

Hariyo Ban Program

CHITWAN-ANNAPURNA LANDSCAPE DRIVERS OF DEFORESTATION AND FOREST DEGRADATION



Hariyo Ban Program

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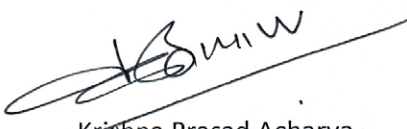
FOREWORD

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

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

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

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


Krishna Prasad Acharya
Joint Secretary



Foreword

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

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

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

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

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



Anil Manandhar
Country Representative
WWF Nepal

Preface

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

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

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

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



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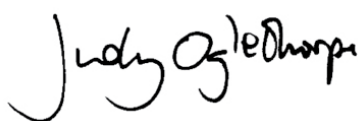
Several organizations and individuals made significant contributions to the study. This work would not have been possible without the support of the Government of Nepal. We would like to thank senior officials in the Ministry of Forest and Soil Conservation (MoFSC) and its various departments for their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

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

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

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Judy Oglethorpe
Chief of Party
Hariyo Ban Program

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Acronyms and Abbreviations

ACA	Annapurna Conservation Area
ANSAB	Asian Network for Sustainable Agriculture and Bioresources
AVI	Advanced Vegetation Index
BI	Bare Soil Index
BZCF	Buffer Zone Community Forest
CARE	Cooperation for Assistance and Relief Everywhere
CFUG	Community Forest User Group
CHAL	Chitwan-Annapurna Landscape
DDC	District Development Committee
DFO	District Forest Office/Officer
DoF	Department of Forests
DFRS	Department of Forest Research and Survey
EIA	Environmental Impact Assessment
ERDAS	Earth Resources Data Analysis System
FCD	Forest Canopy Density
FECOFUN	Federation of Community Forestry Users, Nepal
FRISP	Forest Research Information System Project
GIS	Geographic Information System
IAS	Invasive Alien Species
ICIMOD	International Centre for Integrated Mountain Development
IEE	Initial Environmental Examination
IFAD	International Fund for Agricultural Development
INGO	International Non-governmental Organization
IUCN	International Union for Conservation of Nature
LPG	Liquefied Petroleum Gas
LRMP	Land Resources Mapping Project
MoFSC	Ministry of Forests and Soil Conservation
MoHP	Ministry of Health and Population
MRV	Measurement, Reporting and Verification
MSFP	Multi Stakeholder Forestry Program
NDVI	Normalized Difference Vegetation Index
NEFEJ	Nepal Forum of Environmental Journalists
NFA	Nepal Foresters' Association
NFI	National Forest Inventory
NGO	Non-governmental Organization
NORAD	Norwegian Agency for Development Cooperation
NPC	National Planning Commission
NTFP	Non-Timber Forest Product
NTNC	National Trust for Nature Conservation
PA	Protected Area
PES	Payment for Ecosystem Services
REDD	Reducing Emissions from Deforestation and Forest Degradation
SALT	Sloping Agricultural Land Technology
SI	Shadow Index
TCN	Timber Corporation of Nepal
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
VDC	Village Development Committee
WECS	Water and Energy Commission Secretariat
WRFD	Western Regional Forest Directorate

Executive Summary

Deforestation and forest degradation are two important dimensions of environmental change that are directly related to global warming and pose threats to biodiversity and livelihoods of forest-dependent local communities. Deforestation refers to complete loss of forest cover. Forest degradation relates to loss of biomass (carbon) and reduction in the capacity of forests to produce ecosystem services. Understanding human-induced causes of deforestation and forest degradation in different social, economic and ecological contexts is one of the key and contentious questions in environmental change research.

In Nepal, there have been several studies aimed at explaining the causative pattern of forest cover changes in different pocket areas during the last two decades. There is, however, a dearth of studies that analyzed the drivers of deforestation and forest degradation in larger geographical spaces. In this context, this study explored and analyzed drivers of deforestation and forest degradation in the Chitwan-Annapurna Landscape, using an integrated analysis and synthesis of available secondary data and information, stakeholder consultations, spatial analyses of remote sensing and Geographic Information System (GIS) data, and limited field visits. The objective was to provide a basis for the USAID-funded Hariyo Ban Program to develop a strategy for addressing these problems in the landscape.

An analysis of changes in major land use/land cover in the landscape for the period 1990-2010 showed that the area under forest remained more or less constant during the period; area under grasslands substantially decreased and agriculture area slightly increased. The finding that forest area remained largely unchanged during the period does not, however, mean that there was no forest

dynamism in the landscape. In some areas of the Siwaliks, for example, there has been substantial loss of forest area to infrastructure development, resettlement, urban expansion, and agriculture expansion. Similarly, unregulated construction of rural roads has caused forest loss in the midhills. These losses might have been compensated by forest gains in some places, particularly within protected areas.

Further analysis of changes in forest area within different physiographic zones revealed that forest area continuously increased in the Siwaliks and high mountain zones during 1990-2010, whereas it continuously decreased in the midhills during the same period. The findings support the speculation that unregulated construction of rural roads has caused widespread forest loss in the midhills, but contradict the general perception that the community forestry program has contributed towards controlling or reversing deforestation and forest degradation trends in the region. Increase in forest cover in the Siwaliks and high mountains might be due to forest gains inside protected areas.

An analysis of trends in forest canopy condition shows a general improvement in canopy cover during the last three decades. This is evidenced by a decrease in degraded and open forest areas and an increase in moderately dense and dense forests in between 1990 and 2010. There was not a substantial difference in the trend among the four physiographic zones.

The above findings, which are based on analysis of Landsat satellite images, provide only a rough general idea of the changes in forests, and therefore, should be treated accordingly. For more accurate classification of land use/land cover and

EXECUTIVE SUMMARY

analysis of trends of changes in forest area and condition, high resolution satellite images (such as WorldView-2 or Rapid Eye) with sufficient ground truth data should be used.

The findings indicate that over, and unsustainable, harvesting of wood and non-wood forest products and encroachment of forestlands for agricultural expansion, infrastructure development, resettlement and urban expansion are the major drivers of deforestation and forest degradation in the Siwaliks. Excessive harvesting of forest products comprises felling of trees and saplings (mostly illegally) for timber and poles, firewood collection for domestic use and sale, and repeated and unsustainable harvesting of non-wood forest products, which is common in the Siwaliks zone (including the lowlands of Chitwan and Nawalparasi Districts). Agricultural expansion can be further categorized into permanent conversion of forestland to farmland, and shifting cultivation that is widespread in the hilly parts of the Siwaliks. Unplanned and unregulated opening of road tracks by local Village Development Committees is found to be the major driver of deforestation and forest degradation in the midhills. Forest fire and invasion by alien plant species are other important drivers of forest loss and degradation in the Siwaliks and midhills; overgrazing is a driver in the Siwaliks and high mountains, and stone mining and landslides are other drivers in the mountainous regions.

The direct or proximate drivers of deforestation and forest degradation are the results of several underlying causes that range from high forest dependency; widespread poverty and very limited livelihood alternatives; weak law enforcement and overall poor forestry sector governance; lack of scientific forest management; financial and human resource constraints in district forest offices; to poor coordination among different government and non-government agencies. The drive to economic development, along with weak enforcement and inter-agency coordination, has led to haphazard construction of infrastructure inside forestlands. Excessive political interference has further weakened the law enforcement capacity of district forest offices. These factors, together with high reliance on agriculture and continuation of inherited modes of farming systems, have caused conversion of forests for agriculture. Political and institutional factors such as poor central planning, lack of political will, and conflicting sectoral policies, lack of alternative sources of energy

and ambiguous land and forest tenure are other underlying causes. Climate change could be a major contributor to deforestation and forest degradation in the future.

The government and its development partners are making several efforts to abate deforestation and forest degradation. Some of the noteworthy efforts include substantial expansion of protected areas during the last three decades; implementation of innovative community based forest management and conservation area management programs; establishment of protected forests; and awareness raising campaigns.

Although some successes have been achieved, several challenges and gaps remain, which are hampering the efforts towards effectively addressing the drivers of deforestation and forest degradation. Inadequate financial, human and technical capacities of district forest offices; absence of transparent reward and punishment systems; excessive political interference; lack of trust and cooperation among stakeholders; endemic corruption; ad-hoc decisions; poor participation of women and other socially disadvantaged groups in decision making; and inadequate knowledge about climate change impacts and adaptation are some such gaps and challenges that need to be addressed.

The report has suggested several strategies to address the drivers of deforestation and forest degradation in the landscape. These, among others, include reducing forest dependency through promotion of alternative energy; efficient forest product utilization technologies; promoting agroforestry and private forestry; addressing poverty and livelihood issues; improving law enforcement and overall forestry sector governance; promoting scientific forest management, and strengthening and expanding community based forest management where feasible. Other strategies include reclaiming and restoring encroached forestlands and controlling further encroachment; optimal and sustainable financing for forestry research and development; enhancing inter-agency coordination and cooperation; capacity enhancement of user groups and government forestry staff; investigating and mitigating the effects of climate change; implementing Payment for Ecosystem Services (PES) and Reducing Emissions from Deforestation and Forest Degradation (REDD)/REDD+, where feasible; controlling and

managing invasive alien plant species; designing and implementing effective forest fire control systems; controlling overgrazing, and introducing participatory land use evaluation and land use planning system.

One of the strategic actions that the Hariyo Ban Program can take in the near future includes promotion of non-conventional energy sources (such as biogas, solar energy, and small hydropower), which can help reduce dependency of households on forests for meeting their energy needs, control forest degradation, and mitigate climate change. Other candidate strategic actions that should be considered include: promotion of

local livelihoods as a driving force for conservation of community forests; replication of the successful leasehold forestry model to other areas in the landscape; introduction and promotion of scientific forest management; promotion of more efficient forest product utilization technologies (bio-briquette, improved stoves, etc); promotion of agroforestry and private forestry through technical support and incentive measures; implementation of PES and REDD+ where feasible; identification and restoration of deforested and degraded forest sites; and strengthening forestry and protected area management offices for enhanced law enforcement through possible financial and technical support.

Country Background

1.2 Overview of Evolution of Forest Policies and Governance

In Nepal, serious public concern on managing forest resources began in the beginning of the twentieth century. In the beginning, the major focus of the government was on both the exploitation of quality forests for export to India to earn revenue, and the conversion of forests to farmlands to widen the tax base. That period was followed by increased national control of forests, as evidenced by the nationalization of forests in 1957, formulation of stringent laws, and expansion of the forest bureaucracy. This approach to governance largely failed and there was widespread deforestation and forest degradation across the country during the 1960s through the 1980s (Gautam et al., 2004a).

The government initiated a community based approach to forest management in 1978 as a means to abate widespread deforestation and increase supply of basic forest products for subsistence needs. Since then, the community forestry program has continuously evolved under the aegis of supportive forest policies and legislations. Although the Forest Act of 1993 does not limit community forestry to any region, its success has been largely limited to the midhills. Since 1992, the government has also been implementing a pro-poor leasehold forestry program, which involves 40-year, rent-free leasing of small areas of degraded national forest land to small groups of local farmers living below the poverty line and with little or no private land resources. More recently, a new policy of collaborative forest management has been introduced in eight Terai districts with the objective of enhancing participation of distant forest users and local government bodies in forest management. Because of these developments, Nepal is considered as one of the leading countries in the world in terms of initiating

innovative forest policies and management approaches. The community forestry program, in particular, has been able to draw considerable attention of scholars, development agencies, and environmental activists during the last 15 years. Despite all these efforts, the centralized forest management system introduced after the nationalization of forests in 1957 still remains the dominant forest management system in the country, at least in terms of its spatial coverage.

Alongside the changes in policy, the process to expand forest bureaucracy and change the organizational structure of the Department of Forests continued. Significant among those were the changes of 1976, 1983, 1988, and 1993. The Department, which was established in 1942 with three regional and twelve Divisional Forest Offices under it, has now 74 District Forest Offices, 92 *Ilaka* (sub-district) Forest Offices and 698 Range Posts. Currently, over 6,000 employees are working in these different level offices, which is a threefold increase in staffing over the last five decades.

1.3 Trends in Forest Cover Change

The innovations of different forest management approaches and expansion of forestry administration have not been fully successful in halting or reversing the deforestation trends in the country. Available records show that the country's forest area decreased continuously since 1964. The forest area decreased from 45.5 percent in 1964 to 38.1 percent in 1978/79 and to 29 percent in 1994 (see Department of Forests (DoF), 1966; Land Resources Mapping Project (LRMP), 1986; Department of Forest Research and Survey (DFRS)/Forest Research Information System Project (FRISP), 1999). A comparison of the results of the two most comprehensive forest

COUNTRY BACKGROUND

Table 1.1: Changes in Forest and Shrub Cover of Nepal Over Time

Category	1978-1979 (LRMP)		1994 (NFI)		% Change, 1979-1994	
	Area (000 ha)	Percent	Area (000 ha)	Percent	Total	Annual
Forest	5,617	38.0	4,269	29.0	-24.0	-1.6
Shrub	690	4.7	1,560	10.6	+126.0	+8.4
Total	6,307	42.7	5,829	39.6	-7.6	-0.5

surveys ever conducted [i.e. LRMP and National Forest Inventory (NFI)] shows that the forest area in the country decreased by 24 percent over a period of 15 years (1979-1994), by an annual rate of 1.6 percent, and the area under shrub increased by 126 percent during the same period (Table 1.1).

According to a more recent estimate, the country's forest area decreased at an annual rate of 2.7 percent and shrubland increased at an annual rate of 12.7 percent during 1991-2001 (CBS, 2008). The Department of Forest Research and Survey (DFRS), with financial and technical support from the Finnish Government, is currently conducting a comprehensive survey of forest resources for the whole country, with mapping of forest resources by physiographic zones. The work is expected to be completed within the next two years.

There are regional variations in terms of changes in forest condition. For example, the forest area in the Terai decreased at annual rate of 1.3 percent during 1978/79-1990/91 (DoF, 2005). This trend of high rates of forest loss and degradation has continued in the Terai and Siwaliks since then. Forests in the midhills are, in general, better managed and in many places forest cover increased in recent years due mainly to the community

forestry program (see e.g. Virgo and Subba, 1994; Jackson et al., 1998; Gautam et al., 2002). Little information exists for the high mountains, except frequent news of cross-border smuggling of timber from some districts to the Tibet Autonomous Region (Ministry of Forests and Soil Conservation (MoFSC), 2010).

1.3 Drivers of Deforestation and Forest Degradation

In Nepal, drivers of deforestation and forest degradation are believed to be diverse, complex and interconnected. The REDD Readiness Program Proposal of the country has identified nine major drivers, including high dependency on forests and forest products, unsustainable harvesting practices, encroachment, forest fire, overgrazing, infrastructure development, resettlement, and invasive species (MoFSC, 2010). These drivers fall in two broad categories: (i) those related to government policies, legal framework and management plans (e.g. infrastructure development, resettlement), and (ii) spontaneous drivers, which are beyond the control of management. Some of the drivers are common while the others vary across the physiographic regions.

Objectives

2

The objective of this study was to provide participatory analytical assessment of the drivers of deforestation and forest degradation in the Chitwan-Annapurna Landscape, evaluate past initiatives undertaken to reverse deforestation and forest degradation trends in different

physiographic zones, and to recommend strategies and approaches for addressing those drivers. The findings are expected to provide a basis for developing strategy and implementation plans for controlling deforestation and forest degradation in the landscape.

3

Study Area

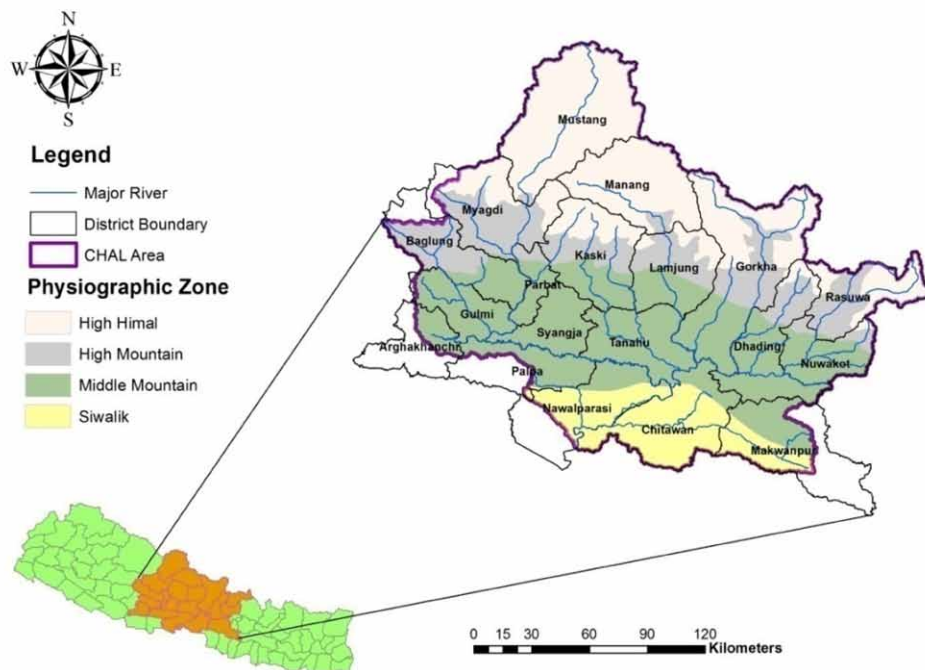
The Chitwan-Annapurna Landscape (CHAL) is located in central Nepal between 27°35' and 29°33' N latitude and 82°88' and 85°80' E longitude, covering an area of 32,057 square kilometers. The landscape includes all or part of 19 districts and is drained by six major perennial rivers, including Kali Gandaki, Seti, Marsyangdi, Budi Gandaki, Trishuli and Rapti and their tributaries of the broader Gandaki River System. Physiographically, the landscape can be divided into four major zones: the Siwaliks, midhills, high mountains, and high Himal (LRMP, 1986; Figure 3.1; Table 3.1). A few small patches of Terai/Inner Terai areas in the districts of Nawalparasi and Chitwan, which fall within the landscape, have been treated as part of the Siwaliks zone in this study.

The wide variation in climate, elevation and topography has contributed to occurrence of different forest types in the landscape that range from tropical mixed deciduous forests dominated by *Shorea robusta* in the Siwaliks to sub-alpine and alpine scrub vegetation comprising *Juniperus* spp. and *Rhododendron* spp. in the high mountains and high Himal areas.

Table 3.1: Physiographic Zones and their Coverage

Zone	Coverage (ha)	Percent Coverage
High Himal	1,029,239	32.1
High mountains	599,849	18.7
Midhills	1,210,954	37.8
Siwaliks	365,667	11.4
Total	3,205,709	100

Figure 3.1: Location of Chitwan-Annapurna Landscape in Central Nepal



Methodology

4

The study used both secondary and primary data and information. Information on the trends of land use and forest cover changes and forest degradation over the last three decades was primarily obtained from analysis of Landsat satellite images. Both qualitative and quantitative methods were used in data analysis.

