	<b>Main responsibility</b>
1	Ministry of Forest and Soil Conservation	To formulate forest policies and strategies
2	Department of Forests	Responsible for the conservation, management and utilization of forests and forest products through its district and field level organizations.
3	Department of Forest Resources and Survey	To undertake research on forest management and to carry out surveys to estimate forest area/growing stocks.
4	Department of National Parks and Wildlife Conservation	Supports the conservation and management of community forests in buffer zones and other protected areas.
5	Department of Soil Conservation and Watershed Management	To conserve and manage forests in watershed areas.
	<b>Projects</b>	
6	BISEP-ST	Funded by SNV of the Netherlands, this project supports the conservation and management of forests in eight Terai districts. The Project has promoted CFM systems for large areas of forest in the Terai.
7	Livelihoods and Forestry Program	Funded by the UK's DFID, this project implements forestry management programs in 15 districts; three in the Terai, four in the eastern Koshi hills, three in the western hill districts and five in the mid-western hill districts. Interventions focus on improving the livelihoods of poor households through forest management.
8	Leasehold Forestry and Livestock Program	Provides funding for the implementation of forest management programs to poor households in 22 hilly districts in collaboration with the Forest Department and the Department of Livestock Services. It helps to manage degraded forests and invigorate natural regeneration as well as working to improve the variety of grasses for livestock.
9	Western Upland Poverty Alleviation Project (WUPAP)	Funded by IFAD, the project implements leasehold forestry projects in 11 remote districts located in the mid-west and far-west regions. It encourages the production of NTFPs/MAPs in high mountain forests.
10	Terai Area Landscape (TAL)	Provides funding for the conservation & management of forests using the landscape corridor concept of wildlife conservation.
11	Western Terai Landscape Project (WTLCP)	Provides funding for the conservation & management of forest in the Western Terai landscape.
	<b>International Agencies</b>	
12	CARE Nepal (SAGUN Program finished in June 2009)	Supports in the preparation of district forestry sector plans; supports advocacy and good governance initiatives for community forests. Funding is supplied by USAID/Nepal.
13	World Wildlife Fund Nepal	Provides funding and also implements biodiversity projects which directly and indirectly support forest management initiatives.
14	International Center for Integrated Mountain Development	Organizes international workshops to enable countries to share experiences. Provides policy formulation support services.
15	Asia Network for Sustainable Agriculture and Bioresources	Supports the management of forests focusing on NTFPs/MAPs.

	<b>Donors</b>	<b>Areas of funding</b>
16	International Fund for Agriculture Development (IFAD)	Provides funding to implement leasehold forestry programs in 33 hilly and mountain districts
17	Department for International Development (UK Government) (DFID)	Provides funding to implement community forestry programs in three Terai and 12 mid-hill districts
18	Swiss Development Cooperation (SDC)	Provides funding to implement community forestry programs in the hilly districts of Dolakha, Ramechhap and Okhaldhunga
19	Netherlands' Agency for Development Cooperation (SNV)	Provides funding to implement the BISEP-ST program in eight Terai and Inner-Terai districts
20	Finnish Embassy	Provides funding for the national forestry survey
21	The World Bank	Provides funding for preparing R-PLAN (REDD)

### Appendix 3: NGOs involved in forest management in Nepal

	<b>Local NGOs</b>	
22	Nepal Foresters Association	Advocates for the conservation and management of forests across Nepal
23	Nepal Forum of Environmental Journalists (NEFEJ)	Advocates for the conservation of forests and against deforestation with <i>Aankhi Jhyal</i> – a TV & radio program - and the publication of reports and journals.
24	Forestry Institutes	Produces trained human resources for the forestry sector and undertakes research into forest management
<b>CBOs and Federations</b>		
25	FECOFUN	Advocates for the rights and welfare of community forest user groups.
26	NEFUG	Advocates for the rights and welfare of community forest user groups and other forest-related groups
27	Association of Collaborative Forest Users in Nepal (ACOFUN)	Advocates for the rights and welfare of collaborative forest management groups in Terai
28	Community Forest User Groups	Manage community forests
29	Leasehold Groups	Manage leasehold forests
30	Collaborative Forest Management Groups	Manage large areas of forest in the Terai
31	Buffer Zone Groups	Manage buffer zone forests

### Appendix 4: Policies Related to Forest Management in Nepal

<b>Year</b>	<b>Policy/strategy</b>
1988	National Conservation Strategy
1989	Master Plan for the Forestry Sector
1993	Nepal Environmental Policy and Action Plan
1995	Agriculture Perspective Plan
1998	Nepal Environmental Policy and Action Plan 1998 II
2000	Revised Forestry Policy
2002	Nepal Biodiversity Strategy
2002	Leasehold Forestry Policy
2003	Nepal Wetland Policy
2004	Herbs and Non-Timber Forest Product Development Policy
2007-10	Interim Plan
	Periodic Five Year Plans 1-10

## Appendix 5: Acts Related to Forest Management in Nepal

Year	Forest related laws
	<b>Acts</b>
1993	Forest Act
1997	Environmental Conservation Act
1998	Local Self Governance Act
	<b>Regulations</b>
1995	Forest Regulations
1997	Environment Conservation Regulations
1999	Local Self Governance Regulations
	<b>Guidelines</b>
2062 B.S.	Collaborative Forest Management Guidelines
2009	Community Forestry Guidelines

## Appendix 6: Agencies involved in biodiversity conservation in Nepal

	Agency	Role in biodiversity conservation
1	Ministry of Forest and Soil Conservation	Focal Ministry for the Convention on Biological Diversity (CBD) in Nepal.
2	Ministry of Agriculture and Cooperatives	Responsible for the conservation of agriculture and livestock diversity.
3	Ministry of Environment, Science and Technology	Responsible for preserving natural and cultural environments
4	Department of National Parks and Wildlife Conservation	Responsible for the conservation of biodiversity in protected areas
5	Department of Forests	Responsible for protecting biodiversity in forests which fall outside protected areas
6	Department of Agriculture	Responsible for the conservation of agricultural biodiversity
7	Department of Livestock Services	Responsible for the conservation of livestock biodiversity
8	Nepal Agricultural Research Council	Carries out agricultural and livestock research
9	Nepal Academy of Science and Technology	Carries out chemical screening (bio-prospecting) of some medicinal plants, mostly conifers
10	National Trust for Nature Conservation	Supports the conservation and management of protected areas.
11	World Wildlife Fund Nepal	Carries out biodiversity research and provides biodiversity policy and planning support in addition to implementation assistance.
12	The World Conservation Union (IUCN)	Carries out research in biodiversity conservation and supports program implementation
13	International Center for Integrated Mountain Development (ICIMOD)	Is active in the conservation of mountain biodiversity and trans-boundary ecological conservation.
14	The Mountain Institute (TMI)	Works for the conservation of biodiversity in mountain regions
15	Forestry, agriculture and livestock related educational institutes	Carry out studies and research on biodiversity conservation
16	FECOFUN and other forest user groups	Work for the conservation of biodiversity in community forests
17	Leasehold forest groups	Work for the conservation of biodiversity in leasehold forests.
18	NGOs: Nepal Foresters Association, Ecological Society of Nepal, Women in Environment Nepal, Save the Environment Foundation, Friends of the Wetlands of Nepal, Nepal Bird Conservation Society and others	Directly involved in biodiversity conservation.

#### Appendix 7: Policy/Strategies related to biodiversity conservation

Year	Policy/strategy
1988	National Conservation Strategy
1989	Master Plan for the Forestry Sector
1993	Nepal Environmental Policy and Action Plan
1995	Agriculture Perspective Plan
1998	Nepal Environmental Policy and Action Plan 1998 II
2000	Revised Forestry Policy
2002	Nepal Biodiversity Strategy
2002	Leasehold Forestry Policy
2002	Water Resource Strategy Nepal
2003	Nepal Wetland Policy
2003	Domestic Elephant Management Policy
2003	Wildlife Farming, Reproduction and Research Strategy
2004	Agriculture Policy (2004)
2004	Herbs and NTFP Development Policy
2004-14	Terai Arc Landscape Nepal Strategic Plan (2004-14)
2006-10	Nepal Biodiversity Strategy Implementation Plan
2006-11	The Greater One-horned Rhino Conservation Action Plan
2006-16	Sacred Himalayan Landscape Nepal Strategic Plan
2007-10	Interim Plan
2060 B.S.	Biosafety Policy 2060 B.S.
	Periodic Five Year Plans 1-10

#### Appendix 8: Acts and Regulations related to biodiversity conservation

	Major Acts Related to Biodiversity Conservation
1961	Aquatic Animals Protection Act 1961
1973	National Parks and Wildlife Conservation Act 1973
1977	Plant Protection Act 1977
1977	Tourism Act 1977
1982	Soil and Watershed Conservation Act 1982
1982	Nature Conservation Trust Act 1982
1989	Seed Act 1989
1991	Pesticide Act 1992
1993	Forest Act 1993
1993	Electricity Act 1993
1993	Water Resource Act 1993
1996	Environmental Protection Act 1996
1998	Livestock Health and Livestock Service Act 1998
1999	Local Self-Governance Act 1999
	<b>Regulations</b>
1966	Elephant Management Regulations 2022 B.S.
1974	National Park and Wildlife Conservation Regulations 1974/2030 B.S.
1974	Chitwan National Park Regulations 2030 B.S.
1995	Forest Regulations 1995
1996	Bardia National Park Regulations 2053 B.S.
1996	Buffer Zone Regulations 2052 B.S.
1996	Conservation Area Management Regulations 2053 B.S.
1997	Environment Protection Regulations 1997
1977	Wildlife Reserve Regulations 2034 B.S.
1979	Himali National Park Regulations 2036 B.S.
1987	Khaptad National Park Regulations 2044 B.S.
1999	Local Self Governance Regulations
2000	Conservation Area Government Management Regulations 2057 B.S.
2008	Kanchenjunga Conservation Area Regulations 2064 B.S.