4.1 Collection and Analysis of Secondary Data

Secondary data and information was collected through review of relevant literature and collection and analysis of secondary data available from the Department of Forests, district forest offices and other agencies. Community forest and leasehold forest handover and forest encroachment data available from the Department of Forests are some examples of secondary data used. Statistics for the districts that are partially included in the landscape were derived based on VDC level information.

4.2 Collection and Analysis of Primary Data

Consultations with key experts and stakeholders in Kathmandu, and at district and selected community level within the landscape formed the major sources of primary data and information. The Ministry of Forest and Soil Conservation, Department of Forests and other government ministries and departments, International Non-governmental Organizations (INGOs), national NGOs, and civil society groups based in Kathmandu were consulted through informal meetings. District level government line agencies, NGOs and civil society representatives were consulted through five day-long meetings organized in Pokhara, Beni, Tansen, Besishahar,

and Trishuli. A substantial amount of time in each of these meetings was devoted to forestry related focus group discussion to identify and prioritize the drivers of deforestation and forest degradation using participatory tools and techniques. Checklists were used to make the meetings efficient and objective oriented (Annex 4.1).

Micro level information was collected from 17 community level meetings and associated field observations. Members of local Community Forest User Groups (CFUGs), Leasehold Forest User Groups, Conservation Area Management Committees, local forestry staff, local hoteliers, women's groups, micro-enterprise operators, and other local villagers participated in these consultations. Group discussions, key informant interviews and other participatory rapid appraisal techniques were used to collect data and information. Checklists were used to make the meetings efficient and objective oriented. Selected forest encroachment sites, community forests, and leasehold forests were visited to observe and understand different dimensions of deforestation and forest degradation and efforts being made to address the problems.

4.3 Spatial Analyses of Land Use and Forest Cover Changes

Landsat satellite image sets from 1990, 2000 and 2010 were used to map land use/land cover for the three periods and analyze the trends in forest area and condition. The main satellite data used in the analyses included Landsat Thematic Mapper images and Landsat Enhance Thematic Mapper Plus images. The images were downloaded free of cost from the Earth Resource Observation System Data Center of the United States Geological Survey. Five scenes were acquired for each year (total of 15 scenes) to cover the entire landscape (Annex 4.2).

The image scenes were ortho-rectified with the help of ground control points and a digital terrain model to remove the distortions arising from variations in topography, and then projected into Universal Transverse Mercator zone 44 and WGS 84 datum. The images were classified through visual interpretation. This was due to limitation of time available for the classification and insufficient ground truth data. Different band combinations (like bands 7,4,2; 5,4,3; 4,3,2 etc) were tried to distinguish similar land use and land cover types.

A total of seven land use and land cover (hereafter, land use) classes were considered in image classification, including “forest”, “alpine meadow and scrubland”, “grassland”, “agriculture”, “ice and snow”, “sand and bare soil”, and “water”. The choice of these classes was guided by the objective of the study, and expected degree of accuracy in image classification. The analyses were carried out in Earth Resources Data Analysis System (ERDAS) Imagine and Arc GIS environments. A simplified flow diagram of the land use mapping and change detection procedure is shown in Annex 4.3.

4.4 Assessment of Forest Condition

The assessment of trends in forest condition during the last three decades was carried out by analyzing the changes in forest canopy density. The same Landsat TM imageries that were used in land use analysis were used to serve the purpose. ERDAS Software was used for the correction, geo-rectification and masking of the images before running the imagery in Forest Canopy Density (FCD) Mapper. Four density classes were used to stratify the forests based on their canopy cover, including: non-forest (0-10%), degraded forest (11-40%), moderately dense forest (41-70%), and dense forest (71-100%). Details of the methodology used in the analysis are presented in Annex 4.4.

4.5 Limitations

There were some limitations of the study. The satellite images used in the classification and analyses of land use/land cover had three major limitations: (i) relatively low spatial resolution (30m), (ii) poor quality caused by presence of shadows and cloud in parts of the images, and (iii) wide seasonal variations (September to December) among the image scenes used. The limitation in available time did not allow us to collect sufficient numbers of image training sample data, and for the validation of the classified images in the field. The reference Google Earth images could not provide a clear idea of land use, particularly for the mountain areas. The results of the land use/land cover classification presented in this report can therefore provide only a rough approximation and should not be used as a basis for operational planning.

There are also limitations in the FCD Mapper software that was used to detect changes in forest canopy density. These include: (i) high sensitivity to seasonal variations; (ii) inability to mask clouds completely (faint clouds are not masked at all); (iii) the cloud shadow masking process is a very simple one and cannot address complex topography; (iv) need for thorough idea of the ground conditions to define threshold; (v) inability to mask water completely (shadow areas are also masked together); (vi) no information for complete shadow areas; (vii) method not suitable for large areas, and (viii) degradation analysis is not so successful because of unavailability of cloud free images on the same date for each of the studied years. These limitations have also caused substantial differences in forest area derived from land use analysis and forest canopy density analysis. Notwithstanding these limitations, it is hoped that the findings can contribute to better understanding of the trends in forest cover and forest condition in the landscape and help guide future work of the Hariyo Ban Program over the next five years.

Trends in Land Use and Forest Cover Change in the Chitwan-Annapurna Landscape (1990-2010)

5

The Chitwan-Annapurna Landscape had a total of 1.14 million hectares (35.5% of the landscape area) of forest in 2010. There are variations in forest cover, forest vegetation, and trends in forest cover across the four physiographic zones. The Siwaliks harbor economically valuable forests

dominated by *Shorea robusta*. The zone has 58.1 percent of land under forest cover. The midhills had 42.7 percent under forest. The forests in this zone are scattered, intermixed with settlements and agricultural land, and valued primarily for meeting the livelihood and subsistence needs of the local population. The high mountains zone has around 59.6 percent forest cover and the high Himal (including the trans-Himalayan zone) had 4.8 percent forest cover in 2010 (Table 5.1).

Table 5.1: Forest Area in Different Physiographic Zones of CHAL in 2010

Physiographic Zone	Area (ha.)	Forest Cover	
		Area (ha.)	%
High Himal	1,029,239	49,813	4.8
High mountains	599,849	357,392	59.6
Midhills	1,210,954	516,891	42.7
Siwaliks	365,667	212,614	58.1
Total	3,205,709	1,136,710	35.5

5.1 Changes in Land Use/Land Cover

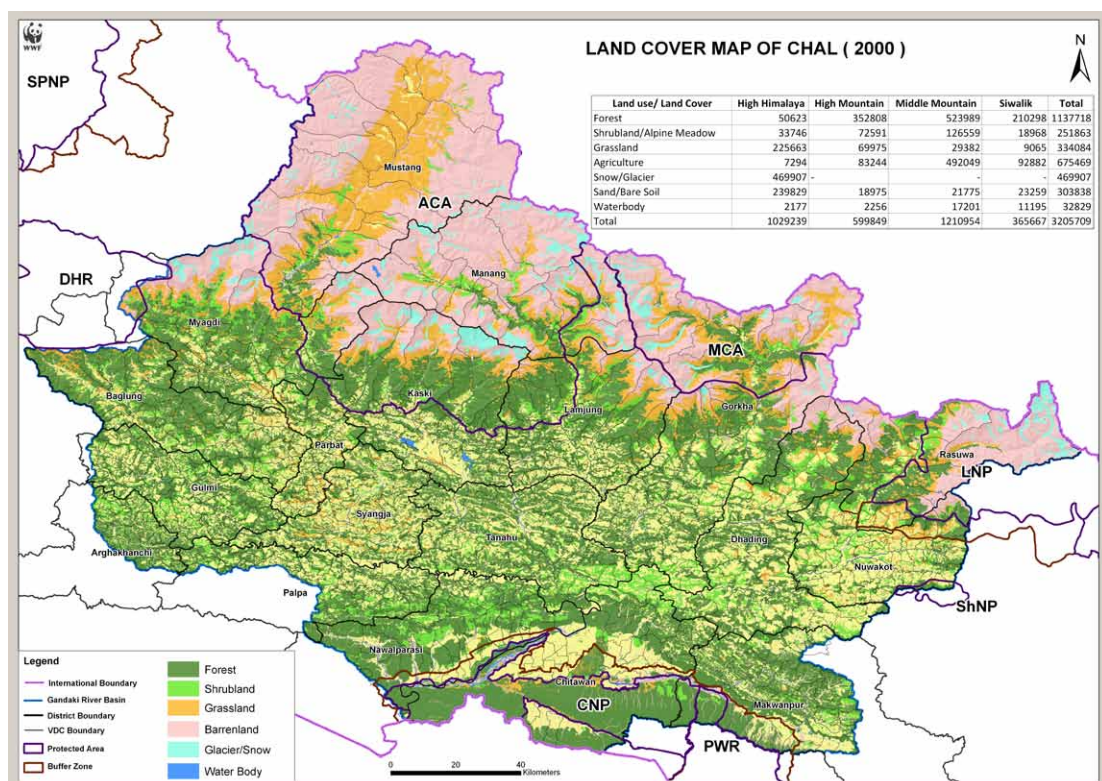
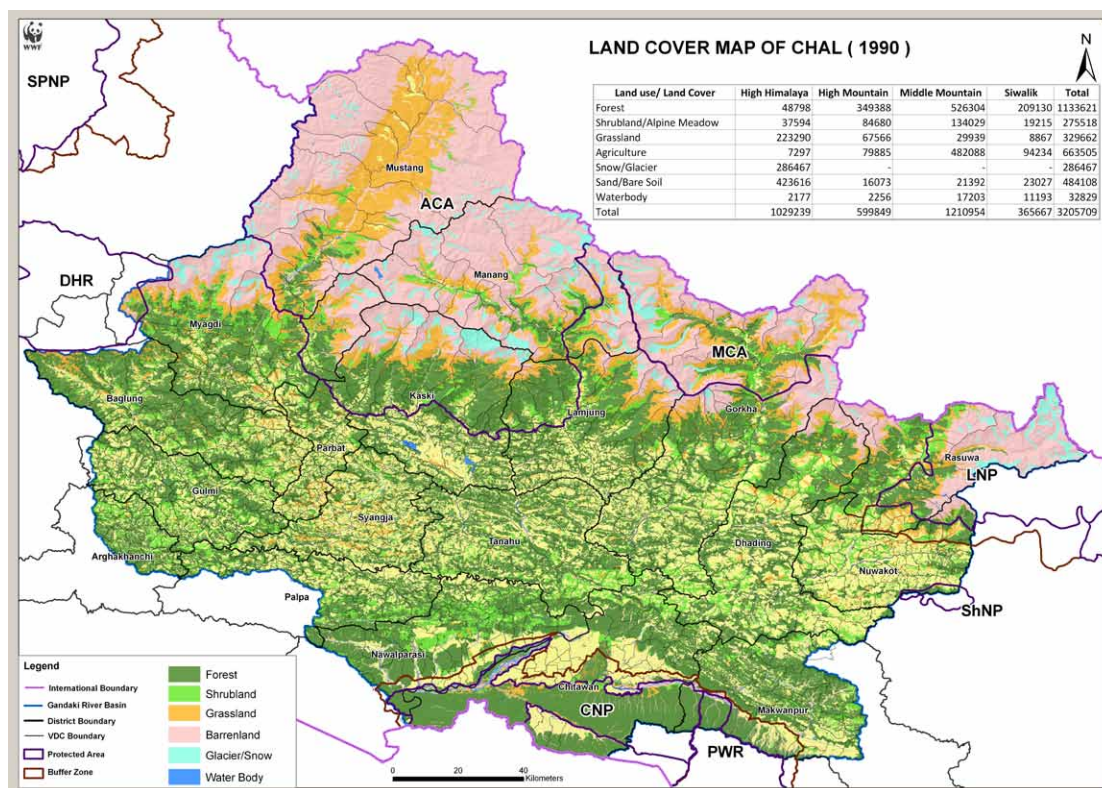
An analysis of changes in major land use/land cover in the landscape for the period 1990-2010 shows that the area under forest remained more or less constant during the period; area under grassland substantially decreased, and agriculture area slightly increased. The changes in area covered by alpine meadows and scrubland did not show a clear trend (Table 5.2; Figure 5.1).

Table 5.2: Areas Under Forest and Other Land Use/Cover in 1990, 2000, and 2010

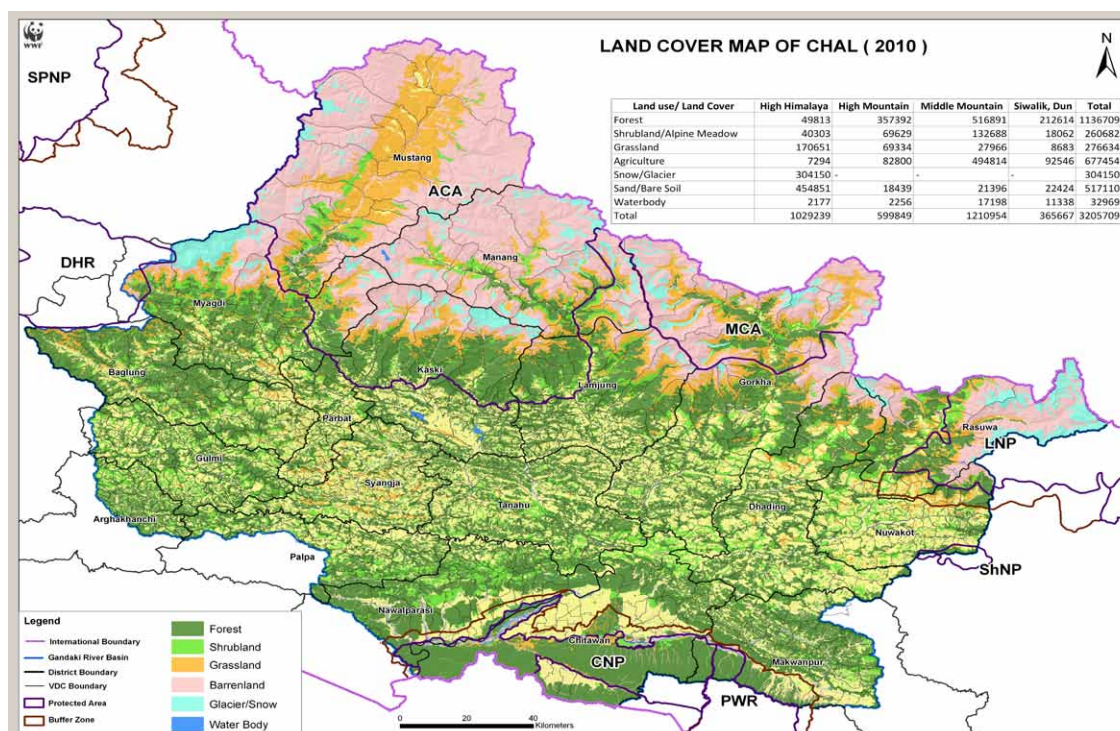
Land Use Class	1990		2000		2010		% Change in Land Use		
	Area (ha)	%	Area (ha)	%	Area (ha)	%	1990-2000	2000-2010	1990-2010
Forest	1,133,621	35.4	1,137,718	35.5	1,136,709	35.5	0.4	-0.1	0.3
Alpine meadow/scrub	275,518	8.6	251,863	7.9	260,682	8.1	-8.6	3.5	-5.4
Grassland	329,662	10.3	334,084	10.4	276,634	8.6	1.3	-17.2	-16.1
Agriculture	663,505	20.7	675,471	21.1	677,456	21.1	1.8	0.3	2.1
Snow/ ice	286,467	8.9	469,907	14.7	304,150	9.5	64.0	-35.3	6.2
Sand/ bare soil	484,108	15.1	303,838	9.5	517,110	16.1	-37.2	70.2	6.8
Water	32,829	1.0	32,829	1.0	32,969	1.0	0.0	0.4	0.4
Total	3,205,710	100	3,205,710	100	3,205,710	100			

TRENDS OF CHANGES IN LAND USE AND FOREST COVER IN THE CHITWAN-ANNAPURNA LANDSCAPE (1990-2010)

Figure 5.1: Area Under Different Land Uses in CHAL in 1990, 2000 and 2010



TRENDS OF CHANGES IN LAND USE AND FOREST COVER IN THE CHITWAN-ANNAPURNA LANDSCAPE (1990-2010)



The finding that forest area remained largely unchanged during the period does not mean that there was no forest loss or gain in the landscape. In some areas of the Siwaliks, for example, there has been substantial loss of forest area to infrastructure development, resettlement, urban expansion, and agriculture expansion. In the midhills, unplanned and unregulated construction of rural roads has caused forest loss in many places, which has undermined the contribution of the community forestry program in improving forest cover and condition.

Some of the findings might be the result of difficulty in identifying features during image classification. For example, the finding that areas under sand and bare soil decreased by 37.2 percent in between 1990 and 2000 and increased substantially

(70.2%) during 2000-2010 could simply be the result of misclassification caused by difficulty in separating bare soil from agricultural land. Similar misclassification might have resulted in the case of some other land use classes (e.g. forest and alpine meadow/scrubland). As discussed above, mapping of land use/land cover for mountain regions using Landsat images has its limitations. Accurate classification of land use/land cover is possible only with high resolution image data.

5.2 Changes in Forest Area in Different Physiographic Zones

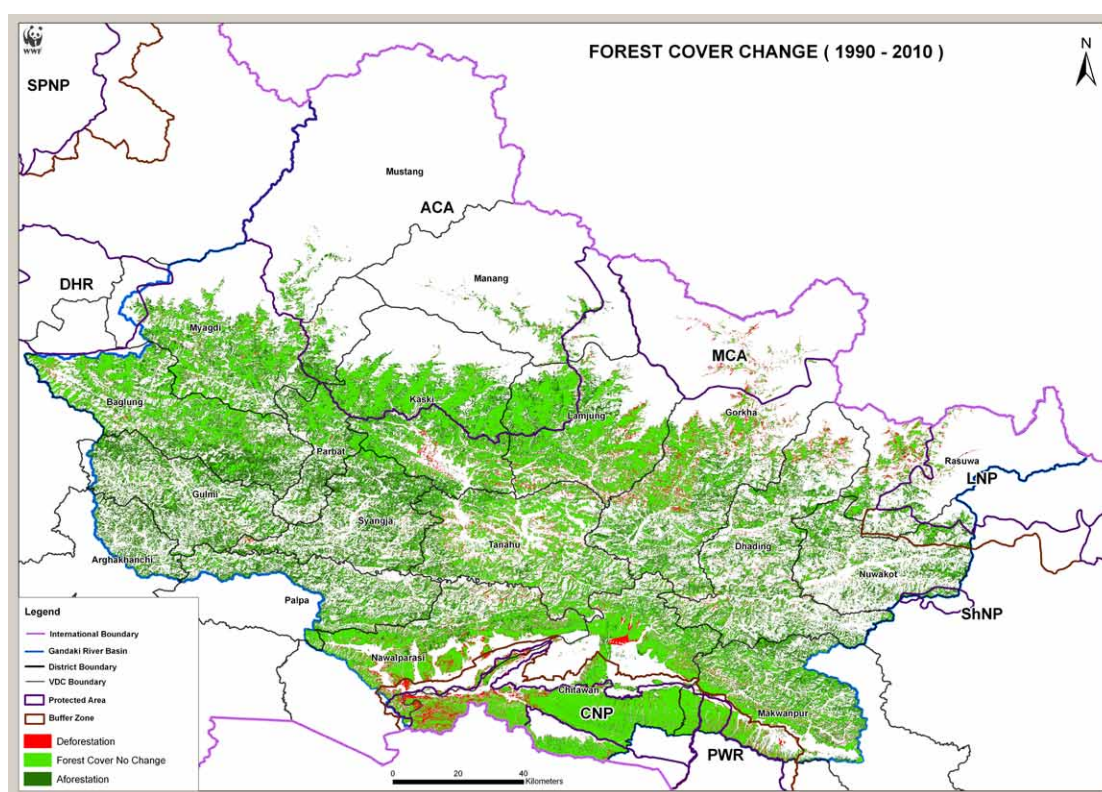
Further analysis of changes in forest area within different physiographic zones revealed that forest area continuously and progressively increased

Table 5.3: Changes in Forest Area in Different Physiographic Zones during 1990-2010

Physiographic Zone	1990		2000		2010		% Change		
	Area (ha)	%	Area (ha)	%	Area (ha)	%	1990-2000	2000-2010	1990-2010
High Himal	48,798	4.3	50,623	4.4	49,813	4.4	3.7	-1.6	2.1
High Mountains	349,388	30.8	352,808	31.0	357,392	31.4	1.0	1.3	2.3
Midhills	526,304	46.5	523,989	46.1	516,891	45.5	-0.4	-1.4	-1.8
Siwaliks	209,130	18.4	210,298	18.5	212,614	18.7	0.6	1.1	1.7
Total	1,133,621	100	1,137,718	100	1,136,709	100	0.4	-0.1	0.3

TRENDS OF CHANGES IN LAND USE AND FOREST COVER IN THE CHITWAN-ANNAPURNA LANDSCAPE (1990-2010)

Figure 5.2: Location and Extent of Changes in Forest Area in CHAL during 1990-2010



in the Siwaliks and high mountain zones during 1990-2010, whereas it continuously decreased in the midhills during the same period (Table 5.3; Figure 5.2).

The finding that forest area in the midhills decreased continuously during the last three decades supports the speculation that unregulated construction of rural roads has caused widespread forest loss in the region. The finding, however, contradicts the general perception that the community forestry program, which is widely implemented in the region, has contributed towards controlling or reversing deforestation and forest degradation trends. Moreover, some forest gain in the region is expected due to forest regeneration in many marginal agriculture lands that have been abandoned in recent years due to decreased productivity and shortage of labor as a large number of rural youth have temporarily migrated to foreign countries seeking employment.

Increase in forest cover in the Siwaliks might be due to forest gain inside the protected areas. One area where that has indeed happened is at Padampur, an enclave inside Chitwan National

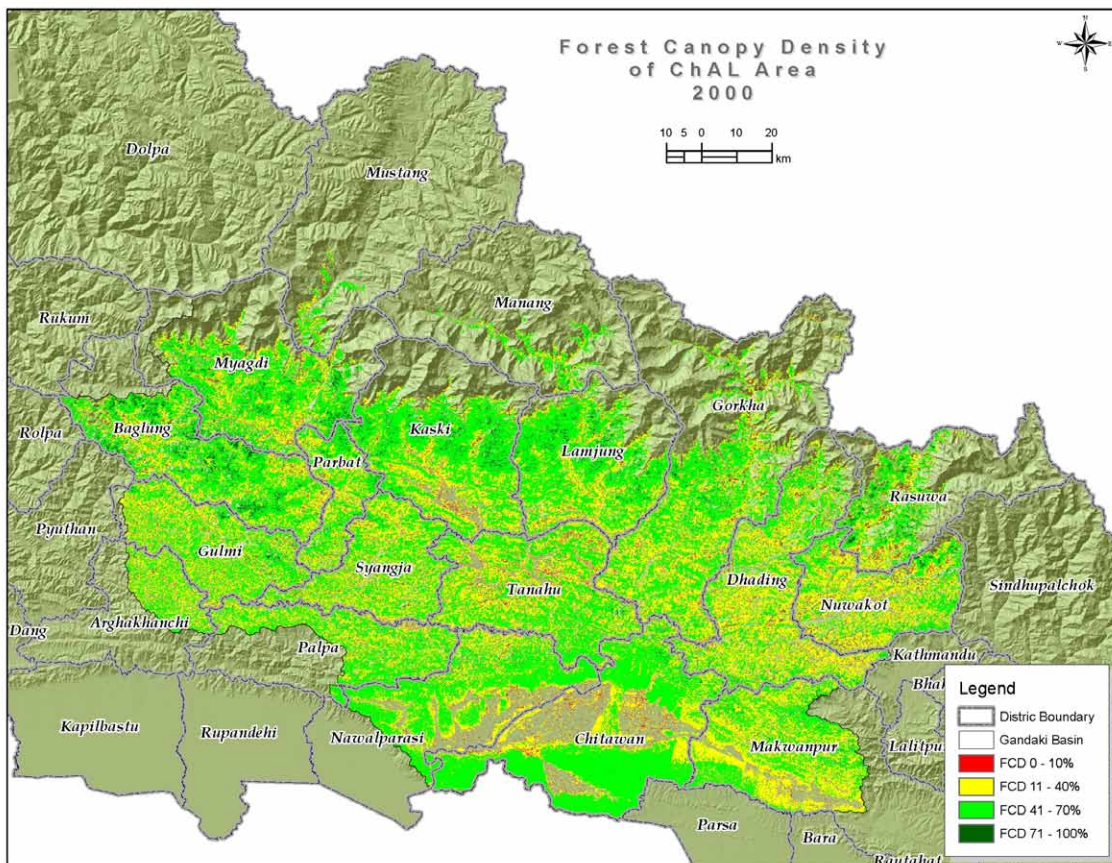
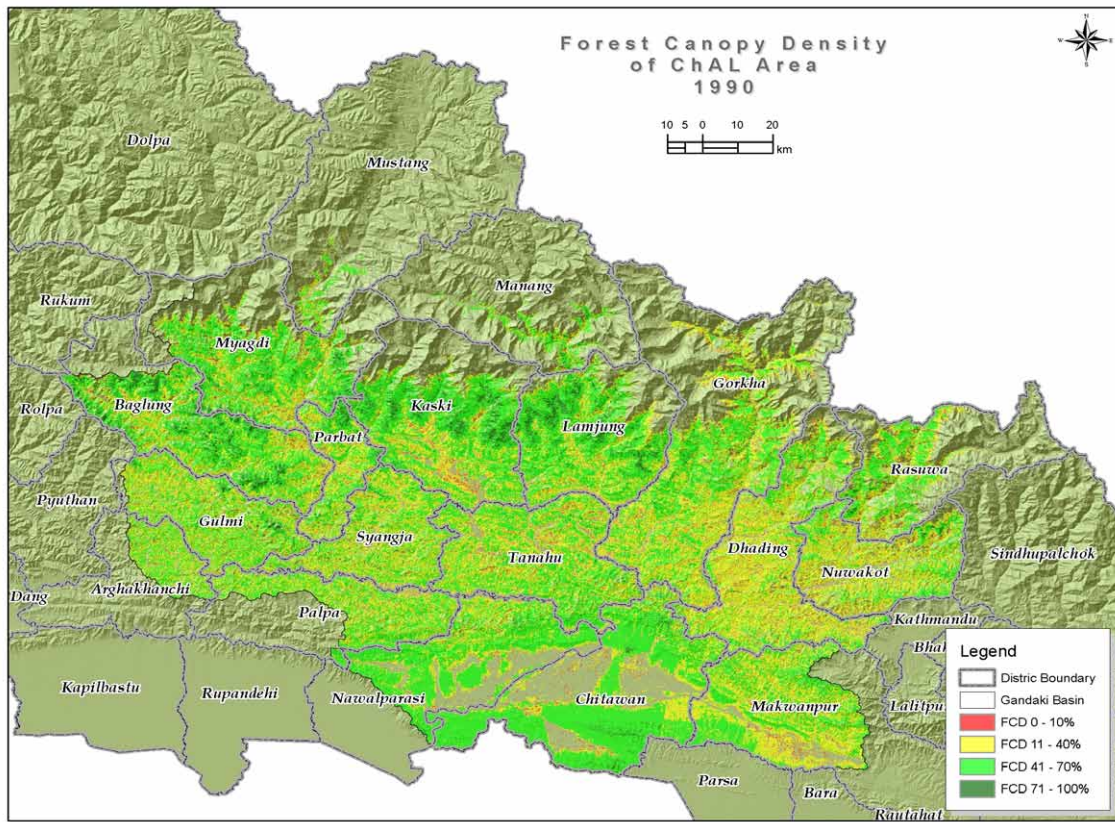
Park. The entire Padampur settlement of ethnic Tharus was relocated to another place within Chitwan District in 2004, under a controversial resettlement scheme, and the forest left for regeneration. Whether such gains in forest cover inside protected areas are sufficient to compensate the forest loss elsewhere in the region is a question requiring further investigation. Another possible reason behind the finding could be related to the difficulty in distinguishing encroached forest sites from other forest areas during image classification. Most of the encroached forest sites in the Siwalik lowlands have a few scattered trees, which makes it difficult to distinguish those areas from other forest areas during classification efforts. Increased forest cover in the high mountains could be because of forest gain inside the Annapurna and Manaslu Conservation Areas.

5.3 Changes in Forest Condition

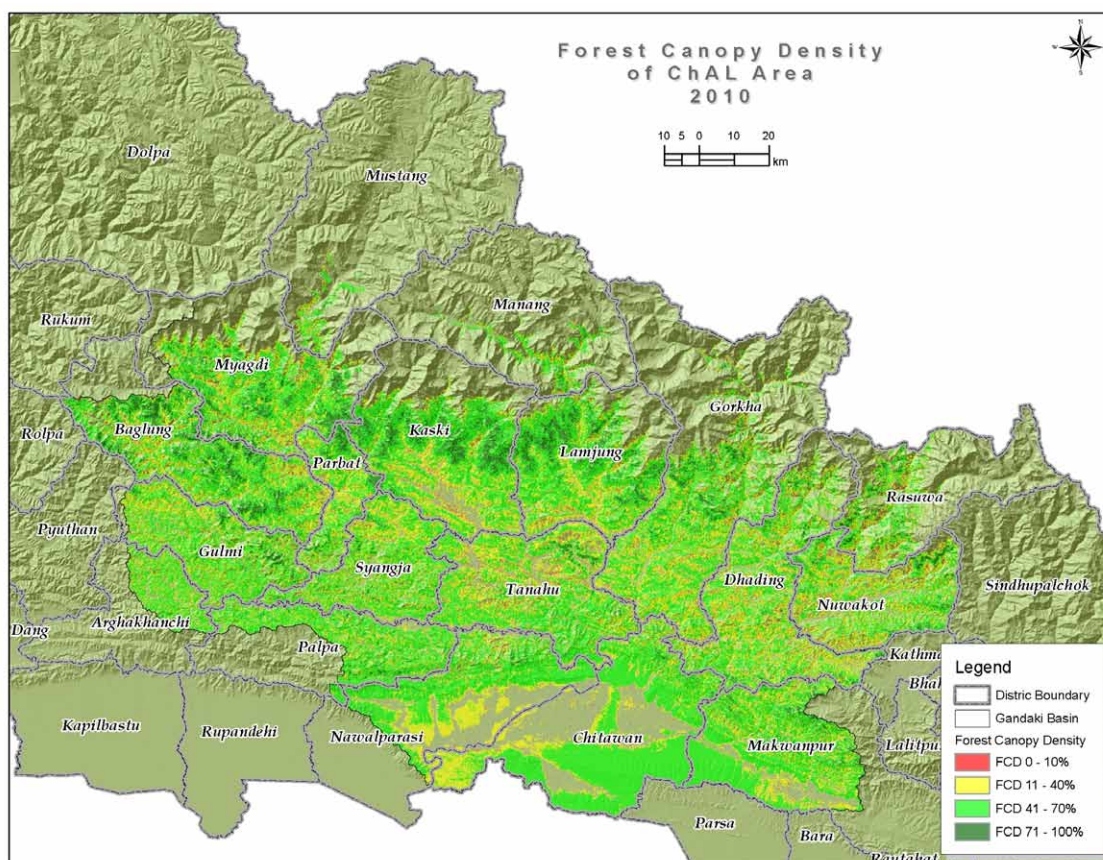
An analysis of changes in forest condition based on trends of canopy cover change show that, in general, forest condition in the landscape improved during the last three decades. This is evidenced by

TRENDS OF CHANGES IN LAND USE AND FOREST COVER IN THE CHITWAN-ANNAPURNA LANDSCAPE (1990-2010)

Figure 5.3: Canopy Density Condition of CHAL Forests in 1990, 2000, and 2010



TRENDS OF CHANGES IN LAND USE AND FOREST COVER IN THE CHITWAN-ANNAPURNA LANDSCAPE (1990-2010)



a decrease in degraded and open forest areas and an increase in moderately dense and dense forests in between 1990 and 2010 (Table 5.4; Figure 5.3).

Comparison of the 1990 and 2010 canopy data by physiographic zones shows a decrease in area

under low density classes (i.e. 0-11% and 11-40%) and an increase in higher class (i.e. 41-70%) in all physiographic zones. This indicates uniform improvement in forest condition, except a decrease in dense forest (>71% canopy cover) in for the Siwaliks between 1990 and 2010 (Table 5.5).

Table 5.4: Status of Forest Canopy Cover during 1990, 2000 and 2010

Forest Canopy Cover Class (%)	% Forest Area Under Different Canopy Cover Classes		
	1990	2000	2010
Degraded (0-10)	5.8	4.9	2.1
Open (11-40)	41.5	42.7	30.9
Moderately dense (41-70)	48.1	48.2	59.3
Dense (71-100)	4.6	4.3	7.7

Table 5.5: Percent of Forest Area under Different Canopy Cover Classes by Physiographic Zone in 1990 and 2010

Canopy Class	0-10 %		11-40%		41-70%		71-100%	
	1990	2010	1990	2010	1990	2010	1990	2010
High Himal	6.5	2.7	45.6	38.3	44.2	52.8	3.6	6.1
High mountains	3.9	1.9	33.1	23.8	52.7	57.1	10.3	17.2
Midhills	7.7	2.6	48.5	35.8	41.2	56.5	2.6	5.1
Siwaliks	3.0	0.5	32.5	25.7	62.5	73.0	2.1	0.8
CHAL	5.8	2.1	41.5	30.9	48.1	59.3	4.6	7.7

Drivers of Deforestation and Forest Degradation in the Chitwan-Annapurna Landscape

6

Drivers of deforestation and forest degradation can be categorized into two groups. Direct drivers are human activities that originate from human choice of land use, which directly impacts upon forest cover (Ojima et al., 1994; Turner et al., 1994). Underlying causes of deforestation and forest degradation are structural (or systemic) in nature. These can be seen as a complex of social, political, economic, technological, and cultural variables that constitute initial conditions in the human-environmental relations (Geist and Lambin, 2002). These drivers may operate at various spatial levels.

A total of nine direct or proximate drivers of deforestation and forest degradation have been identified in CHAL. These include: (i) over and unsustainable harvest of forest products (mostly illegally); (ii) infrastructure development; (iii) forest encroachment for resettlement and urban expansion; (iv) agricultural expansion (permanent and shifting cultivation); (v) uncontrolled forest fires; (vi) overgrazing; (vii) invasion by alien plant species; (viii) landslides and floods; (ix) stone mining, and (x) recreation.

While most of the drivers are common to all physiographic zones, a few are zone-specific. For example, overgrazing is not a major driver in the midhills. Similarly, invasion by alien plant species, which is emerging as a major problem in parts of the Siwaliks (including Chitwan National Park), has not yet occurred in the high mountains and high Himal. Unregulated construction of rural roads is the major driver in the midhills. The degree of effects of some drivers that are common to more than one zone also varies among the physiographic zones. For example, the problem of overharvest is severe in the Siwaliks, moderately severe in the high mountains, and less severe in the midhills where it is limited to government-managed forests. Forest encroachment for

agriculture expansion, settlements, and urban expansion is a major driver in the Siwaliks, while this is not equally so in other zones.

The following sections briefly describe each of the drivers and their underlying causes, efforts made to address them, challenges encountered, and possible strategies required addressing them. Details on the same by physiographic zones (Siwaliks, midhills, and high mountains), and possible activities that the Hariyo Ban Program can pursue to address the drivers are presented in Annex 6.1, Annex 6.2, and Annex 6.3.

6.1 Direct Drivers

6.1.1 Over and unsustainable harvest of forest products

Excessive extraction of forest products to meet persistently high demands for fuel, construction timber, fodder and other forest products is a major cause of deforestation and forest degradation in most parts of the landscape. In the Siwaliks, the problem is compounded by widespread illegal harvesting of timber and firewood for sale. In the high mountains, excessive use of timber for construction of houses and cowsheds, illegal cross-border smuggling of timber to the Tibet Autonomous Region, and repeated lopping of trees for fodder are some of the major drivers of forest degradation.

Although most towns and cities in the landscape now use Liquefied Petroleum Gas (LPG) for cooking and heating, wood fuel is still a major source of energy for people in rural areas. Wood fuel accounts for above 80 percent of the total energy consumed in Nepal (Water and Energy Commission Secretariat (WECS), 2006) and the situation in CHAL is not expected to be much different.

DRIVERS OF DEFORESTATION AND FOREST DEGRADATION IN THE CHITWAN-ANNAPURNA LANDSCAPE

Unemployment and high demand for fuelwood has motivated many people for illegal collection of firewood for sale. This problem is particularly severe along the highways. For example, a large number of people from the adjoining Siwaliks and mountain areas have reportedly migrated to Dumkibas and nearby towns in Nawalparasi district in recent years, making their livelihoods through illegal collection and sale of firewood to local hotels and truck and tractor drivers. Piles of freshly cut firewood for sale is a common scene along many roads, including the recently-opened Beni-Jomsom rough road. There is a common belief among forest managers and experts that intensive collection of fuelwood, which often involves harvesting green branches and even whole stems, is a major factor behind forest degradation in the landscape, although there is no empirical evidence to support this perception.

Unsustainable extraction, such as intensive harvesting of reproductive tissues (flowers, seed, fruit), repeated visits and inappropriate harvesting methods have caused degradation of non-timber forest products (including high value medicinal and aromatic plants) in many areas.