## Appendix 9: Conservation of Wetlands in Kailali district

Situated between Bardia National Park in the east, and Suklaphanta wildlife reserve in the west, Kailali district is rich in both terrestrial and aquatic biodiversity; despite this, there are no protected areas in the district. Kailali is home to the largest number of natural lakes in the country. These lakes cover a combined area of 1,010 hectares and are in dire need of conservation efforts. None of the 174 natural lakes identified in the district has been properly managed and, as a result, they are suffering from rapid encroachment and conversion into agricultural lands. This has caused a great loss to Nepal's wetland biodiversity. A large number of Kailali's lakes are situated in forest lands but there are currently no wetland biodiversity experts in the Department of Forests. The only wetlands management plan for the district is the Ghoda Ghodi Lake conservation plan which was prepared with the support of IUCN, Kathmandu. Ghoda Ghodi Lake is one of the nine lakes categorized as a Ramsar Site of International Importance. The table below lists lakes with an area of more than 10 hectares.

	Name of Lake	Area (ha)	VDC name
1	Ghoda Ghodi	133	Darakh-5
2	Laukaha Bhaukaha	80	Khailad-8
3	Ghod	60	Khailad-9
4	Soniya	40	Khailad-8
5	Khairahawa	35	Ratanpur-6
6	Kailiya	35	Gadadiya-8
7	Behadababa	25	Urma-4
8	Nakrol	23	Sadepani-8
9	Jaginiya	20	Gadariya-9
10	Chamraiya	16.6	Udasipur-5
11	Puraina	15	Lalbojhi-1
12	Duwad	14.6	Udasipur-7
13	Badka Magahar	10.5	Pabera-2
14	Nukli	10	Khailad-8
15	Sahdev	10	Urma-4
16	Jakhad	10.3	Dhangadhi M.

Source: D.ADO, 2063 B.S. (District Agriculture Statistics, Data Book).

### Ghoda Ghodi Tal (Lake)

Ghoda Ghodi lake, located in Kailali district along the East-West Highway, covers an area of 2563 hectares. It was declared a Ramsar Site in 2003. It consists of a large and shallow oxbow lake system with associated marshes and meadows which is surrounded by tropical deciduous forest on the lower slopes of the Siwaliks. The wetlands and forest serve as a wildlife corridor between the lowlands and the Siwalik hills. They support critically endangered species including the red-crowned roofed turtle, and the Royal Bengal tiger. Other valuable species include the otter, stork, swamp deer and marsh crocodile. Endangered plant species include rare varieties of orchid and wild rice (IUCN, 1998).

The lake is an important religious shrine dedicated to the Ghoda Ghodi deity. The indigenous Tharu community celebrates the festival of Aghan Panchami in December with a cleansing dip in the holy waters. The population of the area is estimated to be around 6,700, 50% of which are migrants from adjoining hilly areas. This population depends on the lake for fishing and traditional agriculture (ICIMOD, 2007).

Poaching and hunting, over grazing, illegal tree felling and the smuggling of Sal, and natural eutrophication are the major problems faced by the lake and its environs. The Department of Forests is the principal authority for the area, while it is managed by the Kailali district forest office. Local communities and NGOs support conservation through the formation of user groups; a participatory community-based conservation management plan has been prepared. IUCN Nepal is also supporting conservation efforts with technical and financial assistance. Three 'wetland clubs' were formed in three local schools around Ghoda Ghodi lake in 2007, and over 16 community-based organizations are active in the area. CARE Nepal has recently launched a project aimed at conserving the lake.

A major long-term threat to the lake is natural eutrophication (filling with weeds). No attempt has been made to clean weeds from the lake. Similarly, the lake may start to fill up with soil coming from the rivers and rivulets of the Churia hills. The District Forest Office, District Soil Conservation Office, District Plant Resource Office, DDC Kailali, and IUCN should be working strategically with VDCs, and concerned communities to conserve and manage the lake and its watershed areas.

There are many other natural lakes rich in biodiversity in Kailali district that are in need of conservation. USAID/Nepal and its partners could provide valuable assistance by carrying out studies to explore the status of wetland biodiversity in Kailali district and by preparing a detailed plan on wetland conservation. Although there are two active landscape projects (TAL and WTLCP) in the region, neither is focused on the conservation of wetlands.

## Appendix 10: Gaps in Tropical Forest Management

### Terai/Inner-Terai and Churia Hills

Existing situation	Current need	Gaps
Despite the high productivity potential, there are generally low levels of production per unit in the Terai's forests.	Production levels can be more than doubled if space and quality management systems are adopted.	Silvicultural management systems have not been applied due to lack of institutional commitment.
Many valuable species are vanishing from forests due to over-exploitation and lack of conservation efforts.	To avert the danger of extinction, threatened tree species must be protected and managed both <i>in-situ</i> and <i>ex-situ</i> .	Lack of focused conservation efforts for threatened species such as Bijay Sal, Satsal and Semal.
<p>Massive deforestation and forest degradation due to the presence of land and forest mafias, particularly in the western Terai and Churia Hills.</p> <p>Allocation of forest areas for changes in land use by policy decisions/ interventions. The forestry administration is struggling to prevent forest conversion/encroachment by forest mafias.</p> <p>There was massive forest encroachment during the decade-long Maoist insurgency and forest land grabbing continues to this day.</p>	Maintain at least 40% of forest land in the country to ensure ecological balance.	<p>Lack of control over forest resources and lack of good governance in the forestry sector, particularly in the Terai and Inner-Terai.</p> <p>Lack of will from the political parties/absence of national policy to combat deforestation/forest degradation and allocation of forest land for other uses.</p> <p>Political instability makes it difficult to put a stop of forest land grabbing,</p>
<p>Churia Hill forests are rapidly degrading and have become a source of siltation in both the Bhabar and the Terai zones. This is caused by the massive, unchecked exploitation of the forest products needed to sustain the livelihoods of deprived communities.</p> <p>Conservation of the Churia Hills is a massive challenge for both the government and the nation.</p> <p>Although a river-basin approach for managing the fragile areas linking the Churia Hills to the Terai is mentioned in the Interim Plan (2007-10), no further details have been added.</p>	<p>The desertification of the Terai must be halted if it is to continue in its role as the 'breadbasket' of Nepal.</p> <p>Reduce siltation in the Bhabar and Terai zones by putting a stop to river-bank widening.</p> <p>Put measures in place to prevent the loss of agricultural land from flooding, siltation and natural disaster in the Bhabar and Terai zones.</p> <p>Reverse the rising trend of abject poverty in the Terai.</p> <p>Declare the whole of the Churia Hill corridor (from east to west) a conservation area.</p>	<p>Lack of government commitment, policy/strategy or long-term plans/programs to conserve the Churia Hills.</p> <p>Massive exploitation of firewood and other forest products due to the lack of alternative energy sources/employment for the poorest people in the Churia Hills.</p> <p>Lack of policy or strategy on upstream-downstream links between the Churia Hills and the Terai</p> <p>Lack of awareness about role of the Churia and Bhabar zones in recharging underground water sources in the Terai.</p> <p>Lack of awareness about the role the Churia Hills play in regional ecological services.</p>

Existing situation	Current need	Gaps
Forest lands are currently assessed based on the number of forest products that they deliver and the amount of revenue that these products generate.	The assessment process needs to be redefined, focusing on the provision of ecological services in addition to forest products.	Lack of skills/knowledge/policy/strategy for setting up PES schemes (carbon sequestration/carbon trading, biodiversity valuation, landscape and watershed services)
There is no government policy, strategy or program relating to climate change adaptation in the forestry sector.	Develop the national capacity of the forestry sector to assess and adapt to climate change.	Effects/impacts of climate change on forests not yet assessed. Lack of national capacity/expertise to undertake such a study.
The absence of alternatives to fire wood (e.g. electricity, biogas, briquette, ICS) is putting pressure on forests.	Cheap and readily available alternative energy sources made available in rural areas.	Lack of research on cheap and readily available alternative energy sources for rural areas of the Terai, Mid-hills and high mountains.