6.1.2 Agricultural expansion

Expansion of cultivation in forest areas to meet spiraling demands for agricultural land is a major driver of deforestation in almost all parts of the landscape. High reliance of households on agriculture due to very limited alternative livelihood options and the ever increasing demand

for food due to population growth are the main underlying causes behind these expansions. In most cases, the expansion is spontaneous by small farmers, usually driven by underpinning social and/or economic factors such as scarce land resources in other localities or demographic or ethnic forces promoting migration. The problem is more severe in the Siwaliks (parts of Chitwan and Nawalparasi Districts) where productivity of land and population density is high, and the forestry administration's control over the resource is inadequate. Bandarajhulla and Sunachari in Chitwan, and the Arunkhola area in Nawalparasi are some examples of forest encroachment for agricultural expansion in recent years.

Shifting cultivation on steep hill slopes is a major driver of deforestation in the Siwaliks and adjoining Mahabharat Range, particularly in parts of Nawalparasi, Palpa, Tanahu, Chitwan and Gorkha Districts. Most of the shifting cultivators belong to ethnic Magar and Chepang communities.

In the midhills, expansion of agriculture in forestland has been substantially reduced in recent years and is mostly limited to government managed forests where there is poor monitoring and enforcement of forest law by district forestry staff. In community forests, encroachment for agriculture is minimal due to effective monitoring of the forests by local user groups. Any expansion is limited to minor shifting of farmland boundaries into adjoining forestland at some locations.



Photo 6.1: Shifting Cultivation Plots at Mainaghat (Siwaliks), Nawalparasi

DRIVERS OF DEFORESTATION AND FOREST DEGRADATION IN THE CHITWAN-ANNAPURNA LANDSCAPE



Photo 6.2: A Recently Constructed Rural Road Passes Through a Dense Sal (*Shorea robusta*) Forest Near Lekhnath, Kaski

In some other parts of the midhills, more and more cultivated areas were found to be abandoned and left fallow in recent years for forest regeneration. This was for two main reasons: (i) diminishing productivity due to rapid soil erosion and nutrient depletion, and (ii) labor shortages caused by out-migration of male family members to urban areas (Gautam et al., 2004b). A similar situation

was reported in CHAL where a large number of young people are currently in foreign countries for employment.

6.1.3 Infrastructure development

Development of infrastructure inside forestland is an important driver of deforestation throughout the landscape. Unplanned and unregulated

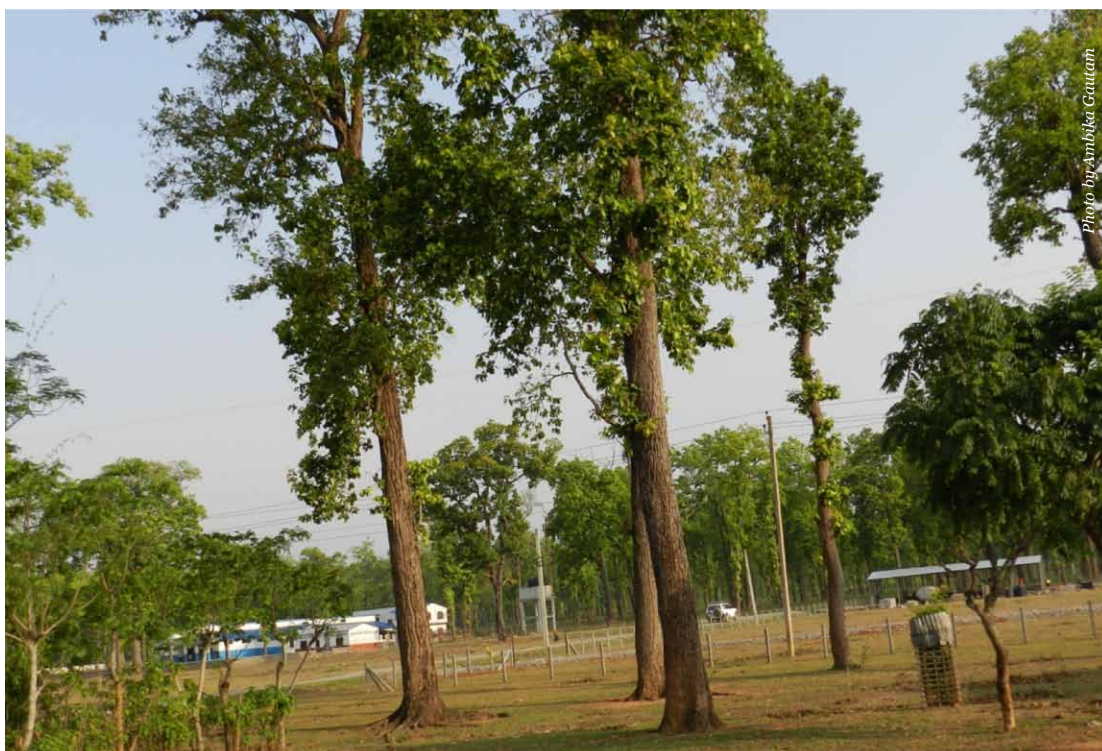


Photo 6.3: A Community Hospital Established Recently Inside a Sal Forest at Danda, Nawalparasi

An Example of Forest Encroachment for Development of Infrastructure

Madhyabindu Community Hospital at Danda, Nawalparasi presents a good example of forest encroachment for development of infrastructure. According to an executive member of the hospital management committee, the hospital building was constructed inside government forestland around five years ago after receiving verbal consent of the then Minister of Forests and Soil Conservation. The hospital is now in the process of registering the occupied 15 hectare forestland in its name. Part of the occupied land (right half in photo 6.3) has been reportedly rented out for two years to a Chinese company involved in construction of an electric transmission line. The company has started construction of a network of gravel roads, a store house and other facilities in the rented forestland.

construction of rural roads by Village Development Committees (VDCs) and District Development Committees (DDCs) is a major direct cause of deforestation and forest degradation in the midhill districts, which has undermined the positive contributions of the community forestry program to some extent.

Unregulated construction of schools, hospitals, electric transmission lines, water storage tanks, army barracks and police camps, temples and recreational facilities (e.g. picnic spots) within forests is a common practice throughout the Siwalik lowlands. Construction of hotels, monasteries and trekking trails in forests is common in the high mountains (e.g. Annapurna Conservation Area) and some places in the midhills (e.g. Panchase Protected Forest).

In many cases, there is planned conversion of forestland by the government for implementing economic development priority projects, such as construction of roads and reservoirs. In some places, community conservation of forests is being directly threatened by the government, which is allowing private and public sector companies to set up mines and other industries inside forests.

Limestone mines in Arghakhanchi, a cement factory in Dhading, and electric transmission lines in Palpa are some recent examples.

6.1.4 Forest encroachment for resettlement and urban expansion

Illegal settlement inside forests is a major cause of forest loss and degradation in the Siwalik lowlands, including the districts of Chitwan, Nawalparasi, and Makwanpur. According to an unpublished record available at the Department of Forests, a total of 10,785 ha of forestland is currently under illegal occupation in these three districts (DoF, 2012a; Table 6.1).

Most of the encroachment took place from the late 1960s until 2005. According to a senior district forest official, around 121 ha additional forest has been encroached in nine locations of Makwanpur District since 2005. A similar trend is expected to be seen in the other two districts, although no records are available.

Encroachment of forestland for resettlement in the Terai and Siwaliks regions of Nepal started with a massive migration of people from the mountains and hills to the Terai in search of fertile agricultural

Table 6.1: Forest Area under Encroachment in Three Siwalik Districts of CHAL

District	Forest Area Encroached (ha)	Main Locations
Chitwan	1,387.7	Jutpani, Shaktikhor, Aaptari (Bharatpur), Korak, Amilepani, Lothar, Dahakhani, Padampur (Thankhola), Ratomate, Chainpur, Bhandara
Nawalparasi	7,836.5	Sunwal, Daunnedevi, Panchanagar, Mukundapur, Rajhar, Tilakpur, Shivmandir, Swathi, Pragatinagar, Gaidakot, Dumkibas, Agyoli, Benimanipur, Divyapuri, Tamsariya, Kohulwa, Makar, Nayabelhani
Makwanpur	1,560.5	Manahari, Raksirang, Sarikhet, Kankada, Basamadi, Manthali, Harnamadi, Hatiya, Shikharapur, Churiyamai, Dhiyal, Gadi
Total	10,784.8	

DRIVERS OF DEFORESTATION AND FOREST DEGRADATION IN THE CHITWAN-ANNAPURNA LANDSCAPE

lands immediately after eradication of malaria in the region during the 1950s and the 1960s. The stated objective of the resettlement program was to control forest encroachment and destruction by settling families in designated areas. In practice, however, the policy indirectly encouraged illegal encroachment of forests for cultivation. People encroached forestlands with the hope of having it registered as private property once the land was cleared and cultivated (Gautam et al., 2004a).

Much of the encroachment is for expansion of local markets and urban areas. For example, in Nawalparasi district alone a total of 1,330 ha forestland in Sunawal, Shiv Mandir, Gaidakot and Kolhuwa VDCs has been encroached for the purpose (Western Regional Forest Directorate (WRFD), 2011). The problem, which is more severe along the highways, has now been compounded due to general lawlessness created by political instability, inadequate capacity of district forest offices to deal with the problem, and poor coordination among the law enforcement agencies.

The problem of forest encroachment is no longer limited to the Siwaliks. A recent (2011) study conducted by the Regional Forest Directorate, Pokhara found an estimated 4,657 ha of forest area is under encroachment in 12 midhills and high mountain districts in the western development region (WRFD, 2011; Table 6.2).

In the mountain areas, forests on southern slopes are more vulnerable to encroachment

by settlements because of warmer conditions. This leads us to speculate that a higher rate of settlement expansion into forested areas might have occurred on the southern slopes as compared to northern slopes (although no evidence to support this speculation exists).

6.1.5 Forest fire

Uncontrolled forest fire is an important driver of forest degradation throughout the landscape, particularly in the Siwaliks. Recurrent forest fires severely damage and prohibit regeneration and growth of seedlings, destroy non-timber forest products and, in some cases, encourage invasive species. Although quantitative information is not available, forest fires are definitely degrading biodiversity, enhancing soil erosion and inducing floods and landslides due to the destruction of the natural vegetation.

Deliberate forest fire is frequently used as a method to clear land for agriculture or promote new growth of grass for grazing. This practice is more common in the shifting cultivation areas across the Siwaliks and also in the high mountains because there has been no change in the traditional farming and livestock raising systems in these areas. When such fires 'escape', the damage is often catastrophic. This is especially true in forest ecosystems not adapted to fire. For example, a forest fire in 2010 killed almost all trees in around 150 ha of conifer forest near Jomsom in Mustang District. The fire was reportedly set by a group

Table 6.2: Forest Area Under Encroachment in Some Mountain Districts of CHAL

S. N.	District	Estimated Forest Area Under Encroachment (ha)	Main Locations (VDCs and Municipalities)
1	Palpa	2,000	Tansen, Baldengadi, Kachal, Satyawati, Jhirubas
2	Arghakhanchi	1,800	Pattharkot, Gauda
3	Gulmi	128	Ridi, Tamghas
4	Tanahu	300	Debghat, Dulegauda, Aabukhaireni, Bhimad
5	Kaski	120	Pokhara, Lekhnath, Bharatpokhari
6	Gorkha	90	Gorkha, Palungtar, Aabukhaireni
7	Syangja	28	Putalibazar, Waling, Krishnagandaki, Ratnapur
8	Lamjung	24	Besisahar, Bhulbhule, Bhotteodar
9	Baglung	60	Burtibang, Daga, Bihu
10	Myagdi	40	Arthunge, Rakhu, Darbang, Tatopani
11	Parbat	42	Kusma, Shaligram, Phalebas
12	Mustang	25	Lete, Jomsom, Muktinath
	Total	4,657	

DRIVERS OF DEFORESTATION AND FOREST DEGRADATION IN THE CHITWAN-ANNAPURNA LANDSCAPE

of local people heading for *Cordyceps sinensis* (Yarchagumba) collection. Local markets are now flooded with timber from that forest (pers. com. with Hridaya Shrestha). The incidence of forest fires is decreasing in the midhills due mainly to community forestry.

6.1.6 Overgrazing

Unregulated grazing in forests by sedentary small farmers (in the Siwaliks) or nomadic herders (in the high mountains) is a widespread practice which negatively affects regeneration and growth of seedlings and ultimately causes forest degradation. The practice of grazing in forests was also common in the midhills in the past but has now been substantially decreased due to the implementation of the community forestry program, as CFUG rules usually do not allow grazing. There have been reported instances of conflicts between nomadic herders and CFUGs because of the grazing ban imposed by CFUGs in their community forests, some of which include traditional transhumance grazing lands.

6.1.7 Invasion by alien plant species

Invasive alien plant species occur and are rapidly spreading in most forest ecosystems in the Siwaliks and midhills. Invasion by *Mikania micrantha* is

widespread in the Siwaliks region (particularly in Chitwan National Park and surrounding forests), which has catastrophic effects on native vegetation and wildlife in some areas. *Lantana camara* is another common invasive species in the Siwaliks and low elevation areas in the midhills. Invasion by *Eupatorium adenophorum* is also common in the midhills. Although there is no evidence of invasive alien species occurring in the high mountains at present, there is a real risk of *Eupatorium adenophorum* and other invasive species spreading to higher altitudes in light of changing climatic conditions.

6.1.8 Landslides and floods

Landslides triggered by both human-induced and natural factors are important drivers of deforestation throughout the hilly and mountainous parts of the landscape. Inappropriate land use and land management systems are the main human-induced causes of landslides, and are heavy monsoon rains, steep slopes and other topographic conditions are the major natural factors.

6.1.9 Stone mining

Stone mining for construction is a localized driver of deforestation in many areas (including parts of Arghakhanchi, Dhading and Kaski Districts).



Photo by Ambika Gautam

Photo 6.4: A Recent Landslide Near Budhachaur, Syangja

6.1.10 Recreation

Forests close to urban and semi-urban areas are facing increased pressure for recreation. For example, picnicking inside forests is a common practice in the midhills and Siwaliks regions.

6.2 Underlying Causes

6.2.1 Demographic factors

The Chitwan-Annapurna Landscape had an estimated population of 4,342,581 in 2001, which grew to 4,518,729 in 2011. Although the overall population growth rate in the landscape (0.41%) was much lower than the national average (1.47%), our analysis shows that there was a high spatial variation in population dynamics across the landscape during the period. For example, the population in Chitwan and Kaski Districts grew by 2.00 percent and 2.89 percent respectively, while it decreased by over three percent in Manang and 0.79 percent in Mustang.

The population growth, along with changing density and distribution patterns of the population, are believed to have driven deforestation and forest degradation in the landscape. Although correlating demographic change with forest use pattern is difficult, it is widely believed that population can affect deforestation in different ways, including changes in the number of rural families seeking land to cultivate, fuel wood or timber; and demand for agricultural and forest products. High reliance of households on forests for energy and timber, high reliance on agriculture for livelihoods, and ever increasing demand for food due to population growth has caused agricultural expansions in forestland.

Migration, both inside and out of the country, which is high in Nepal, is another major demographic factor that is believed to have a direct relationship with the management and use of forest resources. A significant number of migrations (nearly one third of the male migrants) during the last five years took place to the Middle East and Malaysia for labor (Ministry of Health and Population (MoHP)/New ERA/ICF International, 2012). Although there are no CHAL-specific statistics on migration, local consultations indicated that it is high and likely similar to the national scenario.

The high rates of out-migration, however, might also have a positive effect on forest conservation.

Studies in other parts of the midhills of Nepal (Jackson et al., 1998), hills of Thailand (Fox et al., 1995) and Honduras (Kammerbauer and Ardon, 1999), have shown that farming households may abandon some previously cultivated marginal agriculture lands due to labor shortages caused by out-migration of male family members, and the extended fallow of such lands leads to forest regeneration. A similar situation was reported by local people in CHAL but the extent of the changes is unknown and deserves further investigation.

6.2.2 Economic factors

Widespread poverty, combined with lack of or very limited alternative livelihood opportunities and the general underdevelopment situation, is a key underlying cause of forest loss in the landscape, because low economic growth and commercial development have contributed to high forest dependency. As in other parts of Nepal, the inhabitants in most parts of the landscape are poor and a substantial proportion is believed to be living below the poverty line. The economic well-being of these people is very closely bound to natural resources, including forests.

While on the one hand poverty remains a major underlying factor in forest loss, remittance-based economic growth in recent years is creating more and more demand for construction timber to build new houses. In many places, pressure on forests has substantially increased due to increased demand for forestland and timber for infrastructure development. Increased market accessibility has led to increased commercialization of products that in the past were used mainly for subsistence (e.g. fuel wood). Forests close to urban areas are facing increased pressure for recreation. The existing scenario indicates that demand for a diverse array of products and services from different segments of society will continue to be an important challenge facing the forestry sector in the near future.

The drive to economic development coupled with weak enforcement of forest law has led to unplanned and unregulated construction of infrastructure inside forestland throughout the landscape. While unplanned and unregulated construction of rural roads is a common scene in the midhills, illegal construction of schools, hospitals, electric transmission lines, and water storage tanks inside forest boundaries is widespread in the Siwalik lowlands.

6.2.3 Land scarcity

Spiraling demand of land for agriculture and other non-forestry uses (such as development of infrastructure and urbanization) coupled with disputes and uncertainty over land and forest tenure is an important root cause of forest loss and degradation. Shifting cultivation on steep hill the slopes of the Siwaliks and Mahabharat range has not only contributed to deforestation but also induced soil erosion during the monsoon season.

6.2.4 Political and institutional factors

Poor central planning, lack of political will, conflicting sectoral policies, poor coordination, and inadequate capacity of the Department of Forests are some important underlying factors of deforestation and forest degradation. On the one hand, misdirected and conflicting policies have resulted in unintended deforestation and on the other, preventable deforestation has not been precluded due to the failure of government institutions to function effectively. Poor inter-agency coordination and disregard for forestry legislation by other government agencies have hindered forestry officials' efforts to abate deforestation. The long political instability and conflicts have also helped accelerate the deforestation and forest encroachment processes. Inefficient forest product distribution and marketing systems are another factor that has contributed overall, as has unsustainable harvesting of forest products.

One of the widely believed underlying causes of forest loss or degradation in CHAL and Nepal is the failure of government planning procedures to optimally account for forest values. This may be because of the failure of the system to internalize the environmental cost of forest loss or degradation. A more important reason, perhaps, is the imbalance in power and influence among different government ministries. The Ministry of Forests and Soil Conservation and the Ministry of Environment are considered less influential in the government's decision making than, for example, the Ministry of Agriculture or Ministry of Physical Planning and Works, which often results in inappropriate land use decisions and smaller budgetary allocations to the former ministries.

6.2.5 Technological factors

Lack of scientific forest management is a major reason behind low productivity of forests, which has caused an imbalance in the supply of products and less than optimal income from the forestry sector. According to the majority of key district level stakeholders

consulted during the course of this study, insufficient technical inputs, along with lack of political will, weak central administration, inadequate financial and material resources, inadequate trained human resources, and lack of trust between central and district level authorities are the major barriers in implementing scientific forest management.