### Mid-hills

Existing situation	Need	Gaps
Hydro-electricity dams are increasingly able to fulfill the rising demand for electricity but watershed conservation is not sufficiently understood nor properly implemented in watersheds containing dams.	Well-conserved watersheds in hydro-electricity dams and river areas will help to regulate the supply of water and to reduce siltation.	Lack of awareness of the fact that forest and soil conservation are an integral component of watershed management in hydro-electric projects.
A high level of anthropogenic disturbance resulting in rapid siltation is shortening the life of many of Nepal's wetlands including Phewa Lake and Ghoda Ghodi Lake.	Well-conserved watersheds in nationally and internationally recognized Ramsar Sites and wetlands will help to extend their lifespan.	Ramsar Sites often cover only limited parts of a watershed area.
There are currently no laws governing what types of land can be used for different purposes. For example, the steep slopes of the fragile Churia Hills are used for agriculture, which poses serious ecological threats to downstream communities.	A national policy, strategy and long-term plan governing different types of land and their use needs to be enforced. A behavioral change in local communities is needed if any such national policy for the long-term productivity of land is to be successful.	No national policy, strategy or long-term plan governing land use.
The Master Plan for the Forestry Sector (1989) lists soil and watershed conservation as its 5th priority.	There is a need for well-conserved watersheds, at the very least in nationally important wetlands and the hydro-electricity dams areas of flowing rivers.	There is no specific national policy relating to soil and watershed management. The Soil and Watershed Conservation Act 1982 (SWCA) and its Regulations 1985 were promulgated but never implemented.
Fragile mid-hill ecosystems are scattered and isolated – there is no landscape level approach to focus conservation efforts.	Strengthen the ability of mid-hill ecosystems to provide ecological services by linking north-south protected areas through river corridors and/or biodiversity corridors.	Mid-hill forests are extremely important in the provision of ecological services for watersheds, biodiversity and carbon sequestration, but this is not recognized by policy, strategy or in long-term plans. There is no north-south system of linking two or more protected areas. Forest management systems (including community forests) do not take into account the watershed perspective (the need to maintain dense undergrowth and trees).
Although an integrated watershed management approach is used in some of the key hilly watersheds (e.g. Kulekhani and Fewa Lake), it is not	There is a pressing need for functional upstream-downstream linkages in Nepal's river systems; this should follow a river basin	The river basin approach is mentioned in the Interim Plan (2007-10) but detailed plans/implementation schedules are missing.

an appropriate approach for the Churia Hills and the Terai where the Churia Hills are a source of silt and the downstream Terai and Bhabar zones are badly affected by siltation and river-bank cutting.	approach. The watershed/sub-watershed management unit should be used for the management of forests and non-forest lands, animals, water, and populations.	
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### High Mountains

Existing situation	Need	Gaps
<p>The region is a natural store of high value NTFPs/MAPs. The collection of these products is carried out on a massive scale in forests and pasture lands in a manner which is unsustainable.</p> <p>High value NTFPs/MAPs are the principal exportable items from the high mountain districts and one of the main sources of additional income for poor households.</p> <p>Extremely valuable species such as Yarsagumba (<i>Cordyceps sinensis</i>) and Guchi Chyau (<i>Morchella esculenta</i>) give huge amounts of income to local people.</p>	<p>Sustainable conservation, plantation, management and collection of high value NTFPs/MAPs for commercial export.</p> <p>In-district or in-country NTFP/MAP processing/value adding to generate local employment.</p>	<p>Vague/non-existent laws regarding the tenure of forests and pasture lands.</p> <p>The conservation, plantation, and management of high value NTFPs/MAPs have not yet started on a commercial scale, even in community and leasehold forests.</p> <p>Local processing and value addition is very expensive due to a lack of appropriate technology and skills.</p> <p>The cost of transporting NTFPs/MAPs from the high mountains to the Terai is high.</p> <p>The transportation/export of NTFPs/MAPs attracts high levels of harassment from DDCs, the police, the forestry administration and others.</p> <p>The high mountains are rich in natural resources (forests, scenic views, NTFPs, rivers etc.) but are at the same time blighted by poverty and near permanent food deficits.</p>
<p>Pristine scenic views and the ancient Buddhist culture attract thousands of tourists every year.</p> <p>Huge demand for firewood for room and water heating during the winter months.</p>	<p>Sustainable management of the region's forests</p> <p>Adopt cheap and readily available alternative energy sources to reduce the use of firewood.</p> <p>Legalize the export of forest products through the northern borders.</p>	<p>Scientific forest management is not practiced in the high mountains.</p> <p>There is a lack of alternatives to firewood.</p> <p>The illegal trade of timber, firewood and high value NTFPs/MAPs to Tibet continues unabated.</p>
<p>Climate change is affecting agriculture and vegetation; it is also causing water stress.</p>	<p>Prepare and adopt a climate change adaptation plan.</p> <p>Run a massive awareness raising campaign on the effects of climate change and ways to adapt.</p>	<p>There is no climate change adaptation plan for local communities that will be affected.</p> <p>There is a general lack of awareness about how to deal with climate change.</p>

## Appendix 11: Gaps in biodiversity in the Terai, Mid-hills and high mountains

### Terai

Existing situation	Need	Gaps
TAL and WTLCP are the only biodiversity conservation programs in the region.	Conserve biodiversity outside the protected areas.	No effective biodiversity conservation program outside protected areas.
Kailali has the highest number of wetlands in the country but no ongoing conservation efforts (with the exception of Ghoda Ghodi Lake). There is a rapid loss of wetland areas and associated biodiversity.	Immediate implementation of conservation initiatives for the wetlands	Ownership of authority over the wetlands has yet to be determined.  A wetlands policy exists but there is no implementation plan.
Loss of important plant species such as Bijay Sal, Semal, Satisal, Khair and Cycas along with other trees and ferns.	A species conservation plan.	There is a continued lack of long-term planning/programming and a lack of awareness about important species in existing forest management plans.
Many indigenous fruits, vegetables and other crops have disappeared from the region.	An incentive program for <i>in-situ</i> conservation.	Lack of long-term planning and programming to conserve indigenous crop varieties.
People/wildlife conflicts.	Effective habitat management in the protected areas including compensation schemes for local populations.	No policy or action plan exists for locations that fall outside the protected areas.
Crane, dolphin, crocodile, Sahar fish, python, vulture and Thulo Dhanesh populations are not safe outside the protected areas.	A species conservation plan.	A comprehensive action plan does not currently exist.
The fragile Churia Hills ecosystem is an important habitat for many species.  The Churia Hills are becoming denuded as a result of excessive excavation and rock mining.  The Churia corridor links 29 districts (home to 60% of the country's population).	Integrated Action Plan for the Churia Hills area.  Stabilize habitats in the Churia area.	A rapid mitigation and conservation plan does not exist.  There is a lack of effective management/control of Churia Hill resources.

### Mid-hills

Existing situation	Need	Gaps
Few mid-hill ecosystems fall into protected areas.	Mid-hill ecosystems are equally important for species diversity.	Biodiversity issues are not addressed in mid-hill conservation management.
The region forms a corridor for the migratory species of the high mountains and the Terai.	There needs to be an effective corridor management system linking the Terai and the Himal especially for the critical ecosystems linking Chitwan and Annapurna/Mustang, Chitwan-Manaslu, and Chitwan-Langtang.	No effective corridor management system linking the Terai with the Himal.  Lack of policy and implementation plans for linking north-south protected areas.
Existing situation	Need	Gaps
The tropical biology of the hills - especially that of indigenous crops/livestock and epiphytic orchids - are neglected areas of biodiversity conservation.	Community conservation efforts need immediate attention.	Lack of proper identification/promotion of <i>in-situ</i> conservation opportunities and commercial incentives.

The region forms an important biodiversity corridor and contains the habitats of valuable species of birds and mammals.	Prepare and implement biodiversity corridor programs in the Mid-hills, linking the Terai and the Himal.	A landscape level plan for the Mid-hills (including ICDP) is lacking.
Many hydro-electric dams have been constructed in the region and there is the potential to construct many more.	Include important aquatic animals in the Environmental Impact Assessment for hydro-electric dam projects.	The construction of hydro-electric dams in Mid-hills may affect the upstream/downstream mobility of many aquatic animals.

### High Mountains

Existing situation	Need	Gaps
High mountain rangelands are of great ecological and economic significance, especially for livestock and medicinal herbs.	The management of protected areas needs to be strengthened in order to effectively control and monitor grazing, and to establish the rights and responsibilities of local communities.  Start the commercial cultivation of high value NTFPs/MAPs.	The laws governing tenure on rangelands are vague/non-existent.  There is no systematic monitoring or regulation of resource use on rangelands.  The harvest of natural stocks of high value NTFPs/MAPs is not sustainable while no commercial cultivation initiatives exist.
Huge disturbances to the tree line ecosystem from human pressure and climate change.	Monitoring sites to be fixed for long-term time-series data collection to identify indicator species.	A research and mitigation plan does not exist and there are no plans to produce one.
Glacial lakes are highly vulnerable to climate change	Close monitoring/early warning systems need to be in place.	Site specific data/information gaps.
Outside the protected areas, protected wildlife such as musk deer and snow leopard are killed for their skins, meat, bones and body parts.	There is a need to raise awareness among local communities about the laws that protect wildlife in the region.	Lack of strong governance in the region.
A decline in yak breeding due to the availability of alternative livelihood opportunities in tourism and other sectors which provide better incomes.	Indigenous knowledge needs to be conserved and market incentives given.	The incentive gap in biodiversity conservation (including yak breeding).
Transhumant livelihood patterns are declining due to the creation of community forests and a ban on en-route grazing.	There is a need for collaborative arrangements to be made under the community forestry system preserve transhumant livelihoods.	Community forestry does not respect the traditional use rights of transhumant grazers who come with a herd of animals to road heads/towns to fetch food grains.
Those collecting, selling and transporting high value NTFPs/MAPs are routinely harassed. No tax system for NTFPs/MAPS currently exists.	A 'one door' permission system should be adopted for the transport of high value NTFPs/MAPs to wipe out corruption.	Undefined rights and responsibilities in the bureaucratic process.