Damage and wastage associated with the conventional logging system, wastage in wood processing, and lack of cheap technological alternatives to wood fuel are other important technological factors underpinning forest loss and degradation. Most rural households still use inefficient conventional methods of using wood fuel as they have no access to technologies that enhance wood fuel efficiency. Unfortunately, developing and disseminating forestry technologies has actually never been a priority of the government, as evidenced by the fact that the investment in forestry research is negligible as compared to other sectors.

6.2.6 Governance related factors

Weak law enforcement and regulatory mechanisms, and overall poor governance of the forestry sector is a major underlying factor behind deforestation and forest degradation in CHAL (and Nepal). The existing regulatory mechanisms are unable to deal with rampant violations by politicians and forest mafia. Lack of political will and capacity are also considered to be significant underlying causes of poor forestry governance. Laws may exist, but are not implemented because of a lack of political will and financial resources dedicated to their implementation. The government is either unwilling or unable to enforce forest laws and other national laws concerning the environment, especially when there are large-scale projects at stake.

Absence of a transparent system of reward and punishment for government staff and Forest User Groups is one of the reasons behind weak law enforcement, corruption and impunity. Lack of a uniform policy and guidelines regarding harvest and sale of forest products from community forests, lack of a uniform reporting system or format, lack of financial transparency, and weak monitoring by district forest offices and Federation of Community Forestry Users, Nepal (FECOFUN) has led to financial irregularities by some CFUGs. The feudalistic structure of the state can also be linked with lack of good governance in the forestry sector. The state is currently undergoing a difficult restructuring process, which will largely

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determine the structure of future forestry sector governance and the sector's contribution to social and economic transformation.

6.2.7 Cultural factors

Cultural factors such as lack of concern by individuals about the welfare of others and future generations, non-profit orientation, continuation of inherited modes of resource use and farming practices (e.g. shifting cultivation), increasing levels of demand and aspiration, and general disregard for the sacredness of nature are some of the cultural factors underpinning forest loss and degradation in the landscape. Lack of concern about future generations can also be linked with chronic poverty, which makes it difficult for many households to care about future generations when they are struggling to feed their families today.

6.2.8 Ambiguous tenure

Blurred tenure and forest use rights have contributed to perceived open access and degradation of government-managed forests. This perception, which is the result of conflict between traditional tenure systems and contemporary forestry legislation, has encouraged stakeholders to adopt a short-term economic horizon, since their failure to take immediate financial advantage of the resources likely results in others gaining the benefit.

One of the main possible underlying causes of the perception of an open-access resource is the failure to apprehend and punish many of those who violate regulations. Low risk of capture and punishment may be because of the inadequacies of the District Forest Offices (DFOs) and protected area managers to fulfill such a role due to lack of adequate human resources and logistics. However, it may also often be the result of a perception that the offences being committed are not really significant or important. In some cases, corruption by officials tasked with preventing offences could be the major reason.

6.2.9 Lack of alternative sources of energy

In the absence of cheap alternatives, wood fuel remains the major source of energy in rural

areas. Use of alternative fuel (LPG, electricity, kerosene) by residents of major urban centers, and limited use of biogas and LPG in some rural areas has not effectively decreased the demand for firewood. Community level consultations in the landscape revealed that in most places rural households continue using firewood for boiling animal feed, boiling milk, and heating, even if they have biogas and LPG.

6.2.10 Climate Change

Climate change can affect different aspects of forest conditions, including health and vitality, coverage and biodiversity. These effects can vary across space depending upon geographic area, original climatic conditions, species diversity and human activities (FAO, 2012).

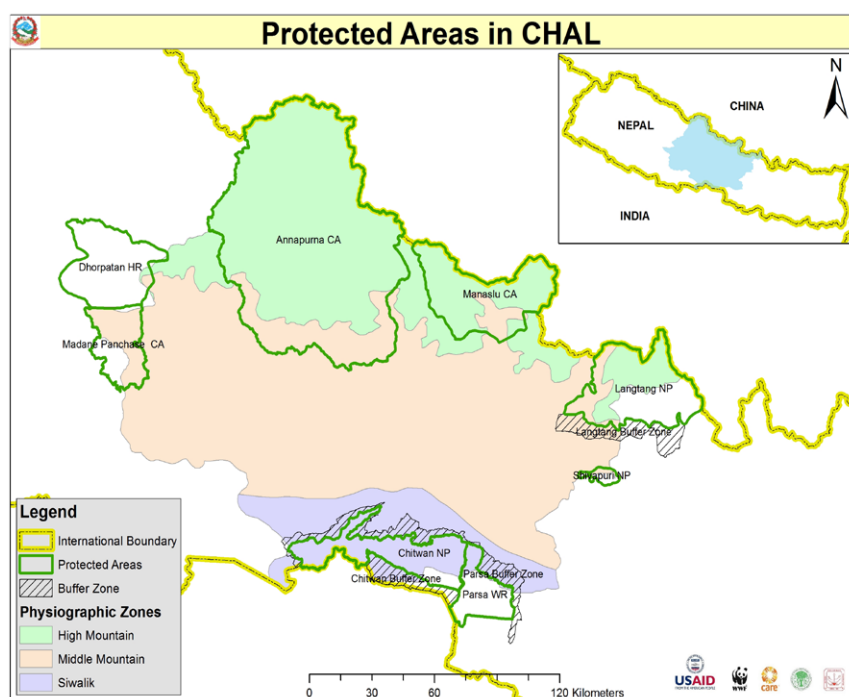
An analysis of changes in climatic patterns in the landscape over the last three decades showed a continuous increase in the average annual temperature, with slight variations in the actual annual rate of increase across the three physiographic and eco-climatic regions (0.034°, 0.039°, and 0.036° Celsius per year in the high mountains, midhills and Siwaliks, respectively). Perceptions of the local people consulted during the course of this study concurred with the increasing trend in temperature in recent years. Along with changes in temperature, there were also changes in precipitation patterns. Increasingly longer dry periods due to delay in monsoon arrival and decreased rainfall in winter, changes in rainfall distribution, and decreasing snowfall at some locations were some of the main findings of the precipitation analysis, which might have links to climate change.

Although there is no concrete evidence, weather related extreme events such as excessive rainfall, longer drought period, landslides and floods, frequent forest fires, and invasion by alien species may have links to climate change. Climate change is also believed to be responsible for extended drought periods that exacerbate the potential for severe forest fires. Whether and how climate change has effects on different forest ecosystems and species, and whether the effects have been variable across different elevations and aspects, need to be further explored.

7

Efforts to Reduce Deforestation and Forest Degradation

Figure 7.1: Location and Extent of Protected Areas in the Chitwan-Annapurna Landscape



7.1 Expansion of Protected Areas

There has been a substantial expansion of the protected area network in the landscape over the last three decades. The first national park (Chitwan), covering an area of 93,200 ha (87.1% in CHAL), was established in 1973. By 1992, land under protected areas in the landscape grew to 957,700 ha, and now it is about 1,124,300 ha (35.1% of the landscape area; Table 7.1; Figure 7.1 and 7.2). The declaration of conservation areas (Annapurna and Manaslu) was the major reason behind the rapid increase in protected areas since the early 1990s.

The Ministry of Forests and Soil Conservation has reportedly decided to extend the 39,000km² Sacred Himalayan Landscape area westward to include a substantial portion of CHAL. If that happens, the measure is expected to greatly help control forest loss and degradation and biodiversity conservation.

Table 7.1: Protected Areas in Chitwan-Annapurna Landscape

S.N.	Name	Establishment Year	Area (000 ha.)		Physiographic Zone
			Total	In CHAL	
1	Chitwan National Park	1973	93.2	81.2	Siwaliks
2	Langtang National Park	1976	171.0	100.3	High Mountains and high Himal
3	Parsa Wildlife Reserve	1984	49.9	7.9	Siwaliks
4	Dhorpatan H. Reserve	1987	132.5	5.4	High mountains
5	Annapurna C. Area	1992	762.9	762.9	High mountains and high Himal
6	Manaslu C. Area	1998	166.3	164.0	High Himal
7	Shivpuri National Park	2002	14.4	2.6	Midhills
	Total		1,390.2	1,124.3	

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7.2 Implementation of Participatory Forest Management Programs

7.2.1 Community Forestry

A total of 305,296 ha of designated forest land in 18 districts (except Mustang) of the Chitwan-Annapurna Landscape in April 2012 was being managed by 5,284 registered Community Forest User Groups (CFUGs), including 448,753 households under the community forestry program (DoF, 2012b; Table 7.2).

The community forestry program is believed to have greatly contributed towards controlling or reversing deforestation and forest degradation trends in the landscape, particularly in the midhills. Protection and development of forests, a ban on grazing, and fire control are some of the specific activities implemented by CFUGs that have helped to control forest loss and degradation. Moreover, the program has led to strengthening natural resources governance, equitable sharing of benefits among the rural populations, and to some extent, enhancement of local livelihoods.

7.2.2 Leasehold Forestry

Leasehold forestry, which involves 40-year rent-free leasing of small areas (up to 10 ha) of degraded national forest land to small groups (6-10 households) of local farmers living below the poverty line and with little or no private land resources, is another community based forest management program, jointly implemented by the Department of Forests (lead) and Department of Livestock. The objective is to provide forest-based economic opportunities to the poor farmers of the hills, who are proportionately more dependent on natural resources (International Fund for Agricultural Development (IFAD), 2004). A total of 8,757 ha of degraded forest in the landscape has so far been leased to 2,038 leasehold forestry groups, involving 15,617 households in 11 districts (Table 7.3; DoF, 2012c).

Leasehold forestry has been successful in restoring degraded lands and improving local livelihoods in some areas, especially the shifting cultivation areas in Palpa, Nawalparasi, Tanahu, and Chitwan Districts. Effective protection of forest and a zero grazing approach has led to substantial improvement in the condition of many forests, including increments in species diversity. Income generating activities have led to improved income of the user households (Development Vision, 2005).

Figure 7.2: Growth of Protected Areas in Chitwan-Annapurna Landscape

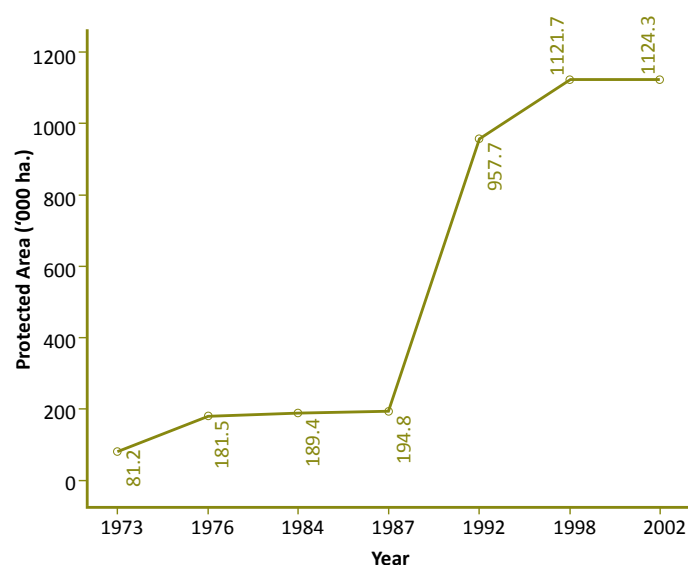


Table 7.2: Community Forestry in Chitwan-Annapurna Landscape

S. N.	District	Area (ha)	Users	
			No. of CFUGs	No. of Households
1	Chitwan	18,055	64	34,056
2	Nawalparasi*	14,891	111	23,395
3	Makwanpur*	34,918	163	30,547
4	Arghakhanchi*	10,096	230	25,962
5	Tanahu	33,229	513	50,097
6	Palpa*	14,567	319	25,213
7	Gulmi*	14,751	363	52,913
8	Baglung*	11,727	332	40,892
9	Parbat	11,815	351	40,069
10	Syangja	10,554	423	45,046
11	Kaski	14,680	421	35,451
12	Lamjung	19,334	304	24,825
13	Dhading	25,241	628	64,799
14	Nuwakot	20,755	277	30,348
15	Myagdi*	19,885	256	29,763
16	Gorkha	21,480	447	53,333
17	Rasuwa	2,580	63	4,972
18	Manang	6,738	19	1,129
Total		305,296	5,284	448,753

* Part of the district falls outside CHAL. The statistics, which are computed based on VDCs, can slightly differ as a few VDCs are divided by the landscape boundary.

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Table 7.3: Leasehold Forestry in Chitwan-Annapurna Landscape

S.N.	District	Area (ha)	Users	
			No. of FUGs	No. of HHs
1	Chitwan	1,532	359	2,557
2	Nawalparasi*	185	16	181
3	Makwanpur*	2,076	446	3,032
4	Tanahu	1,889	455	3,315
5	Palpa*	246	19	227
6	Gulmi	71	7	71
7	Syangja	82	8	82
8	Lamjung	366	110	907
9	Dhading	1,723	430	3,785
10	Baglung	4	2	14
11	Gorkha	583	186	1446
Total		8,757	2,038	15,617

Note: The area figures rounded to nearest whole number.

*The statistics refer to the whole district even though parts of the district fall outside CHAL.

Some of the successes of the leasehold forestry program can be seen in the traditional shifting cultivation areas of Jhirubas (Palpa) and Hupsekot (Nawalparasi) where the program has been piloted since 2010 by the technical assistance component of the leasehold forestry and livestock program. Hundreds of hectares of degraded forest land in these sites have been planted primarily with broom grass (*Thysanolaena maxima*; see Photo 7.1).

The pilot program has also been successful in pooling resources from different agencies for implementing different rural development programs. For example,

in 2011 alone, over 13 million rupees equivalent of resources in four districts (Palpa, Gulmi, Nawalparasi, and Syangja) were pooled for different purposes, including solar energy installation, drinking water, latrine construction, non-formal education, and Non-Timber Forest Product (NTFP) cultivation. The Hupsekot Leasehold Forestry Inter-group also won the “Mountain Development Award 2011” of NRs 100,000 and a letter of appreciation from the Government of Nepal (Bhattarai et al., 2011). There is good scope for replication of this successful leasehold forestry model in the entire shifting cultivation region of CHAL that covers parts of Nawalparasi, Palpa, Tanahu, Chitwan and Gorkha Districts.

7.2.3 Buffer Zone Community Forestry

Breaking the tradition of managing national parks and wildlife reserves under a rigid top-down approach, the government, in 1996, introduced an innovative, decentralized system for managing forests in buffer zones of national parks and wildlife reserves. The program is being implemented by the Department for National Parks and Wildlife Conservation, in cooperation with national and international NGOs and the local communities.

In CHAL, three of the protected areas have declared buffer zones. The first buffer zone was established in 1996 in Chitwan National Park. Currently, 40,303 households residing in these three buffer zones are managing 127 community forests covering a total area of 18,046 ha (Table 7.4; DNPWC, 2012).



Photo 7.1: Broom Grass (*Thysanolaena maxima*) Plantation in a Leasehold Forest at Hupsekot, Nawalparasi

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Table 7.4: Buffer Zone Community Forestry in Chitwan-Annapurna Landscape

Location	No. of BZCFs	BZCF Area (ha)	Users	
			No. of HHs	No. of People
Chitwan National Park	47	8,319.9	24,383	136,740
Langtang National Park	49	1,835.6	5,419	520,00
Parsa Wildlife Reserve	31	7890.7	10,601	555,91
Total	127	18,046.2	40,403	244,331

7.2.4 Participatory Management of Conservation Areas

Implemented in Annapurna and Manaslu Conservation Areas, this program involves establishing Conservation Area Management Committees at the local level to oversee management of natural resources under the authority of the Conservation Area Management Regulations. The committees promote economically viable and ecologically sustainable activities in and around a multiple use area, including alternate sources of energy, and local tourism for enhancing their livelihood opportunities.

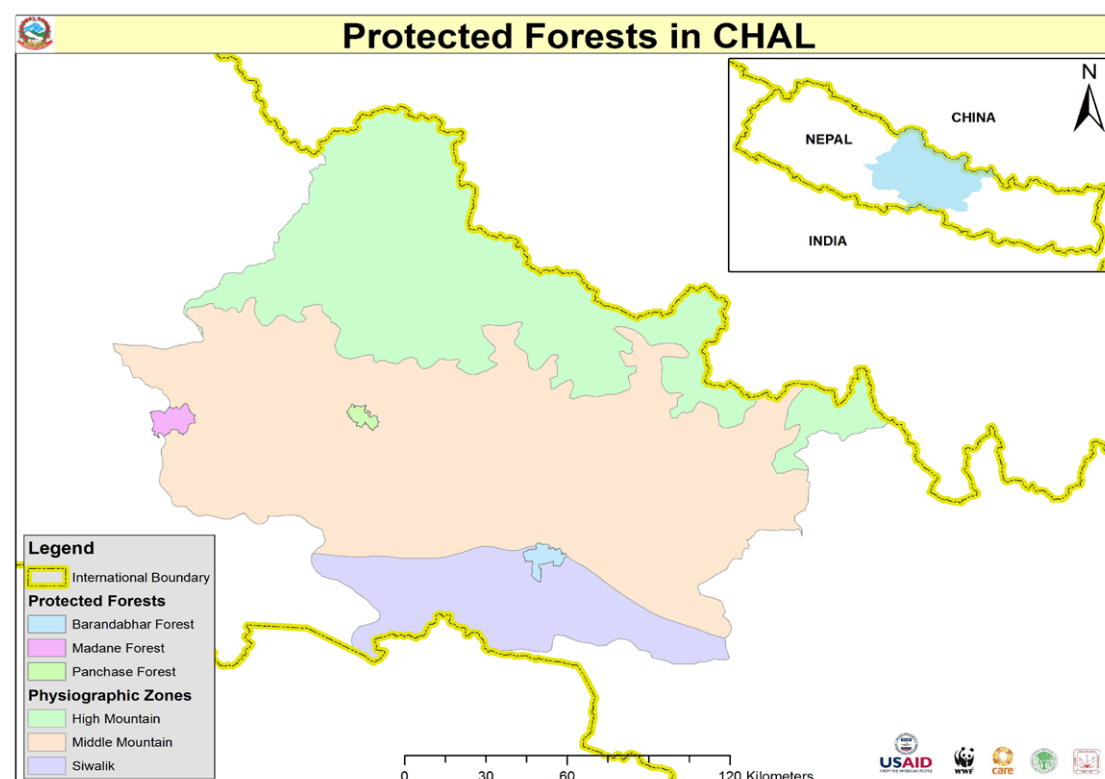
One of the unique characteristics of this management system is that local residents are allowed to live and own private property within the boundaries of a protected area and

maintain their traditional rights to access and use natural resources. Capacity building of local people to manage local natural resources, eco-tourism development, alternative energy programs, and conservation awareness camps are some of the main activities implemented. Promotion and management of mountain tourism for local community development is one of the successful initiatives in Annapurna Conservation Area (Bajracharya *et al.*, 2006).