## Appendix 12: River Corridors and Landscapes

### Landscape Level Information

#### 1. Terai Arc Landscape

##### Introduction

The Terai Arc Landscape Strategic Plan (2004-14) states that the Terai Arc Landscape (TAL) is a vast conservation landscape that extends from Nepal's Bagmati River in the East to India's Yamuna River in the West. The landscape covers an area of 49,500 square kilometers, comprising 11 protected areas and forest corridors stretching along the Indo-Nepal border from Parsa Wildlife Reserve in Central Nepal to India's Rajaji National Park. TAL Nepal encompasses an area of 23,199 square kilometers and covers 14 Terai districts. The landscape is vital to the country for economic reasons as well as for the ecological services it provides and its globally important biodiversity. It also includes the Churia foothills, which are important watersheds for maintaining the high agro-productivity of the Terai region. TAL Nepal houses over 75% of remaining forests of the Terai and Churia foothills. These forests fulfill national and local demands for forest products.

##### Significance of the landscape or corridor in terms of tropical forests and biodiversity

The landscape is important from both a national and a global perspective for its rich biological diversity. Its highly productive alluvial grasslands and subtropical forests support some of the highest densities of Royal Bengal tiger (*Panthera tigris*) in the world and the second largest population of the greater one-horned rhino (*Rhinoceros unicornis*). It is also home to other endangered species such as the Asian elephant (*Elephas maximus*), the Gangetic dolphin (*Platanista gangetica*), the Gharial crocodile (*Gavialis gangeticus*), the Great Hornbill (*Buceros bicornis*), the Sarus Crane (*Grus antigone*) and the Bengal Floricans (*Houbaropsis benglensis*). The TAL contains two of the World Wildlife Fund's (WWF) Global 200 eco-regions: Terai-Duar Savanna and Grassland/Himalayan Subtropical Broadleaf Forest. It also includes many areas identified as "biodiversity hotspots". An in-depth biological assessment of the TAL in Nepal was carried out in 2001, confirming that it supports over 85 species of mammal, 550 species of bird, 47 known species of reptile and amphibian, and over 125 species of fish. The landscape also contains three wetlands of international importance: Ghoda Ghodi Lake, Jagadishpur Reservoir and Beeshazari and associated lakes. It also houses one world heritage site - Chitwan National Park.

##### Ramsar Sites of International Significance in TAL Areas

Name	Area in ha	Date Declared	Eco-region & district	Altitude range (m)
Ghoda Ghodi Lake	2,563	13 Aug 2003	Terai, Kailali, located outside protected areas	205
Jagadishpur Reservoir	225	13 Aug 2003	Terai, Kapilvastu, located outside protected areas	197
Beeshazari and associated lakes	3,200	13 Aug 2003	Terai, Chitwan, located in a protected area (buffer zone of Chitwan National Park)	286

##### Major Threats to Tropical Forests and Biodiversity in the TAL

### DEFINITIONS

**Protected Area:** Any of six categories: National Park, Strict Nature Reserve, Wildlife Reserve, Hunting Reserve, Conservation Area, and Buffer Zone.

**National Park:** An area set aside for the conservation and management of the natural environment, including ecological, biological and geomorphic associations of aesthetic importance.

**Wildlife Reserve:** An area established for the conservation and management of plants and wildlife and their habitats.

**Landscape:** a system of patches, corridors, matrices – this is a larger area where the implications of past, existing and future land-use practices can be understood.

**Corridor:** an area of natural habitat that facilitates the movement of organisms between habitat fragments.

**Bottleneck:** part of a habitat narrowed or constricted by external threats.

**Connectivity:** the measure of how connected or spatially continuous a corridor, network, or matrix is.

**Matrix:** the background ecological system of a landscape with a high degree of connectivity.

**Network:** an interconnected system of corridors.

Over the past three decades, the natural wildlife habitat of the Terai has become highly fragmented due to pressure from human populations. The human population in the TAL area has increased by 81% in the past 20 years and the deforestation rate in the Terai between 1979 and 1991 was estimated at 1.3 percent per annum. This degradation has forced wildlife to remain in small, insular refuges, which are too small to support large numbers of species and their ecological interactions. The poaching of wildlife and the illegal cutting of timber has increased in recent years as a result of the political instability. The ever decreasing numbers of one-horned rhinoceroses, Royal Bengal tigers and black bucks are now limited exclusively to the protected areas and are threatened by illegal poaching.

The TAL program has identified five critical areas for biodiversity - two trans-boundary forest corridors (Basanta in Kailali district and Khata in Kailali and Bardia districts) and three bottlenecks (Mahdevipuri in Banke district, Lamahi in Dang district and Dobhan in Palpa district). These areas are priorities for conservation and restoration as they facilitate the dispersal of the region's mega fauna. The critical status of the bottlenecks was determined on the grounds of biodiversity conservation, the preservation of habitat integrity, and the need to enhance the socio-economic status and capacity of local communities, without which, conservation efforts would not yield dividend. Immediate restoration was deemed necessary to provide future dispersal corridors and migration paths for tigers, rhinos, elephants and other important species. There is high pressure from deforestation and forest encroachment in the TAL, particularly in Kailali and Kanchanpur districts. Deforestation and forest deterioration in the western Terai forests poses a great threat to both the forests and to biodiversity. Similarly, the rapid expansion of exotic invasive species (e.g. Ban Mara and Makenia) poses a biological threat to grasslands. This has a negative impact on several species of herbivore (e.g. deer), and goes on to affect species further up the food chain such as tigers and leopards.

The dolphins of the Karnali River and the crocodiles of the Narayani River are threatened by both over-fishing and the construction of large hydro-electric dams. Many wetland species such as vultures and hornbills are rapidly disappearing due to encroachment (for example in Kailali district) and a lack of wetland conservation and management. Trees and plants such as Bijay Sal (*Pterocarpus marsupium*), Satisal (*Dalbergia latifolia*) and Semal (*Bombax ceiba*) are also at risk.

Changing weather patterns in the TAL have led to the region experiencing short periods of heavy rainfall and long periods of drought. The heavy rainfall has caused rivers to change course, thereby expanding the river-beds and destroying large tracts of forest land and productive agriculture land.

**Opportunities in the TAL**

The TAL vision, endorsed by the Government of Nepal, aims at the creation of a single functioning landscape, through the restoration and maintenance of forest corridors and connectivity between protected areas in both India and Nepal. The TAL Nepal Program was initiated in 2001 with the implementation of the Critical Areas Restoration Plan (CARP), supported by WWF Nepal. The major objectives of the TAL-CARP are to restore and manage degraded forests, conserve tiger, elephant, rhino and other species of special concern, promote environmental services that enhance local livelihoods and reduce poverty, promote conservation education to build the capacities of local communities, develop effective coordination and communication systems, and strengthen institutional coordination and trans-boundary cooperation. The TAL strategy was also adopted by the Western Terai Landscape Complex Project (WTLCP). TAL has helped to restore highly degraded forests in areas lying outside national parks and wildlife reserves through the effective management of community forests. The program not only sped up the process of formation and handing over of community forests, but also helped Community Forest User Groups to network with each other through community forestry coordination committees.

<p><b>Terai Arc Landscape-Nepal at a Glance</b></p> <p>Area: 23,199km<sup>2</sup>          Population: 6.7 million</p> <p>WWF's Global 200 Ecoregions:</p> <ol style="list-style-type: none"> <li>1) Terai-Duar Savanna and Grassland</li> <li>2) Himalayan Subtropical Broadleaf Forest</li> </ol> <p>Level 1 Tiger Conservation Unit          Important Bird Area          Biodiversity Hotspot</p> <p>World Heritage Sites:</p> <ol style="list-style-type: none"> <li>1) Chitwan National Park</li> <li>2) Lumbini</li> </ol> <p>Protected Areas:</p> <ol style="list-style-type: none"> <li>1) Shuklaphanta Wildlife Reserve</li> <li>2) Bardia National Park</li> <li>3) Chitwan National Park</li> <li>4) Parsa Wildlife Reserve</li> </ol> <p>Ramsar Sites:</p> <ol style="list-style-type: none"> <li>1) Ghodaghodi Tal</li> <li>2) Jagadishpur Reservoir</li> <li>3) Bees-Hazari Tal</li> </ol>
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**Payment for Environmental Service (PES)—Ecotourism:**

Chitwan National Park receives more tourists than any other protected area in Nepal. There are opportunities and scope for shifting part of the tourist load to Bardia National Park, and Suklaphanta Wildlife Reserve.