7.3 Establishment of Protected Forests

The Government has recently declared three forest complexes in CHAL, including Barandabhar, Madhane and Panchase, as protected forests (Figure

Figure 7.3: Protected Forests in the Chitwan-Annapurna Landscape



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Table 7.5: Protected Forests in the Chitwan-Annapurna Landscape

S.N.	Name	Size (000 ha.)	Location	
			District	Physiographic Zone
1	Barandabhar	10,466	Chitwan	Siwaliks
2	Madhane	13,761	Gulmi, Baglung	Midhills
3	Panchase	5,776	Kaski, Parbat, Syangja	Midhills
	Total	30,003		

7.3; Table 7.5). Enhancing biodiversity through rehabilitation of habitats of rare and important species, biological corridors, and wetlands; achieving self-dependence on forest products through development of multi-storey and multiple use forests, and enhancing local livelihoods through implementation of income generating activities, including market-oriented green enterprises and tourism are the main objectives of protected forest management (Thapa, 2011).

A number of activities aimed at forest conservation and livelihoods enhancement have been initiated as part of protected forest management. In Panchase, for example, these activities are currently being implemented: (i) skill development on producing NTFP-based products; (ii) REDD awareness training; (iii) support to renew community forest operational plans with provisions for climate adaptation; (iv) organization of inter-district forestry coordination meetings; (v) establishment of demonstration plots for important species (orchids and rhododendrons); (vi) establishment of forest nurseries; (vii) training on forest fire control; (viii) publication of booklets and brochures; (ix) support to activities promoting ecotourism (homestay, management of museum on culture of local indigenous communities), and (x) support to off-season vegetable farming.

7.4 Formulation and Implementation of Policies and Strategies

The government has put effort into formulating some policies, strategies and plans for conservation and sustainable management of forests. Some of such recent efforts include formulation and implementation of the Nepal Biodiversity Strategy (2002) and Nepal Biodiversity Strategy Implementation Plan (2006-2010); Collaborative Forest Management Directives (2003); Herbs and Non-Timber Forest Products Policy (2006); REDD Readiness Program Proposal (2010); National Adaptation Program of Action (2010), and the Forest Encroachment Control Strategy (2011). The

Department of Forests is reportedly in the process of finalizing forest product collection and sales, and monitoring guidelines for community forests to address the issue of financial irregularities that have surfaced in some places in recent years.

7.5 Law Enforcement

In spite of several limitations, forestry administration has been making efforts to control deforestation and forest degradation and conserve forest resources under its jurisdiction through enforcement of existing legislations. Compilation of information on forest area encroachment in the three Terai districts of the Western Development Region by the Western Regional Forestry Directorate, and reclamation of some of the encroached forest lands in Chitwan (60 ha) and Nawalparasi (85 ha) districts during 2010-2011 are some evidence of the most recent efforts. The achievements, however, are very limited and less than satisfactory.

7.6 Awareness Raising Campaigns and Training

Many Community Forest User Groups and Leasehold Forestry Groups are implementing awareness campaigns against forest fire. The Ministry of Forests and Soil Conservation, Department of Forests and some district forest offices are using different media (television, radio) to raise awareness on forest fire, uncontrolled grazing, and afforestation. Several television channels and newspapers regularly broadcast or publish news related to forest conservation, including illegal logging, timber smuggling, and forest fires. Training on REDD awareness and forest fire control are important components of protected forest management. Similar awareness raising activities are also being implemented in Annapurna and Manaslu Conservation Areas and the Buffer Zones of Chitwan National Park, Langtang National Park and Parsa Wildlife

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Reserve. In addition, Panchase Protected Forest management has establishment demonstration plots for some important species, including orchids and rhododendron.

7.7 Alternative Energy

Promotion of improved cooking stoves, bio-energy, solar energy, hydropower development and rural electrification are integral components of conservation area management. Similar activities have been recently initiated in some protected forest sites (e.g. Madhane). Bio-briquettes are becoming popular in some areas.

7.7 Afforestation and Reforestation

Reforestation of deforested sites and enrichment plantation in degraded forest patches are regular activities implemented by most Community Forest User Groups (CFUGs). For example, according to an unpublished record available in the District Forest Office, around 245 ha of reclaimed forest encroachment sites at Padampur (Jutpani VDC), Gardas and Barhachoti (Dahakhani VDC) in Chitwan District have been reforested by respective CFUGs in recent years. CFUGs often use high value timber or non-timber species to reforest deforested or degraded forest areas (e.g. *Cinnamomum* sp. is a popular choice in Palpa). Most district forests distribute seedlings for institutional and private plantations during the monsoon season.

7.8 Piloting REDD+ and PES

There have been some initiatives towards implementing REDD+ and PES in the landscape. The Norwegian Agency for Development

Cooperation (NORAD)-funded REDD+ pilot project (2009-2013) is being implemented by International Centre for Integrated Mountain Development (ICIMOD), with FECOFUN and the Asian Network for Sustainable Agriculture and Bioresources (ANSAB), in community forests of two watersheds: the Kayarkhola Watershed in Chitwan District and Ludikhola Watershed in Gorkha District. This project has prepared a sub-national level REDD Strategy and Measurement, Reporting and Verification (MRV) system by using a combination of remote sensing analysis and field measurements by CFUGs. It has provided useful insights and ideas of challenges, which can help improve design and implementation of REDD projects in the near future.

PES schemes implemented at the Kulekhani Hydropower Project in Hetauda District (outside CHAL), and Rupa Lake in Kaski District, have established mechanisms for compensating upstream CFUGs for their efforts to conserve forest and soil in the catchments, and local benefit-sharing.

7.9 Review and Possible Revision of Forest Department's Organizational Structure

Currently, the Ministry of Forests and Soil Conservation is contemplating changing the organizational structure and responsibilities within the Department of Forests, with the objective of making the District Forest Offices more focused on the technical aspects of forest management. The idea is to have a separate entity to take care of forest product collection and distribution. A taskforce coordinated by a Joint Secretary was known to be drafting a proposal to this effect in 2012.

8

Challenges and Gaps in Addressing the Drivers of Deforestation and Forest Degradation

8.1 Financial Constraints

The overwhelming majority of forestry officials consulted in Kathmandu and in districts identified financial constraints as the major challenge for abating deforestation and forest degradation. Inadequate budget in districts for day-to-day operations (including DSA for field staff, staff transportation, collection and transportation of seized timber etc.) has severely hampered efforts to contain illegal logging and forest encroachments in Chitwan, Nawalparasi and Makwanpur districts. Budgetary constraints in District Forest Offices have also negatively affected technical support to CFUGs. Many forestry field offices that were destroyed during the insurgency period have not yet been reconstructed or repaired due to financial constraints, thereby resulting in lack of or poor infrastructural facilities particularly in the field (sub-district and range post levels). Lack of financial resources has been a bottleneck in expanding good forestry practices (e.g. successful leasehold forestry models) to wider areas.

8.2 Political Interference

Excessive political interference in day-to-day activities of forestry administration has caused demoralization of staff at all levels in general and the district and field levels in particular. Most forest encroachment is either taking place with direct or indirect involvement of influential politicians or the encroachers have strong backing from political parties, which makes it difficult for DFOs to take action against them. Extended political transition and instability have aggravated the situation in recent years.

8.3 Insufficient Human Resources and Technical Capacity

Most of the District Forest Offices are currently understaffed, which has negative effects on forest conservation. For example, lack of technical capacity for forest inventory and other technical aspects makes most Community Forest User Groups dependent on the concerned District Forest Office for such services, but inadequacy of staff makes it difficult for these offices to assist CFUGs in times of need. This has hampered timely preparation or renewal of community forest operational plans in many cases. Some CFUGs, which have sufficient income, hire independent consultants for the task but the vast majority is compelled to wait (sometimes for years) for DFO assistance before they can renew their community forest operational plans and implement forest utilization and management activities. Understaffing has a direct implication for forest protection in the Siwaliks and high mountain districts.

Insufficient human resources together with poor technical capacity and motivation of technical staff have posed a great challenge in controlling deforestation and implementing scientific forest management. Lack of fire-fighting equipment and training has been a major barrier for local communities as well as agencies in controlling forest fires.

8.4 Corruption

Forest conservation is challenging due to weak law enforcement and corruption. Nepal has very strong forest legislation and institutional structures

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to control illegal activities but due to weak law enforcement there are incidences of corruption, with cases filed in court against some Government employees and members of Community Forestry User Groups. Corruption is deeply intertwined with illegal logging, particularly in forest areas with road access.

Maintaining financial transparency in community forest management has been problematic due to both the lack of a uniform policy and guidelines on harvesting and sale of forest products, and weak monitoring by the Department of Forests and FECOFUN.

8.5 Poor Levels of Trust, Coordination and Cooperation among Stakeholders

Poor levels of trust between government and non-government stakeholders, and lack of coordination and cooperation among different government agencies is a major challenge in controlling deforestation and forest degradation. Poor levels of trust between the Ministry of Forests and Soil Conservation and FECOFUN is a major issue, which is evidenced by the fact that a recent attempt by the Ministry to amend the Forest Act of 1993 has not been successful due to strong opposition to the proposed amendment by FECOFUN.

Efforts of District Forest Offices to control forest encroachment in the lowlands of the Siwaliks have received little or no cooperation from other government agencies. Instead, some public agencies themselves (such as those under the Ministry of Physical Planning and Works, Ministry of Energy, and Ministry of Education) have been encroaching forestland by ignoring the provisions of forestry legislation.

8.6 Ad-hoc Decisions

Ad-hoc decisions by central level policy and decision makers are another factor which can be linked to deforestation and forest degradation. An example of such a decision relates to the ban on the harvest of old, diseased, and even standing dead trees from government forests. The exact reason behind such a decision is unknown. It could simply be due to lack of knowledge of scientific principles or it could be aimed at avoiding controversy

and getting cheap popularity on the part of the decision-maker. Whatever the reason behind it, these non-scientific and illogical practices are detrimental and barriers in sustainable forest management. This might also indirectly encourage illegal logging.

8.7 Non-existence of Scientific Land Evaluation and Land Use Planning System

Each kind of land use has a set of conditions which are favorable or adverse to that use. A severe limitation to one kind of land use may be less serious or even beneficial to another use. Making appropriate decisions about use of land for different purposes requires scientific land evaluation and land use planning. Moreover, land use planning can help resolve disputes with regard to local and indigenous communities' tenure systems and land uses. In the absence of an established system of land evaluation and land use planning, most decisions related to management of forests and other natural resources in the landscape are ad-hoc.

8.8 Inadequate Knowledge and Capacity to Control Invasive Alien Species

Poor knowledge on the mode of propagation, extent, and control; absence of separate legislation, strategy and action plan for control and management; and inadequate quarantine and detecting capacity of the customs and quarantine departments are some of the major gaps that pose challenges in controlling invasion of alien species.

8.9 Challenges in Implementing REDD and REDD+

Despite high potential and growing interest and support from the government and donors, implementation of REDD and REDD+ in CHAL has so far been limited to a pilot scale project in Chitwan and Gorkha Districts. One of the challenges in implementing REDD+ relates to developing a viable strategy for setting reference levels for carbon credits and establishing a suitable benefit sharing mechanism that is agreeable to

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stakeholders at the national, district and local levels. Ensuring rights of the local forest user groups who are managing and utilizing forest resources and involving private sector are other important needs and challenges for long-term sustainability of REDD+ schemes.

Getting effective participation of local communities, most of which are poor, in the REDD process could be difficult as they use most of their time in searching for opportunities to meet their daily subsistence needs. Some other limitations for implementing REDD and REDD+ in CHAL (and Nepal) include the following:

The difficult and cumbersome process in accessing international financial mechanisms that requires measuring carbon and showing both additionality and permanence of the carbon stock is a major challenge for CFUGs and government agencies.

Nepal may not be a priority country for REDD (a mechanism for mitigating climate change), so considering only carbon credits may not be a beneficial strategy for Nepal.

REDD is not directly linked to biodiversity, which could be a matter of particular concern for the Hariyo Ban Program.

8.10 Limited Participation of Women and other Disadvantaged Social Groups

Although there are some positive signs, the participation of women and other disadvantaged social groups in forest governance and management continues to be limited. Achieving effective participation of these groups is a challenge.

Strategies to Address the Drivers of Deforestation and Forest Degradation

9

9.1 Reducing Forest Dependency

Reducing dependency of households on forests for meeting their energy and timber demands should be an important strategy to reduce deforestation and forest degradation. This, among others, will involve: (i) development and promotion of non-conventional energy sources (such as biogas, solar energy, and hydropower); (ii) promotion of alternatives to construction timber (e.g. bamboo, steel, aluminum); (iii) promotion of agro forestry and private forestry where feasible, and (iv) improving access to technologies that enhance wood fuel efficiency (e.g. bio-briquettes, improved stoves). Slowing of population growth will help long term sustainability of any measure intended to reduce forest dependency.

9.2 Addressing Poverty and Livelihood Issues

Addressing the widespread poverty and livelihood issues requires identifying conservation strategies that favor livelihoods, while achieving conservation, including: (i) promoting sustainable green micro-enterprises and other off-farm income generating activities to enhance rural livelihoods and income; (ii) integrating poverty reduction and livelihoods strategy with forest management strategy (in community, leasehold, buffer zone, and protected forests), and (iii) promoting PES and REDD+ as means of income generation by forest-dependent local communities.

Other strategic options include increasing non-forestry employment opportunities for poor and marginalized communities through increased investment in those areas, by: (i) providing vocational education to landless, poor and marginalized local people; (ii) making small farmers more competitive by helping

them overcome market, capital, technical, and management problems, and (iii) reviewing and, if necessary, revising the regulatory system (e.g. regulation on private forestry).

9.3 Improving Law Enforcement and Overall Forestry Sector Governance

It is widely believed that the enforcement of law and overall governance of the forestry sector in Nepal is weak, which is a major barrier in controlling deforestation and forest degradation. Combating illegal logging and other illegal activities requires substantial enhancement of law enforcement through: (i) provision of adequate financial and human resources to district and field level offices; (ii) designing and implementing effective monitoring and evaluation systems at different levels; (iii) introducing transparent reward and punishment systems for government staff and local user groups; (iv) identifying and implementing safeguards against political interference; (v) enhancing technical capacities of forestry staff and user groups, and (vi) enhancing coordination and cooperation amongst government law enforcement agencies (e.g. police, armed police, and army).

Other strategic options for improving governance include: (i) resolving land tenure related issues; (ii) enhancing political awareness and will through sensitization of political parties and influential politicians on forestry governance issues; (iii) empowering CFUGs and local agencies (such as VDCs); (iv) eradicating bribery, corruption and impunity, and (v) reviewing and, if necessary, revising organizational structure, policies and regulatory systems. These measures can bring renewed commitments by donors and attract investments from private sector, which will ultimately help effectively abate deforestation and forest degradation and reduce carbon emissions.

9.4 Promoting Sustainable Management of Forests

Scientific management of community and government-managed forests is required to maximize benefits for the forestry sector to their full potential. This will not only ensure sustainability but will also lead to legal production of essential forest products, some of which are currently being supplied illegally, and help meet ever increasing demand. Moreover, sustainable forest management can also help forest managers to reduce the risk of damage and possible losses from changing climatic conditions and also to undertake effective mitigation actions.

The management plans of community forests need to be developed or revised to balance protection with active forest management, which could be a strategic solution to increase the supply of fuel wood and other basic products from the community forests, and avoid a pressure shift to government-managed forests. Management plans need to be based on the principles of specific ecosystem management approaches to increase positive impacts on conservation outcomes and help meet biodiversity and climate change objectives along with community needs.

9.5 Supporting Community Based Conservation

Experience shows that community based forest management programs have been relatively more successful in ensuring forest restoration and conservation. Further efforts should be made to ensure the rights of local and indigenous communities to protect and enhance their forest-based livelihoods. Some of the actions required include: (i) protecting the rights of local and indigenous communities with respect to wood and non-wood forest products (e.g. medicinal herbs), (ii) providing alternative energy; (iii) giving special care to the culture, skill and tradition of indigenous and ethnic people; (iv) promoting NTFP-based forest enterprises and tourism based on local culture and environment, and (v) increasing access of remote communities to education, health services, electricity, drinking water, and communications technologies.

9.6 Promoting Agroforestry and Private Forestry

Agroforestry can help control deforestation and forest degradation primarily in two ways: (i) by reducing the need to deforest additional land for agriculture, and (ii) by providing alternative sources of forest products to the local population. Agroforestry can also help conserve biodiversity by providing an alternative habitat for partially forest-dependent native plant and animal species that would not be able to survive in a purely agricultural landscape. Moreover, in a landscape (such as CHAL) where the forests are fragmented and scattered over the agricultural areas, agroforestry can be a benign matrix land use that can better serve as a biological corridor than agricultural fields (Schroth et al., 2004).

There is a need for participatory research on different aspects of agroforestry, including to: (i) develop indicators and effective monitoring systems to assess the ecological services fulfilled by agroforestry systems in different physiographic zones; (ii) determine the effectiveness of different types of agroforestry systems as biological corridors; (iii) develop methods of increasing the productivity of traditional agroforestry systems while maintaining biodiversity benefits, and (iv) identify indigenous tree species suitable for shading cash crops (such as coffee and tea). The government should consider providing some incentives (such as exemption from land tax) to farmers opting for agroforestry and private forestry in their private land.

9.7 Reclaiming and Restoring Encroached Forestlands and Controlling Further Encroachment

There is an urgent need to address the chronic problem of forest area encroachment for non-forestry uses. This is a complex issue requiring a coordinated approach and efforts involving several strategic measures, including: (i) sensitizing political parties, political leaders, policy-makers, planners, DDCs, VDCs and other district and local level authorities to the issue; (ii) identifying and addressing inconsistencies and conflicts between forestry and other sector policies and legislation;

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(iii) enhancing law enforcement capacity of district forest offices; (iv) improving coordination and cooperation of relevant agencies related to planning and execution of development projects; (v) fully and compulsorily implementing Environmental Impact Assessment (EIA)/Initial Environmental Examination (IEE) provisions for all projects that use forestland, and (vi) providing alternative land outside forest boundaries for new settlements and urban expansion. Reclaimed forestland should be reforested by recognizing the need to enhance human well-being and restoring long-term ecological integrity at the landscape level.

9.8 Optimal and Sustainable Financing for Forestry Research and Development

One of the widely believed underlying causes of forest loss or degradation in Nepal is the failure of government planning procedures to optimally account for forest values, and allocate an optimum budget for forestry operations. One of the reasons behind this is the low power and influence of Ministry of Forest and Soil Conservation (MoFSC) on the central planning system as compared to many other ministries. The imbalance in power and influence often results in inappropriate land use decisions and lower budgetary allocations to the MoFSC.

There is a need for improving coordination amongst the MoFSC, National Planning Commission and Ministry of Finance for promoting policy-planning linkages so that there is adequate budgetary allocation for forestry research and development. The MoFSC also needs to take a more proactive approach in raising funds from external sources (donors, INGOs). Lobbying to optimally account for forest values during evaluation of contributions from the forestry sector in government planning procedures is another important strategic option for controlling deforestation and forest degradation.

9.9 Enhancing Inter-Agency Coordination and Cooperation

As the drivers of deforestation and forest degradation are diverse and relate to different government agencies within the Ministry of Forest

and Soil Conservation and beyond, there is a need for improving coordination among these agencies (such as agriculture, physical planning and works, roads, energy etc). For example, effective cooperation between the District Forest Office and the police is required for controlling forest encroachment. Consensus between the Ministry of Forests and Soil Conservation and FECOFUN on major issues is required for smooth functioning and further development of community forestry.

9.10 Capacity Enhancement

This includes the following:

- Enhancing capacity of Community Forest User Groups and the Department of Forests for scientific forest management through appropriate training or refresher training;
- Building the capacity of forestry staff and community based Forest User Groups for MRV systems related to REDD;
- Raising awareness and improving communities' organizational capacity. This can involve forming alliances amongst different stakeholders in civil society, and raising awareness about the consequences of deforestation in affected communities and amongst the general public. Training programs should cover aspects such as the establishment of conditions for local decision-making, and strengthening of planning processes, including inter-sectoral planning. FECOFUN should take lead responsibility;
- Enhancing the law enforcement capacity of District Forest Offices to combat forest encroachment and illegal logging;
- Developing and implementing sustainable management of government-managed forests, and
- Developing and implementing more effective conservation and management of protected areas.

9.11 Increasing Efficiency of Forest Utilization

Inefficient harvest of forest products and distribution and marketing systems is one of the underlying causes of forest degradation. This needs to be addressed by: (i) developing and disseminating more efficient forest utilization

technologies (e.g. to reduce damage and waste associated with conventional logging; wastage in wood processing), and promoting technologies that enhance fuelwood efficiency (e.g. bio-briquette, improved stoves); (ii) investigating and addressing gaps and deficiencies in current forest product collection, distribution and marketing system (including value-chain analysis of main products), and (iii) enhancing the technical capacity of government forestry staff, CFUGs, and Timber Corporation of Nepal (TCN) staff through appropriate training and provision of necessary equipment and logistics.

9.12 Investigating the Effects of Climate Change

As mentioned in the preceding section, climate change can affect different aspects of forest conditions, including health and vitality, area and biodiversity. When viewed in the context that there has been continuous increase in the average annual temperature and changes in precipitation pattern in the landscape over the last three decades, the situation is alarming.

Weather related extreme events such as excessive rainfall, longer drought period, landslides and floods, frequent and severe forest fires, and invasion by alien species are speculated to have links with climate change. There is, however, clear lack of knowledge on whether, and if so, how, climate change has affected different forest ecosystems and species, and whether the effects have been variable across different elevations and aspects. This needs to be further investigated.

9.13 Implementing PES and REDD+

Despite some limitations, past studies have indicated high potential to implement REDD projects in Nepal (e.g. Karki et al., 2009; Gurung et al., 2010). There is also a growing interest and support from the government and donors. The NORAD-funded REDD+ pilot project has provided useful insights and ideas of challenges. These developments have laid a good foundation for launching PES and REDD+ projects in selected sites within CHAL.

9.14 Controlling and Managing Invasive Alien Species

The following strategic actions are required:

- Abating forest degradation by controlling over grazing, forest fires, and over harvesting;
- Conducting a thorough survey on distribution, spatial extent and damage by invasive alien species. The government can also seek support from the Global Invasive Species Network;
- Conducting research on control and possible utilization of invasive alien species, and implementation of the findings;
- Preparation of a separate legislation, strategy and action plan for control and management of invasive alien species;
- Enhancing the quarantine and detecting capacity of custom and quarantine departments through appropriate facilities, training and incentives;
- Setting up invasive alien species early warning and monitoring systems;
- Formulating a separate legislation, strategy and action plan for control and management of invasive alien species, and
- Sensitizing concerned authorities on their roles and responsibilities to control invasion and spread of invasive alien species.

9.15 Controlling Forest Fires

Strategic options to control forest fires include: (i) increasing awareness and local participation in forest fire control and management; (ii) reviewing and strengthening legislative arrangements and enhancing their enforcement to discourage deliberate forest fires; (iii) replacing shifting cultivation practices by more suitable land use practices (e.g. leasehold forestry); (iv) promoting stall feeding practice and discouraging free grazing in forests; (v) preparing and implementing strategies and plans for controlling climate-induced forest fires and mitigating the effects in different physiographic zones and forest management regimes; (vi) implementing sustainable forest management by also taking into consideration fire management in the context of changing climatic conditions and the need for undertaking effective mitigation measures; (vii) developing effective mechanisms for forest fire monitoring, early

warning and control; (viii) providing training and necessary equipment to frontline forest fire fighters, and (ix) institutionalizing forest fire monitoring and control systems at different levels by involving all key stakeholders.

9.16 Controlling Overgrazing

The strategic options, among others, include: (i) collaborating among the Ministry of Agriculture, Ministry of Finance, and MoFSC to gradually replace the poor quality livestock with improved breeds through improving access of the farmers/herders to breeding programs and financial mechanisms; (ii) promoting fodder production in community-managed forests, waste lands and agricultural lands; (iii) developing or enhancing fodder reserves (e.g. silage and hay) for use during slack periods; (iv) creating off-farm income generation opportunities; (v) raising awareness of local communities on the environmental consequences of overgrazing and prospects for improving livelihoods through alternative practices, and (vi) promoting stall-feeding where feasible.

9.17 Participatory Land Use Evaluation and Land Use Planning

Implementation of the national land use policy, preparation and implementation of participatory land evaluation and land use planning, and promotion of appropriate land use and land management systems (e.g. Sloping Agricultural Land Technology (SALT) for sloping land) are some of the strategic options for controlling conversion of forestlands to non-forestry use, controlling landslides and soil erosion and enhancing productivity of agriculture lands. This should be carried out by taking into account the need to conserve forests and biodiversity, enhancing ecosystem services, and resolve any disputes with regard to local and indigenous communities' tenure systems and land uses.

9.18 Other Strategies

Encouraging development away from forestland, enhancing political will and capacity, and promoting international cooperation to control cross-border smuggling of timber and other forest products are some other strategies to control deforestation and forest degradation.

10

Opportunities for Hariyo Ban Program to Address Deforestation and Forest Degradation

10.1 Promotion of Non-Conventional Energy Sources

The Hariyo Ban Program can collaborate with relevant government and non-government agencies in the promotion of non-conventional energy sources (such as biogas, solar energy, and small hydropower), which can greatly help reduce dependency of households on forests for meeting their energy needs and control forest degradation.

10.2 Promotion of More Efficient Forest Utilization Technologies

Inefficient forest products harvest, distribution and marketing is one of the underlying causes of deforestation and forest degradation. The Hariyo Ban Program can help address this issue by: (i) providing financial and technical support to relevant agencies (e.g. Forest Research and Survey Department) to develop and disseminate appropriate forest utilization technologies; (ii) piloting and promoting use of more efficient wood technologies (e.g. particle board); (iii) collaborating with credible NGOs to promote fuelwood efficient technologies (e.g. bio-briquette, improved stoves) where appropriate and feasible; and (v) conducting research on possible utilization of invasive alien species, and support MoFSC to implement the findings.

10.3 Promotion of Forest and Biodiversity Based Livelihoods

This is especially relevant for community managed forests. Some of the specific activities include: (i) promoting NTFPs and agriculture based micro enterprises; (ii) supporting the establishment of multi-purpose private nurseries (including forest trees, NTFPs, horticulture spp.); (iii) supporting

CFUGs in the revision of community forest operational plans to make them more livelihood and conservation oriented; (iv) launching and supporting participatory survey and registration of community forest biodiversity; (v) supporting implementation of PES and REDD+ in selected sites; and (vi) providing skill-development training to poor and marginalized local people.

10.4 Extending Support to Enhance Law Enforcement

The program can: (i) extend logistical and financial support to District Forest Offices and Warden Offices to enhance law enforcement; (ii) help improve CFUGs' organizational and management capacities; and (iii) help expand community based forest management systems, especially in remote areas where law enforcement is difficult.

10.5 Introduction and Promotion of Scientific Forest Management

Not a single forest in the landscape is under scientific management at the moment, despite a need felt by all stakeholders for implementation of scientific management in community forests and government-managed forests. This is a good opportunity for the Hariyo Ban Program to take lead in this initiative. This can be started at a pilot scale in different physiographic zones. The focus should be effective and improved silvicultural operations for improving site-specific productivity with focus on local livelihoods.

Some of the specific actions include the following:

- Providing financial and technical support to CFUGs and District Forest Offices for piloting scientific forest management at a few sites;

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- Collaborating with suitable civil society organizations [e.g. Nepal Foresters' Association (NFA), Nepal Forum of Environmental Journalists (NEFEJ)] in raising awareness of politicians, media and general public on the necessity for scientific forest management;
- Organizing refresher training to District Forest Office staff and protected area staff on technical aspects of forest management;
- Providing technical and financial support to CFUGs to prepare (or revise) and implement community forest operational plans based on the principles of sustainable forest management; and
- Helping for certification of community forests.

10.6 Supporting Expansion of Leasehold Forestry and Community Forestry

There is a good scope for replicating the successful model of leasehold forestry that is currently being implemented in Jhirubas (Palpa) and Hupsekot (Nawalparasi) to other parts of the landscape, including the shifting cultivation areas in the Narayanghat-Mugling corridor (on both sides of the Trishuli River). The leasehold forestry program is likely to face severe financial challenges to continue the activities after the IFAD support comes to end in 2013. Hariyo Ban can fill in the financial vacuum and collaborate with the Department of Forests to continue and expand the good practices initiated by the leasehold forestry program. The program can also help expand community forestry, especially in remote areas where government-managed forests virtually remain as open access due to inadequate capacity of District Forest Offices to enforce forest law.

10.7 Promotion of Agroforestry and Private Forestry

As agroforestry is already in practice in most parts of the landscape, there is a good scope and opportunity for the Hariyo Ban Program to further enhance this land use system through necessary research, extension, and suitable incentive measures. Participatory research is needed to: (i) assess the ecological and economic services fulfilled by agroforestry systems in different physiographic zones; (ii) determine the effectiveness of different types of agroforestry systems as biological

corridors; and (iii) develop methods of increasing the productivity of traditional agroforestry systems while maintaining biodiversity benefits.

10.8 Increasing Effectiveness of Protected Forest Management

Protected forest is a relatively new paradigm in the management of natural forests in Nepal. The government has recently declared three forests in CHAL as protected forests (Barandabhar in Chitwan, Madhane in Gulmi, and Panchase in the region bordering Kaski, Parbat and Syangja) and has started implementation of some forest management and livelihood enhancement activities. While International Union for Conservation of Nature (IUCN), United Nations Development Program (UNDP) and United Nations Environment Program (UNEP) are planning joint implementation of a forestry ecosystem project in Panchase, Hariyo Ban should consider extending similar support to the Ministry of Forests and Soil Conservation for the management of Barandabhar and Madhane protected forests. The support can start from preparation of forest-specific management plans.

10.9 Supporting Restoration of Deforested and Degraded Forestlands

The program can provide financial and technical support to the Department of Forests to reforest reclaimed forest encroachment sites and other deforested sites.

10.10 Facilitation to Enhance Inter-Agency Cooperation

The Hariyo Ban Program can facilitate to improve cooperation between MoFSC and FECOFUN, and FECOFUN and NTNC for improved conservation and sustainable management of forests. The program can also facilitate and technically support development and implementation of integrated local level planning and monitoring systems for district and local level infrastructure projects.

10.11 Training and Extension

Some of the specific activities include:

- Building capacities of CFUGs and forestry staff for MRV system related to REDD;

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- Providing skill-development training and supporting vocational education to poor and marginalized local people;
- Launching awareness raising campaigns to promote suitable and sustainable alternatives to construction timber (e.g. bamboo, steel, aluminum);
- Organizing refresher training to District Forest Office and protected area staff on technical aspects of forest management;
- Raising awareness about the consequences of deforestation among the relevant government agencies, DDCs, VDCs, affected communities and amongst the general public;
- Helping MoFSC to develop strategy and guidelines for optimally accounting forest values;
- Collaborating with MoFSC and suitable civil society organizations to sensitize political parties and influential politicians on deforestation and forest degradation related issues (e.g. forest encroachment for infrastructure development, resettlement, etc.);
- Extending the necessary financial and technical support to DoF to raise awareness about forest fire through media and other means;
- Raising awareness of local communities about the environmental consequences of overgrazing and prospects for improving livelihoods through alternative practices;
- Providing training and logistical support to enhance quarantine and detecting capacity of customs and quarantine departments with regard to invasive alien species; and
- Extending financial and technical support to the government to set up invasive alien species early warning and monitoring systems.

10.12 Supporting Implementation of REDD+ and PES

REDD and REDD+ offer opportunities for immediate financial benefits from halting deforestation and sustainable forest management. The Hariyo Ban Program should review the components and *modus operandi* of the pilot REDD+ and PES projects in detail and consider

replicating them in selected sites. The program can collaborate with the Multi-Sector Forestry Program, ICIMOD and other suitable agencies in this activity.

10.13 Investigating and Impacts of Climate Change Adaptation Measures

Weather related extreme events such as excessive rainfall; longer drought periods; landslides and floods; frequent and severe forest fires; and invasion by alien species are speculated to have links with climate change. The existing knowledge, however, is insufficient to fully understand the impacts of climate change on different forest ecosystems and species across different elevations and aspects. The Hariyo Ban Program should investigate this further.

10.14 Support to Control and Manage Invasive Alien Species

In addition to the capacity building support mentioned above, the Hariyo Ban Program should conduct a survey and research on control and possible utilization of invasive alien species, and support MoFSC to implement the findings.

10.15 Controlling Forest Fires

The program should consider providing technical and financial support to District Forest Offices to prepare and implement strategies and plans for controlling forest fires in different forest management regimes. Moreover, it can extend the necessary financial and technical support to the Department of Forests to raise awareness about forest fires through different media, and provide training and equipment to CFUGs and District Forest Offices for firefighting. The program can also play a role in incorporating the provisions of forest fire management in community forest management plans by taking into consideration changing climatic conditions.

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Annexes

Annex 4.1: Checklist for Assessing Drivers of Deforestation and Forest Degradation

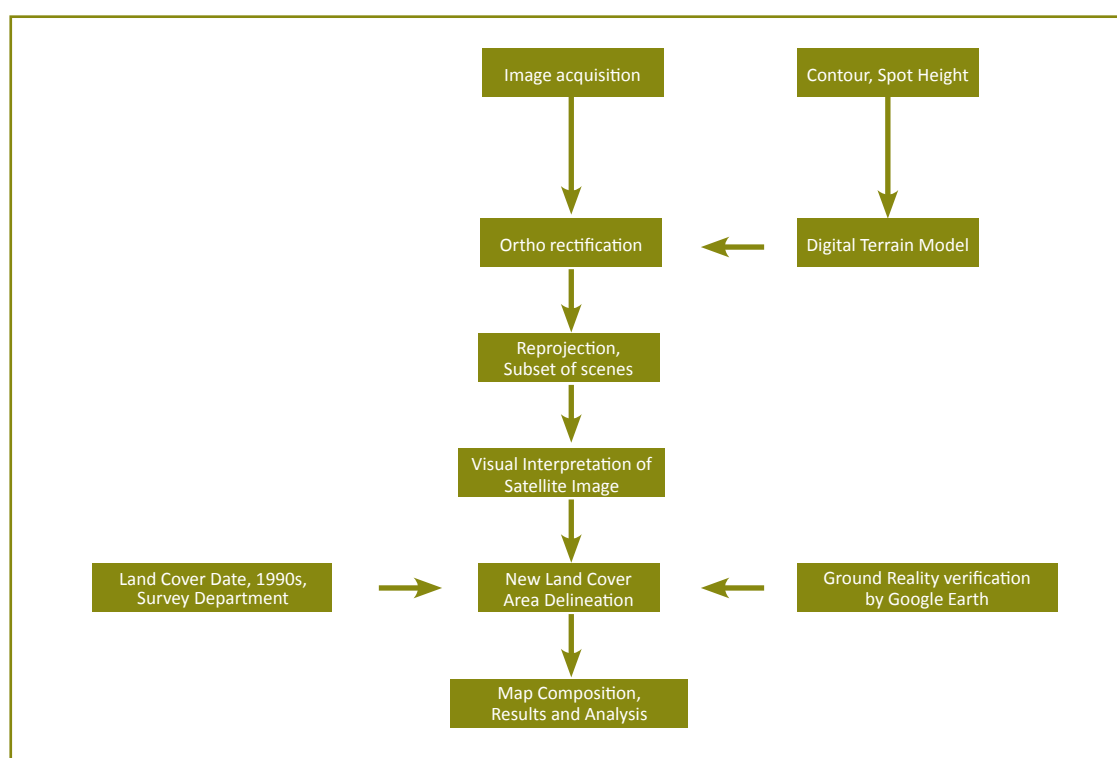
Subject	Checklist of Data Need	Possible Data Source and Collection Methods												Remarks
		Secondary	RS/ GIS	Stakeholder consultation meetings			KII			FGD		Obs		
				C	D	Co	C	D	Co	D	Co			
General Status	Trends of forest cover changes over the last three decades	X	X	X	X	X	X	X	X	X	X	X		Questions in consultation meetings, key informant interviews and focus group discussions to relate relevant spatial scale (district or community)
	Area deforested/degraded	X	X	X	X	X	X	X	X	X	X	X		
	Major locations – deforested/degraded	X	X	X	X	X	X	X	X	X	X	X		
	Major forest gained/improved areas	X	X	X	X	X	X	X	X	X	X	X		
	Invasive Alien Species (IAS) infestation – major sp., locations, extent of coverage	X		X	X	X	X	X	X	X	X	X		
	Major forest encroachment areas	X		X	X	X	X	X	X	X	X	X		
	Forest fire prone areas	X	X	X	X	X	X	X	X	X	X	X		
Direct drivers	Open areas available for reforestation/afforestation	X		X	X	X	X	X	X	X	X	X		Community level focus group discussions will be with social groups (women, Dalits etc) to be conducted by the GIS expert. This is applicable to all cases.
	Identification			X							X	X		
	Validation of secondary information			X							X	X		
	Ranking			X							X	X		
Underpinning drivers	Identification			X							X	X		Participatory ranking in 4 ordinal scales – rank 1 to most important and 4 to least important
	Validation of secondary information			X							X	X		
	Ranking			X							X	X		

Annex 4.2: Satellite Images Used in Land Use Classification

Year	Satellite type and sensor	Path	Row	Date
2010	Landsat 5 TM	141	40	7-Nov-09
		141	41	7-Nov-09
		142	40	3-Dec-10
		142	41	5-Feb-11
		143	40	7-Dec-09
2000	Landsat 7 ETM+	141	40	22-Nov-00
		141	41	27-Dec-01
		142	40	13-Dec-99
		142	41	13-Dec-1999***
		143	40	25-Dec-01
1990	Landsat 5	141	40	12-Oct-88
		141	41	31-Oct-89
		142	40	10-Nov-90
		142	41	7-Nov-89
		143	40	17-Nov-90