**River canoeing:** Bird and wildlife spotting from river canoes is also popular in Chitwan National Park. This activity is also available in Bardia National Park and Suklaphanta wildlife reserve. Ethnic groups such as the Majhi people,

who are dependent on wetlands for their livelihoods, should be given the opportunity and training to profit from the river canoeing business.

**Buffer zone programs/livelihoods programs for local communities:** Both the TAL and WLCLP programs are supporting livelihoods programs for poor households in buffer zone areas and/or project command areas. 50% of the revenue generated from protected areas is spent through buffer zone councils/committees for community and livelihood development. This program should be further extended to reach the poorest of the poor and households and those negatively affected by wildlife.

**Revival of riverian forests:** Most of the riverian forests in the region have already disappeared due to heavy flooding and river-bank cutting. This in turn threatens riverian forest ecosystems in natural forests of Khair (*Acacia catechu*), Sissoo (*Dalbergia sissoo*) and Semal (*Bobax ceiba*). There is much scope for the revival of riverian forests and the protection of wildlife and bird species which depend on them for survival.

**Opportunities for the conservation and management of wetland biodiversity:** There is much scope for the conservation of wetland biodiversity which can be achieved by protecting and managing natural wetlands. This is one of the neglected thematic areas in the TAL (Kailali DFSP, 2008) and would help in the conservation of threatened species such as dolphins and crocodiles.

**Retardation of deforestation and forest degradation in sub-tropical tropical forests:** Protecting the sub-tropical forests in the TAL from encroachment is a challenging task for the government, community forest user groups and other agencies, particularly in times of political transition. The opportunity to "save what is left" of the sub-tropical forests outside protected areas in the TAL must be seized.

### **Suggested interventions**

Immediate restoration is necessary to provide dispersal corridors and migration paths for tigers, rhinos, elephants and other important species. Five critical areas are currently at great risk. Although the TAL program was launched to restore these critical areas, it has, at the time of writing, been unable to achieve its objectives. The rampant encroachment of forest lands has fragmented wildlife movement corridors and destroyed habitat in the critical areas. The governments of Nepal and India should sign a memorandum of understanding governing the maintenance of the trans-boundary corridors and should provide support for the same at both national and local levels. International agencies should also be brought on-board to assist with restoration efforts.

**Protection of sub-tropical forests from encroachment:** The subtropical forests of the TAL area, particularly those that fall outside protected areas, are also in need of conservation. For this to happen, political commitment is a must.

**Ensuring the protection of protected species from a biodiversity perspective:** The one-horned rhino and the Royal Bengal tiger are extremely vulnerable and are not fully protected even in the core protected areas. Both flagship species must be protected from illegal poaching in protected areas, buffer zones and outside protected areas.

**Conservation of wetlands in the TAL:** Wetlands and their biodiversity are neglected areas in the TAL. Plans and programs should be prepared and implemented for the conservation of important wetland species.

**Role of USAID:** The Government of Nepal, with technical and funding support from WWF Nepal, has prepared and approved the Terai Arc Landscape Strategy. The first phase of the project ran from 2001-2006 while the second phase runs until 2011. There is no current need for USAID to invest in this program.

## **2. Sacred Himalayan Landscape (SHL)**

### **Introduction to the landscape**

The Sacred Himalayan Landscape Strategic Plan (2006-2016) states that the SHL is a trans-boundary conservation area covering 39,021 square kilometers. Approximately 73.5% of the SHL is in Nepal, 24.4% is in Sikkim and Darjeeling (India) and the remaining 2.1% is in Bhutan.

### **The Significance of the landscape in terms of tropical forests and biodiversity**

The SHL is unique in terms of biodiversity, culture and heritage, and water systems. In addition, it provides opportunities for trans-boundary collaboration and partnership in maintaining the integrity of natural resources and indigenous cultures. The SHL extends from Langtang National Park in central Nepal through the Kanchenjunga region in India, and then on to Toorsa Strict Nature Reserve in western Bhutan. The northern boundary of the landscape coincides with Nepal's international boundary with the Tibet Autonomous Region. The eastern boundary includes a chain of intact, temperate and subtropical habitats in which run through the Kanchenjunga complex in India, and then head southwards to Toorsa in Bhutan and to the eastern districts of Nepal. The north-western boundary in Nepal includes all of Langtang National Park. In terms of the topography, SHL has elevations ranging from 139m in India to 8,848m in Nepal (Mount Everest, the highest point on earth). The landscape features two globally important contiguous ecoregions - Eastern Himalayan Alpine Scrub and Meadows/Eastern Himalayan Broadleaf and Conifer Forests. These regions harbor a great deal of important flora including oaks (*Castanopsis* and *Quercus*), rhododendrons and Himalayan larch (*Larix griffithiana*). They are also home to globally threatened fauna, such as the charismatic snow leopard (*Uncia uncia*), the takin (*Budorcas taxicolor*), the musk deer (*Moschus chrysogaster*), the red panda (*Ailurus fulgens*), and several pheasants. The landscape hosts a significant variety of endemic plants and animals, including many wild relatives of commercial species, and important demonstration species (both crop varieties and livestock species). The landscape is also home to a diverse array of ethnic groups and human cultures; this helps in the conservation of diversity. More than 40 languages are spoken throughout the landscape, by communities with their own cultural traditions and land management practices. A belief in Buddhism or Hinduism, or various blends of both religions cuts across these groups. Local beliefs that there are 'hidden lands' (*beyuls*), and 'hidden treasures' (*ters*) are often linked to the practice of maintaining conservation areas for both human well being and to preserve nature. Many of the mountains in the Himalayan range including Sagarmatha (Mount Everest), Kanchenjunga, and Jumolhari are also held sacred by both the indigenous people living in their environs and many others across South Asia. The landscape supports ecological services critical for maintaining biodiversity and human lives and livelihoods. Snow caps, glaciers and water towers and the rivers that cascade down the Himalayan slopes, are essential to the lives and livelihoods of thousands of people who live within the landscape, and millions beyond its borders.

### Threats to Tropical Forests and Biodiversity

The degradation of large tracts of agricultural, forest and pasture land in the hills and mountains of the SHL seems to have increased considerably over the last 2-3 decades. The predominantly agro-pastoralist livelihood in the mountains of the SHL, which includes slash and burn or shifting cultivation practices, is associated with this land degradation and loss of biodiversity. Croplands are characterized by increasing soil erosion, landslides, slope failure, declining fertility and reduced crop intensity. About 30% of the total land in Nepal that is classified as pasture is situated in the SHL region (Acharya 2003) and provides a source of forage for a large number of livestock in high altitude areas. Some of the grazing lands are in such poor condition (e.g. Sailung in Ramechhap) that they look almost like wasteland. There have been significant changes in the forest areas of the SHL in recent years, especially at high altitudes. Forest land is not often converted for cultivation, as in the Mid-hills, but the change from forest cover to shrubland and grassland is conspicuous.

Among the prominent wetlands located in the SHL area are Gosainkund, Gokyo Lake (Dudh Pokhari), Panch Pokhari, Salpha Pokhari, Mai Pokhari and Shinjema Tal. These wetlands provide a critical habitat for a number of rare and endemic species of flora and fauna. They are also important breeding and resting sites for trans-Himalayan migratory birds. The wetlands also serve as headwaters for major local and regional river basins and are excellent indicators for climate change. Those wetlands which fall outside protected areas (e.g. Mai Pokhari) are conservation hotspots.

Vulnerability, hazard and risk are omnipresent in the SHL. Mountains areas are prone to natural disasters due to unstable geology and extreme climate. Landslides are the most common natural disasters in this region, caused by intense seasonal precipitation during monsoon. Landslides are associated with soil erosion, mass wasting, debris flows, the depositing of sediment, and flash floods. The higher elevations in the SHL are vulnerable to avalanches and glacial lake outburst floods (GLOFs). This landscape is also prone to earthquakes. Climate change is emerging as a major threat to the biodiversity of the SHL and is likely to exacerbate the impact of other threats. A recent model scenario (Nelleman *et. al*/2005) indicates that climate change has the potential to reduce the abundance of wildlife by between 20-40% in mountain areas by 2030.

### Opportunities in the SHL

**PES:** Sven Wunder (2005) states that PES schemes exist to provide four main services: (i) **carbon sink functions:** e.g. an electricity company paying farmers in the tropics for planting and maintaining trees, (ii) **hydrological functions:** e.g. downstream water users paying upstream farmers for adopting land use practices that limit deforestation, soil erosion and the risk of flooding, (iii) **biodiversity:** e.g. donors paying local people to set aside or

naturally restore areas of land to create a biological corridor, and (iv) **landscape aesthetics/ecotourism**: e.g. tourism operations paying a local community not to hunt in a forest being used by tourists to view wildlife. Some biodiversity/landscape aesthetics schemes are already up and running and there are opportunities for more PES schemes of all four types in the SHL.

**Control slash and burn cultivation to conserve biodiversity**: The potential exists for converting slash and burn cultivation areas into permanent farms by planting multipurpose/forage species and conserving plant biodiversity. Leasehold forestry programs in the Mid-hills have already developed technology and processes for this which can also improve the productivity/income generation capacity of land on steep slopes.

**Conserve biodiversity hotspots outside protected areas**: Hotspots are areas which have valuable biodiversity but are threatened by human activities. They are mostly found outside protected areas (e.g. Mai Pokhari).

**White water rafting**: The rivers of the Saptakoshi are renowned for their white water rafting and are popular with adventure tourists. The rafting business has great potential in the SHL.

**In-situ and ex-situ conservation of NTFPs/MAPs**: The high mountains of the east provide natural stocks of many non-timber forest products (NTFP) and medicinal and aromatic plants (MAP) including nettle fiber (*Girardinia zeylanica*), rudraksha (*Elaeocarpus sphaericus*), chiraito (*Swertia chirayita*), and broom grass. These species present opportunities for *in-situ* and *ex-situ* conservation.

**Conservation of high mountain rangelands/pasture lands**: The SHL has many high mountain rangelands/pasture lands which are largely unmanaged. There are therefore many opportunities for the conservation/management of these areas.

**Tropicality**: There are many tropical species found along river corridors in the high Himalayan region which are in need of conservation (for example the Sal hill forests in Sankhuwasabha).

### Suggested interventions

**Mai Pokhari biodiversity conservation**: Mai Pokhari is a Ramsar site of international significance. It is currently conserved and managed by local groups and does not fall into a protected area. There are many opportunities for forest and biodiversity conservation at Mai Pokhari and at other sites that fall outside protected areas.

**Arun valley biodiversity conservation**: Arun valley is extremely rich in biodiversity and there is lots of scope for biodiversity conservation.

**Hydrological services**: The Saptakoshi rivers have the potential to produce large amounts of hydro-electricity and present opportunities for a number of PES schemes (e.g. watershed services).

**Role of USAID**: The Government of Nepal, with the technical support of WWF Nepal, has already prepared and approved the Sacred Himalaya Landscape Strategy and is in the process of preparing a detailed Action Plan. There is therefore no need for USAID to invest in the SHL program.

## 3. Kali Gandaki River Corridor

### Introduction

The Kali Gandaki river corridor is situated between the Annapurna Conservation Area Project (ACAP) and the Chitwan National Park (CNP). The Kali Gandaki gorge is said to be the deepest gorge on the planet; running between the 8,000m+ peaks of Annapurna and Dhaulagiri, the river valley is up to 5000 meters deep while the river flows at an average of 3000 meters above sea level. The river however, is older than the mountains; as evidenced by the ammonite fossils known as "*Saligram*" found in the upper stretches of the corridor at elevations of above 4000m.

The Gandaki River (also, the Kali Gandaki and the Narayani in Nepal, and the Gandaki in India) is one of Nepal's major rivers and a left bank tributary of the Ganges in India. The headwaters of the river are formed at an altitude of 3,900m (12,795 ft) in the Mustang region of Nepal which borders Tibet. The two headwaters (Nup Chhu and Shar Chhu or West River and East River) meet near the town of Lo Manthang in upper Mustang. The river then flows southwest and is referred to as the Mustang Khola. In Kagbeni, a major tributary – the Kak Khola - coming from Muktinath in the North, meets the Mustang Khola; from this point on, the river is called the Kali Gandaki. South of the gorge, the river is joined by the Rahughat Khola at Galeshwor, the Myagdi Khola at Beni, the Modi Khola near Kushma and the Badigaad at Rudrabeni. The river then takes a right-angle turn and runs east along the northern edge of the Mahabharat Range. The largest hydroelectricity project in Nepal is located along this stretch of the river.

Turning south again and breaking through the Mahabharats, the Kali Gandaki is then joined by another major tributary, the Trishuli, at Devighat and then by the (East) Rapti where it drains into Chitwan in the Inner Terai. The river then crosses the outermost foothills of the Himalayas – the Siwalik Hills – and continues to the plains of the Terai and is known as the Gandaki. It also flows southwest at Devighat; this stretch is known as the Narayani or the Sapt Gandaki, which later curves back towards the southeast as it enters India. The river system has a total catchment area of 46,300km<sup>2</sup>, most of which is in Nepal and is located between the Koshi system to the east and the Karnali system to the west. Major towns and cities along the banks of the Kali Gandaki are Lo Manthang, Jomsom, Beni, Baglung, Kusma, Ridi, Devighat, Narayangarh, Valmikinagar and Triveni.

The ridge of hills and mountains on both sides of the Kali Gandaki River forms the boundary of the river corridor between ACAP in the north and CNP in the south. The total land area of the corridor is 245,567.6 hectares, of which, 46% is used for agriculture, 41.5% is forest and 6.3% is shrubland. Rivers, streams and sand banks cover 2.3% of the area, while 3% is grassland.

#### Land use in the Kali Gandaki Corridor between CNP & ACAP

Land-use	Total area in hectares	Percent
Barren land	313.8	0.1
Built up areas	10.7	Less than 0.1
Cultivation	114,292.7	46.1
Embankment/cliff cutting	533.7	0.2
Forest	102,860.4	41.5
Grassland	7,349.7	3.0
Nursery	1.9	Less than 0.1
Pond/lake	3.9	Less than 0.1
River/stream	2,851.9	1.2
Sand	2,749.0	1.1
Scattered trees	29.6	Less than 0.1
Scrubland	15,557.3	6.3
Orchards & other	13.0	Less than 0.1
<b>Total</b>	<b>246567.6</b>	<b>100</b>

Source: Land-use Map, 1996

The table below shows an analysis of the different forests types found in the Kali Gandaki River corridor between ACAP and CNP.

Forest Types	Forest area in Hectares	Percent
Chir Pine Forest	1,143.2	1.1
Chir Pine-Broad Leaved Forest	2,681.3	2.6
Hill Sal Forest	53,523.9	52.0
Lower Temperate Oak Forest	4,655.9	4.5
Schima-Castanopsis Forest	36,249.8	35.2
Temperate Mountain Oak Forest	2,56.0	0.2
Lower Tropical Sal and Mixed Broad Leave	2,967.2	2.9
East Himalayan Oak-Laurel Forest	1,383.0	1.3
<b>Total</b>	<b>102,860.3</b>	<b>100</b>

Source: Land-use Map, 1996

#### Significance of the corridor in terms of tropical forests and biodiversity

The Kali Gandaki valley (KGV) is of special interest with regard to species diversity as it serves as a boundary or borderline for many types of flora and fauna. An analysis of 67 species of *Primula* showed that 16 species do not cross the KGV from east to west (for example *P. bellidifolia*, *P. gambeliana*, and *P. prenantha*). Similarly, the eastward distribution of eight of the West Himalayan *Primula* species stops here; these include *P. Radii* (from Kashmir, India), *P. Sessile* (from Kumar, India) and *P. Sharma*. Of the 15 species of Himalayan poppy (*Meconopsis*), 13 occur in the KGV, with nine of them not extending further west. Nepal has 30 species of *Rhododendron*, of which, only eight species reach as far as the KGV and only four extend beyond to the eastern Himalayas. Most West Himalayan coniferous species do not cross the KGV; examples of these include *Abies pindrows*, *Cedrus deodara*, *Cupressus torulosa*,

and *Picea smithiana*. The horse chestnut (*Aesculus indica*) of the western Himalaya does not extend beyond the KGV and nor do the mid-hill forests of *Schima-Castanopsis* (Chilaune-Katus) in eastern Nepal; the latter being largely replaced by Chirpine (*Pinus roxburghii*) forest; the Chirpine in the eastern Himalayas are secondary in nature. Similarly, eastern Himalayan oak-laurel forest is wide spread in eastern Nepal but comes to a halt in the KGV. The valuable Champ species (*Michaelia champaca*) is found in the watershed areas of the KGV which lie in Syangja, Parbat, Baglung, and Myagdi districts. Similarly, *Daphne papyracea* (the handmade paper plant) is mainly found in the KGV watershed areas of Parbat district where it is processed into handmade paper for commercial sale.

East Himalayan pheasants (e.g. blood pheasant and snow cock) are not found to the west of the KGV. Similarly, the west Himalayan Chyakhura is found only east of the KGV. The valley is one of the most important migratory routes to the southern parts of the sub-continent for central Asiatic birds such as the Demoiselle Crane (Kryang-Kurung) and the Bar-Headed Goose.

In terms of climate, the force of the monsoon rains on the southern reaches of the Himalaya remains strong as far as KGV, but then weakens dramatically to the west. The trans-Himalayan region towards north experiences extremely heavy rainfall; Lumle (Kaski) for example receives 4000mm of rainfall per year while Jomsom (Mustang) receives less than 100mm. The Upper Kali Gandaki valley also experiences high velocity winds, especially in the Mustang valley.

**Protected Areas:** The western part of ACAP lies in the KGV in Mustang and Myagdi districts. Chitwan National Park in Nepal and Valmiki National Park in India are adjacent to each other in the Valmikinagar area around the Gandak Barrage.

### **Threats to Tropical Forests and Biodiversity in the corridor**

The use of slash and burn cultivation on steep slopes, particularly in government managed forests, is the main threat to biodiversity and forest conservation in the corridor. These slopes are often located far away from the District Forest Office which means that forestry personnel do not have easy access; a lack of monitoring mechanisms compounds the problem. Another issue is the heavy migration of the male population from villages to towns/abroad in search of better job opportunities. Local women are unable to attend to failed terraces without the physical assistance of the men folk.

The Kali Gandaki forms the western border of Chitwan National Park. Along the stretch in Nepal, the river carries heavy amounts of glacial silt, giving it a black color. The river is a popular whitewater adventure destination.

The Gandaki river basin is reported to contain 1,025 glaciers and 338 lakes. These contribute substantially to the dry season flows of the river. Glacial lakes, among the most hazardous features of high mountains, are usually formed behind dams of moraine debris left behind by retreating glaciers, a trend that can be seen all over the world. Even though glacial lake outburst flood events have been occurring in Nepal for many decades, the Dig Tsho glacier outburst, which took place in 1985, triggered detailed study of this phenomenon.

### **Opportunity in the corridor**

**Unexplored area of biodiversity:** The Kali Gandaki river corridor is a unique area that contains both eastern and western floral species. A detailed study may unveil many of the undiscovered characteristics of this flora. This is a good opportunity for botanists, foresters, climatologists and other experts to work in a largely unexplored area.

**Hydropower Development:** The water wealth of Nepal is as precious as the oil wealth of the Middle East. The Sapta Gandaki alone has a hydropower potential of 20,650 MW (economically exploitable potential of 5,270 MW) out of a total estimated countrywide potential of 83,290 MW (economically exploitable potential of 42,140 MW). The country has so far been able to generate only around 600 MW of hydropower out of which the Gandaki basin projects contribute more than 44% or 266 MW. There are hydropower projects in Trishuli at Nuwakot (21 MW), Devighat at Nuwakot (14 MW), Nawalparasi (financed by the Indian government - 15 MW), Marsyangdi at Tanahu (69 MW), Kali Gandaki at Syangja (144 MW) and Syangja (2 MW). The Middle Marsyangdi Hydro Electric Project (70 MW) at Lamjung is in the final stages of construction. Several major projects are likely to be implemented in the near future. With the government of Nepal now according priority to private-sector participation in the sector, the pace of hydropower development will accelerate. The Kali Gandaki "A" Hydro Electric project is the largest hydropower project in Nepal. It generates 144 MW from three Francis turbines. A hydroelectric generating station with an installed capacity of 15 MW (3x5 MW) has also been constructed and on the Eastern Gandaki Canal.

**White water rafting:** The Kali Gandaki hurtles down between the Dhaulagiri and Annapurna ranges, creating one of the world's deepest river canyons. Rafting on this majestic river gives the adventure tourist the opportunity to

experience great white water rapids and extraordinary scenic beauty. Sailing past remote hamlets set in gorgeous, tranquil surroundings is a remarkable experience. Abundant wildlife on the banks of the river and impressive waterfalls add to the charm. The Kali Gandaki rapids require a high degree of technical skill to navigate successfully but can be appreciated by both novice and experienced rafters. Superb views of the Annapurna and Dhaulagiri ranges are clearly visible from the river. A proposed hydro electric dam along the rafting route is, however, a major threat to the rafting business. The Kali Gandaki is also one of the holiest rivers in Nepal.

### Suggested interventions

Out of a total of 102, 860 hectares of forest, 21,674 hectares (21%) is managed under the community forestry system. The remaining 81,186 hectares, (79%) which fall outside protected areas, are administered under nine District Forest Offices as common property resources. On the steep slopes of the foothills, such common property resources are frequently encroached and slash-and-burn cultivation practices employed. This poses a major threat to both biodiversity and tropical forests in terms of deforestation and degradation. Simply handing over community forests to forest user groups is not the solution; the forests need to be scientifically managed. The river-corridor approach will focus on conservation and the scientific management of community forests. Those forest areas which are not currently managed will be brought under the community forestry system.

### Community Forests in KGV River Corridor

District	No. of Community Forests	Area in hectares
Baglung	114	2,400.19
Gulmi	8	217.1
Myagdi	42	2,427.8
Nawalparasi	6	591.8
Palpa	141	4,978.85
Parbat	201	4,986.8
Syangja	94	2,652.6
Tanahu	44	3,418.9
Chitwan	0	0
<b>Total</b>	650	21,674.04

Source: CFD, MIS, 2007

The river corridor approach will also focus on PES. There are two main services which can be provided in the corridor outside protected areas. The first is the conservation of critical upstream sub-watersheds in the Kali Gandaki hydro-electricity dam areas which will reduce siltation. In close coordination with the Kali Gandaki Hydro Electric Project, District Soil Conservation Offices, District Forest Offices and the Federation of Community Forestry User Groups, effective forest conservation & management is possible in the critical upstream watersheds. For this purpose, part of the revenue generated from the Kali Gandaki hydro-electric projects should be used for conservation and community development. The second service is white water rafting in the Kali Gandaki River. In close coordination with the Water Rafting Association, community forest user groups, and local communities, basic infrastructure should be installed along the riverside to draw in more adventure tourists. Part of the revenue generated from white water rafting can be used for community and infrastructure development.

The use of such a river corridor system will increase the representation of mid-hill ecosystems in conservation and management initiatives. It will also generate employment/income for the indigenous people who are dependent on river and forest resources for their lives and livelihoods.

To sum up, the river corridor approach will make a substantial contribution to the conservation and management of natural resources along the watersheds and sub-watersheds of the river. It will significantly reduce siltation, making the water cleaner. It will also contribute to the conservation of aquatic, marsh-land and terrestrial biodiversity along the river corridor.

**Role of USAID:** Outside the protected areas, the Kali Gandaki river valley and corridor has many unique characteristics and a wide range of floral and avian species, making it a prime candidate for biodiversity conservation. Biodiversity conservation efforts in this unexplored area will help to increase representation of mid-

hill ecosystems in national conservation efforts. A detailed study will disclose the many secrets of the corridor's wetland ecosystems. No such study has been undertaken in past, apart from some work carried out for the Kali Gandaki hydro-electricity project. We strongly recommend that USAID make a detailed plan and program for the conservation and management of river corridor ecosystems. In the light of the current climate change scenario, this project will provide a baseline for the future study of eastern and western floral species found at different altitudes.

## 4. Koshi River Corridor

### Introduction

The Koshi River traverses the borders of Nepal and India and is one of the largest tributaries of the Ganges. The river, along with its tributaries, drains a total area of 69,300 km<sup>2</sup> up to its confluence with the Ganges in India (29,400 km<sup>2</sup> in China, 30,700 km<sup>2</sup> in Nepal and 9,200 km<sup>2</sup> in India). The watershed also includes part of Tibet (the Mount Everest region) and the eastern third of Nepal. The river basin is surrounded by ridges which separate it from the Brahmaputra in the north, the Gandaki in the west, the Mahananda in the east, and the Ganges in the south. Over the last 250 years, the Koshi River has shifted its course by over 120 kilometers from east to west. The unstable nature of the river can be attributed to the heavy silt which it carries during the monsoon season.

In Nepal, the Koshi lies to the west of Kanchenjunga. It has seven major tributaries: the Sun Koshi, the Tama Koshi, the Dudh Koshi, the Indravati, the Likhu, the Arun, and the Tamur. The Dudh Koshi joins the Sun Koshi at the Nepalese village of Harkapur. At Triveni, the Sun Koshi is joined by the Arun and the Tamur, after which, the river is called the Sapta Koshi. At Barahchhetra in Nepal, it descends from the mountains and it is then called simply the Koshi. These tributaries encircle Mt Everest from all sides and are fed by the world's highest glaciers. Further down the Triveni, the river cuts a deep gorge across the lesser Himalayan range of Mahabharat Lekh for a length of 10 km and then descends into the plains near Chatara. After flowing for another 58 km, it enters the northern Bihari plains near Bhimnagar, and after another 260 km, flows into the Ganges near Kursela. The river travels a distance of 729 km (453 miles) from its source to its confluence with the Ganges.

### Significance of the river corridor in terms of tropical forests and biodiversity

There are two famous protected areas in the Koshi river basin: the Sagarmatha National Park, located in eastern Nepal, which houses part of the Himalayan range including the southern half of Mount Everest; and the Koshi Tappu Wildlife Reserve, situated on the flood plains of the Sapta-Koshi River in Eastern Nepal.

### Threats to tropical forests and biodiversity in the river corridor

The use of slash and burn or shifting cultivation (*keboriya*) practices in the mountainous part of the river corridor has caused land degradation and the subsequent loss of biodiversity. Croplands are characterized by increasing soil erosion, landslides, slope failure, declining fertility and reduced cropping intensity. Grazing lands are also in poor condition. There have been significant changes in forest areas and forest conditions in recent years, especially at high altitudes. Forest land is not often converted for cultivation, as in the middle mountains, but the change of forest cover to shrubland and grassland is conspicuous.

The river corridor wetlands provide a critical habitat for a number of rare and endemic species of flora and fauna. They are important sites for breeding and resting for trans-Himalayan migratory birds. The Sapta Koshi river wetlands also serve as headwaters for major local and regional river basins as well as providing excellent indicators for climate change through the melting of their glacial sources.

The mountainous areas of the Saptakoshi Rivers are prone to natural disaster due to their unstable geology and extreme climate. Landslides are the most common form of natural disaster in this region and are caused by intense seasonal precipitation during monsoon. Landslides are associated with soil erosion, mass wasting, debris flows, sediment deposition and flash floods. At present, in the Himalayan region, glaciers are melting and retreating resulting in the formation of lakes which are insecurely dammed by ice or moraines. If any of these dams were to fail, they could trigger a GLOF with flows as great as 10,000 cubic meters a second. Such floods are likely to destroy communication systems and infrastructure such as bridges, roads, hydropower projects, trails, villages, fields and terraces and irrigation canals. They could also cost hundreds or even thousands of lives. GLOFs also transport huge amounts of sediment. In the past two decades GLOF has become a topic of intense discussion within the development community in Nepal. Studies of glaciers and glacial lakes were carried out in 1988 by a joint Sino-Nepalese team. In the Tibetan section of the Arun-Koshi river basin, there are 737 and 229 glacial lakes, of which, 24 are potentially dangerous. Similarly, there are 45 glacial lakes in the Sun-Koshi basin, 10 of which are potentially dangerous. The Dig Tsho GLOF on 4 August 1985 completely destroyed the nearly completed Namche hydropower plant, in addition to the bridges, trails, fields, houses and livestock which blocked its path, up to the confluence of the Dudh-Koshi and the Sun-Koshi rivers - a distance of 90 km (56 miles). This event brought into focus the seriousness of such events and studies to assess glaciers, glacial lakes and GLOF followed. According to a Sino-Nepalese study, since the 1940s, there have been at least 10 cases of GLOF within the river basins investigated. Five of these occurred in the three glacial lakes of the Arun River Basin, and four in the three glacial lakes of the Sun Koshi River Basin.

## **Opportunity in the river corridor**

Nepal has a total estimated hydropower potential of 83,290 MW out of which 42,140 MW is economically exploitable. The Koshi river basin contributes 22,350 MW of this potential (360 MW from small schemes and 1875 MW from major schemes) with the economically exploitable potential assessed as 10,860 MW (including the 3300 MW Sapta Koshi Multipurpose Project).

White water rafting is the third most popular adventure sport in Nepal after mountaineering and trekking. The Sun Koshi River offers the longest river trip in Nepal, traversing 270 km (170 miles) and meandering its way through the picturesque Mahabharata mountain range. A rafting trip on the Sun Koshi is listed as one of the world's top ten classic river journeys. The sport is also popular on the Bhote Koshi.

The Koshi and other rivers draining the Himalayas have populations of Mahaseer which are esteemed as game fish and known as the Indian Salmon. Mahaseer can weigh up to 50 kg and are said to put up a greater battle than any other type of fish of equivalent weight.

There are many tropical plant and tree species which are found in the high Himalayan region along its river corridors. Subtropical Sal forests can be found in Sankhuwasabha and in other hilly districts. There are opportunities to conserve such species in the Mid-hills.

## **Suggested interventions**

**Arun valley biodiversity conservation:** The Arun valley is extremely rich in biodiversity providing much scope for conservation.

**Hydrological services:** The Saptakoshi Rivers have great potential for hydro-electricity production and PES schemes for hydrological or watershed services.

## **5. Karnali River Corridor**

### **Introduction**

The Karnali river is a perennial, torrential, turbulent and relatively undisturbed Himalayan river which is the third of Nepal's four major rivers (the other three being the Gandaki (or Narayani), the Mahakali and the (Sapta) Koshi). It originates in Lake Mansarovar and is joined by many snow-fed rivers such as the Mugu Karnali and the Humla Karnali in the Himalayan belt. The Karnali basin lies between the mountain ranges of Dhaulagiri and Nanda Devi in the western part of Nepal. In the north, it lies in the rain shadow area of the Himalayas. The Karnali River basin has 1,361 glaciers and 907 lakes, with the glaciers covering an area of 1,740.22 km<sup>2</sup> and an estimated ice reserve of 127.72 km<sup>3</sup>.

At 507km, the Karnali is the longest river in Nepal, and has formed several gorges with its swift currents. The 202km long Seti River, its feeder stream, drains the western part of the catchment, and joins the Karnali at Doti, north of Dunderas Hill. Another feeder stream, the 264km long Bheri River, drains the eastern part of the catchment and meets the Karnali River near Kuineghat in Surkhet. The Karnali enters a spectacular gorge near Chisapani which contains diverse varieties of trans-Himalayan and sub-Himalayan fish. The bottom of the Karnali River is mostly boulder-strewn in its upper reaches and sandy in its lower reaches; the water is generally clean except in the rainy season. Its depth ranges from 3-10 m except for in deep gorges where it varies from 50 m-100 m. The Karnali fans out and divides into two main channels downstream from Chisapani: the Geruwa to the left and the Kauralia to the right.

### **Significance of the corridor in terms of tropical forests and biodiversity**

14% of the total area of the Karnali basin is protected. A total of 4 national parks, one wildlife reserve and Nepal's only hunting reserve are found in the area: Shrey Phoksundo National Park in Dolpa, and Rara National Park in Mugu/Jumla are located in Himalayan region; Khaptad National Park and Dhorpatan Hunting Reserve are located in the high hills, while Bardia National Park and Suklaphanta Wildlife Reserve can be found in the Terai. The corridor therefore covers protected areas in all three ecoregions and houses a huge diversity of floral and faunal species. The basin and its influence area alone constitute 27% of the country's total protected areas: 63% of total national park areas, 25% of buffer zone areas, 100% of hunting reserve areas and 31% of wildlife reserve areas. The whole Karnali zone, located in the rain shadow of the Himalayas, is a rich natural store of high value NTFPs and MAPS. Its meadows, valleys, rangelands and pasture lands are rich in biodiversity.

### **Threats to tropical forests and biodiversity in the river corridor**

Despite its richness in terms of biodiversity/high value MAPs/NTFPs the Karnali River corridor is a permanent food deficit zone. Acute poverty is rampant, and the area has one of the lowest development indexes in the country. Remoteness, lack of access, poor transportation, and poor communication infrastructure are the main barriers to development. High value MAPs/NTFPs are the main exportable goods. Slash and burn cultivation is very common, even on steep slopes and mountain tops; this has threatened the biodiversity of valuable floral and faunal species. Over-exploitation of high value NTFPs/MAPs species without conservation and management has also threatened many such species. Remoteness and inaccessibility have made easy the illegal poaching of wildlife such as the musk deer. For the past few years, hundreds of people from other districts have been traveling to high mountain rangeland/pasture lands to collect the highly valuable Yarsagumba.

Two species of crocodiles swim in the Karnali, Geruwa, and Babai Rivers - the blunt-snouted Marsh Mugger and the fish-eating Gharial, with its long thin snout. These creatures share the river with the fresh-water Gangetic Dolphin. The Karnali is also home to the Great Mahaseer fish, which weighs up to 90lb (41 kg) - an angler's prize catch. The Karnali River provides the upper ranges for the Gangetic river dolphin (*Platanista gangetica*), the largest freshwater mammal on the Indian subcontinent. River dolphins are considered a vulnerable species under CITES Appendix 1 and are classified as endangered on the IUCN Red list (IUCN, 2004). River dolphins are legally protected in Nepal and classified as endangered mammals under Schedule I of the protected list of the National Parks and Wildlife Conservation Act, 1973. Living at the upstream range limit, the dolphins in the Karnali River are particularly vulnerable to threats from habitat degradation. They are often found in places where human activity is at its most intense, and are sometimes accidentally caught by local people in the lower stretches of the basin. The river supports the last potentially viable population of these dolphins in Nepal. The dolphins here are at their farthest upstream range, and have become isolated by the Girijapur Barrage (a low gated dam), located about 16km downstream of the Nepal/India border. A high dam has been planned for some time, just upstream of the dolphins' current (or at least recent) range. If built, this structure would almost certainly eliminate the small amount of dolphin habitat in the last of Nepal's rivers with a potentially viable dolphin population. Disturbance and environmental degradation, and bridge and road construction for the dam, already may have contributed to a decline in the number and range of dolphins above the Nepal-India border.

### **Opportunity in the river corridor**

**High value MAPs/NTFPs:** The collection, sale and export of high value NTFPs/MAPs are the top priority for generating additional sources of income and livelihood for the people living in the Karnali corridor. There is immense scope for the *in-situ* and *ex-situ* conservation/management/commercial cultivation of high value NTFPs/MAPs for biodiversity conservation.

**Dolphin Conservation:** Dolphin conservation is another opportunity.

**Hydro-electricity dams and watershed conservation:** The Karnali has the highest potential in Nepal for generating hydro-electricity. In view of this, watershed conservation and forest/biodiversity conservation and management are other options in the corridor.

**White water rafting:** The Karnali offers white water thrills over a 180km stretch. It is rated at grade 4 to 5 in terms of difficulty (suitable for expert rafters).

### **Suggested interventions**

**High value MAPs/NTFPs:** The *in-situ* and *ex-situ* conservation/management/commercial cultivation of high value NTFPs/MAPs in the river corridor for biodiversity conservation.