*** This scene with cloud cover area was masked by the scene of 2 February 2002

Annex 4.3: A Simplified Procedure Used in Land Use Mapping



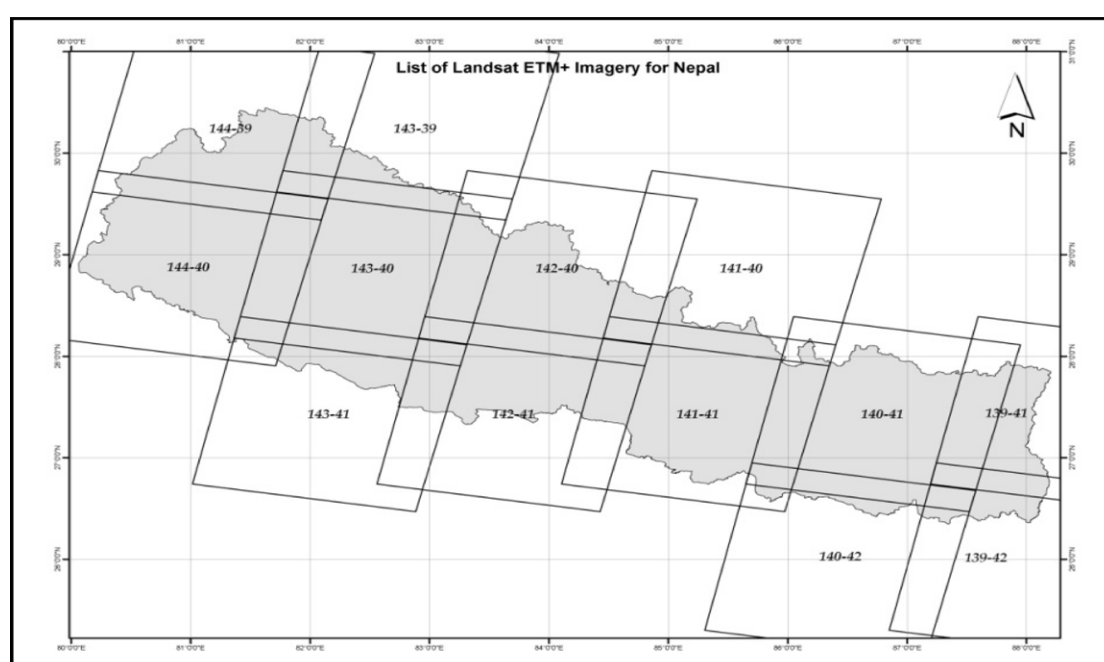
Annex 4.4: Methodology Used in the Analysis of Forest Canopy Density

The following steps were involved:

a) Delineation of landscape boundary – using the Gandaki Basin boundary

b) Selection of image scenes

Altogether 18 image scenes (six scenes each for 1990, 2000 and 2010) were used in the analysis. Satellite images of Landsat mission after 2003 are with scan line gaps because of malfunctioning of SLC correction instrument onboard. So, images used after 2003 are also Landsat TM. All the imagery were downloaded from the USGS web site free of cost. The images are from different months, ranging from September to December.



Year	Landsat TM Scenes Path (p) and Row (r)					
1990	p141r040	p141r041	P142r040	P142r041	P143r040	P143r041
2000	p141r040	p141r041	P142r040	P142r041	P143r040	P143r041
2010	p141r040	p141r041	P142r040	P142r041	P143r040	P143r041

c) Image enhancement

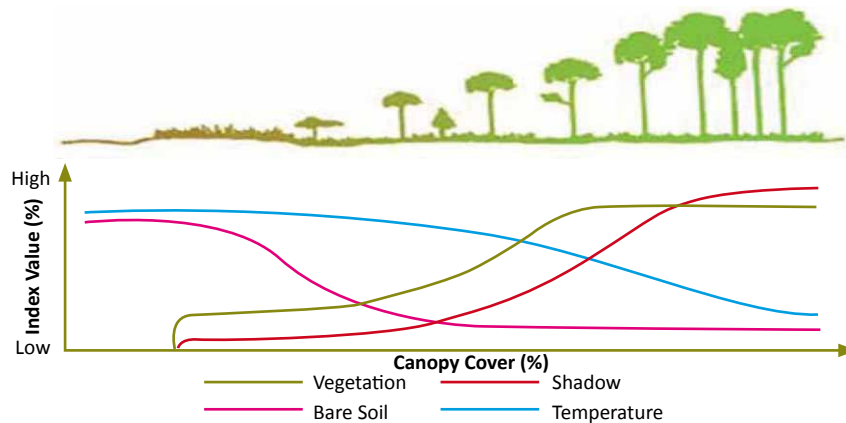
The images of different time series were radiometrically corrected (calibrated) through gain and haze corrections to minimize the variations in digital numbers of same kind of features. After the radiometric enhancement, images were ortho-rectified to geometrically rectify the scene with respect to height. This process also eased the process of edge matching during the process of making mosaics of adjacent images.

Spatial resolution of thermal bands is 60m while resolution of other bands (1, 2, 3, 4, 5 and 7) is 30m. So, the thermal bands of all scenes were re-sampled to 30m. The adjacent scenes were grouped in mosaic form and clipped with the boundary of the study area. The 7 bands were then exported into Geo-tiff format and exported to FCD Mapper software.

d) Image Classification

Rikimaru (1996) introduced a semi-expert system in image classification, an alternative deductive approach, *i.e.* Forest Canopy Density Mapper to map forest canopy density using four indices (vegetation, bare soil, shadow and surface temperature) derived from Landsat TM imagery. Based on these four variables, ten canopy density classes namely 0, 1-10, 11-20... 91-100 were obtained.

The characteristics of four prime indices of the forest condition (Source: Rikimaru, et al., 2002)



This model involves bio-spectral phenomenon modeling and analysis utilizing data derived from four indices namely: Advanced Vegetation Index (AVI), Bare Soil Index (BI), Shadow Index (SI), and Thermal Index (TI). Using these four indices, the canopy density for each pixel was calculated in percentage.

Characteristics combination between major four indices

Indices	Hi-FCD	Low-FCD	Grass Land	Bare Land
AVI	Hi	Mid	Hi	Low
BI	Low	Low	Low	Hi
SI	Hi	Mid	Low	Low
TI	Low	Mid	Mid	Hi

Normalized Difference Vegetation Index (NDVI) is unable to highlight subtle differences in canopy density. It has been found to improve by using power degree of the infrared response. The index thus calculated has been termed as advanced vegetation index (AVI). It has been more sensitive to forest density and physiognomic vegetation classes. AVI has been calculated using equation:

$$\text{if } B_4 - B_3 > 0, \text{ AVI} = 0 \dots\dots\dots (\text{Case a})$$

$$\text{if } B_4 - B_3 > 0, \text{ AVI} = (B_4 + 1) \times (256 - B_3) \times (B_4 - B_3)^{1/3} \dots\dots\dots (\text{Case b})$$

The bare soil areas, grasslands, vegetation with marked background response are enhanced using this index. Bare soil index (BI) is a normalized index of the difference sums of two separating the vegetation with different background viz. completely bare, sparse canopy and dense canopy etc.

$$B = \frac{(B_5 + B_3) - (B_4 - B_1)}{(B_5 + B_3) + (B_4 + B_1)} \times 100 + 100$$

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The crown arrangement in the forest stand leads to shadow pattern affecting the spectral responses. The young even aged stands have low canopy shadow index (SI) compared to the mature natural forest stands. The latter forest stands show flat and low spectral axis in comparison to that of the open area.

$$S = (256 - B_1) \times (256 - B_2) \times (256 - B_3)$$

Where: B is the spectral band of ETM+ image.

The Digital Number (DN) value of thermal band (band 6) of ETM+ images were converted to units of absolute radiance using 32 bit floating point calculations (NASA, 2005). The temperature calibration of the thermal infrared band (band 6) into the value of ground temperature has been done using equation:

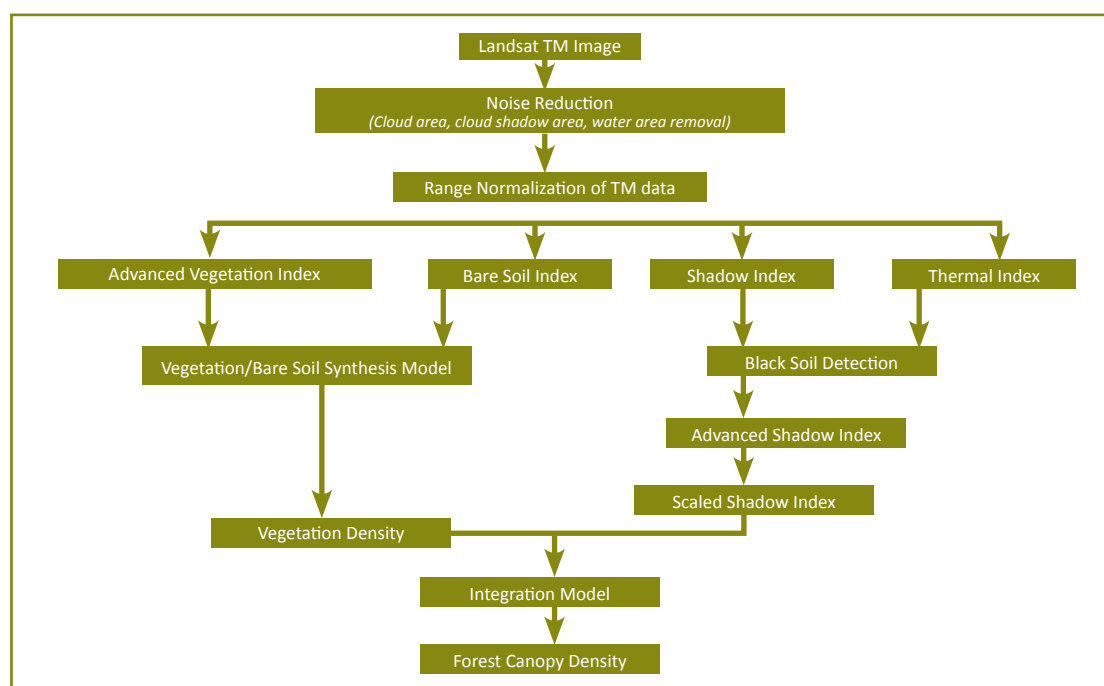
$$T = \frac{K_2}{\ln\left(\frac{K_1}{L\lambda} - 1\right)}$$

Where: T = Effective at-satellite temperature in Kelvin; K_1 = 666.09 watts/(meter squared * ster * μm) K_2 = 1282.71 Kelvin; L = Spectral radiance in watts/(meter squared * ster * μm).

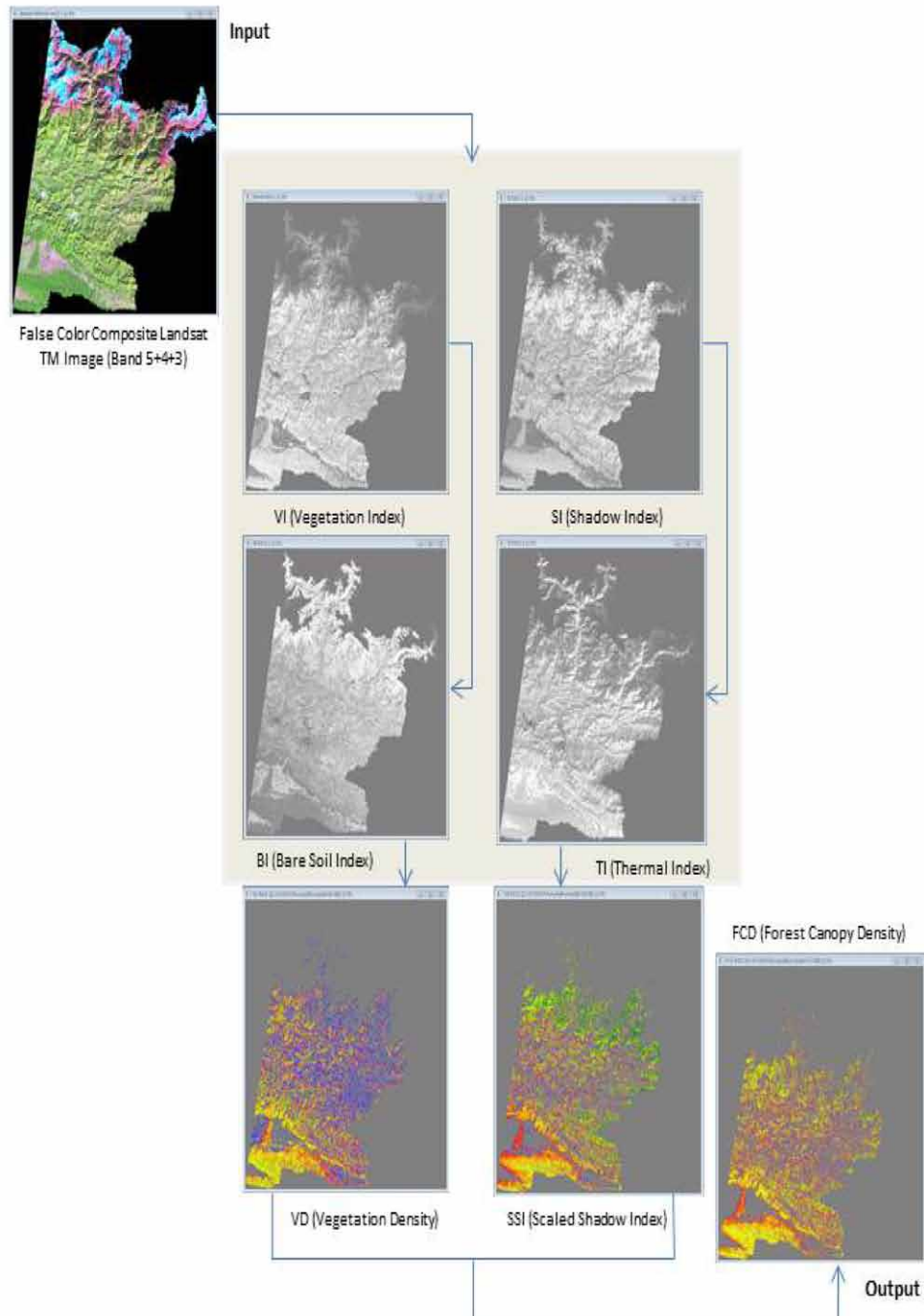
After that, VI and BI were synthesized by using principal component analysis. Since, VI and BI have high negative correlation. In areas where the SSI value is zero, this corresponds with forests that have the lowest shadow value (i.e. 0%). In areas where the SSI value is 100, this corresponds with forests that have the highest possible shadow value (i.e. 100%) (Rikimaru 1997). The vegetation density (VD) and SSI parameters mean transformation was integrated to estimate FCD in percentage scale unit of density. It was possible to synthesize both these indices safely by means of corresponding scales and units of each by using following equation to derive forest canopy density:

$$FCD = (VD \times SSI)^{1/2} - 1$$

Flow chart of FCD Mapping Model (Rikimaru et al., 2002)



Procedure for Forest Canopy Density Mapping Model



For the stratification of forest into different strata, FCD Mapper can produce maps with forest canopy density from 0-100 percent with good accuracy and also reduces the number of sample points needed for field verification. The stratified maps produced by FCD Mapper of different time series can provide trend of forest degradation of the study area. This shows the situation of forest strata over the period of time and the trend of forest cover, whether density is going up or down.

Annex 6.1: Drivers of Deforestation and Forest Degradation in the Siwaliks*

Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
Over and Unsustainable Harvest of Forest Products	High forest dependency for household energy and timber	Reduce forest dependency through: (a) development and promotion of non-conventional energy sources, (b) promotion of alternatives to construction timber, (c) promotion of agroforestry and private forestry through favorable policies and supports, and (d) improving access to technologies that enhance woodfuel efficiency.	(i) Promotion of non-conventional energy sources (such as biogas and solar energy) in collaboration with relevant government and non-government agencies; (ii) Support the development of agroforestry and private forestry. and (iii) Promotion of technologies that enhance woodfuel efficiency (e.g. bio-briquette, improved stoves).
	Poverty and very limited livelihood alternatives	(i) Promote sustainable green micro-enterprises and other off-farm income generating activities to enhance rural livelihoods and income; (ii) Integrate poverty reduction and livelihoods strategy with forest management strategy (in community, leasehold, and buffer zone forests); (iii) Promote PES and REDD+ as means of income generation by forest-dependent local communities; (iv) Increase non-forestry employment opportunities for poor and marginalized communities through increased investment in those areas; (v) Provide vocational education to landless, poor and marginalized local people, and (vi) Review and, if necessary, revise regulatory system.	(i) Help establishing NTFPs and agriculture based micro-enterprises in suitable locations; (ii) Building capacities of CFUGs and forestry staff for MRV system related to REDD; (iii) Supporting implementation of PES/ REDD+ in selected sites; (iv) Providing skill-development training and supporting for vocational education to poor and marginalized local people; (v) Supporting establishment of multi-purpose private nurseries (including forest trees, NTFPs, horticulture sp.), and (vi) Promoting more suitable agricultural land use practices (e.g. agroforestry) that can enhance household income and food security
	Weak law enforcement and overall forestry sector governance	(i) Enhance law enforcement to combat illegal logging and other illegal activities through: (a) provision of adequate financial and human resources to district and field level offices, (b) designing and implementing effective monitoring and evaluation system at different levels, (c) introducing transparent reward and punishment systems for government staff and local user groups, and (d) identifying and implementing safeguards against political interference (ii) Control bribery, corruption and impunity; (iii) Enhance political awareness and will through sensitization of political parties and influential politicians on forestry governance issues; (iv) Increase awareness on forestry legislation, coordination and cooperation amongst government law enforcement agencies (e.g. police, armed police, army), and (v) Expand community based forest management where appropriate.	(i) Provide logistical and financial support to DFOs and warden offices to enhance law enforcement; (ii) Help improve CFUGs' organizational and management capacities, and (iii) Help expand community based forest management systems, especially in remote areas where law enforcement is difficult.
	Increased demand for forest products	(i) Increase productivity of forestland (particularly of community and government-managed forests) through scientific management and (ii) Reduce demand for the forest products through: (a) population growth control, and (b) promotion of alternatives.	(i) Provide financial and technical supports to CFUGs and DFOs for piloting scientific management of selected forests; (ii) Provide technical and financial supports to CFUGs to prepare (or revise) and implement community forest management plans based on the principles of sustainable forest management (by balancing protection with active forest management), and (iii) Awareness raising campaigns to promote suitable and sustainable alternatives to construction timber (e.g. bamboo, steel, aluminum).
	Lack of scientific forest management	(i) Develop and implement scientific forest management in government-managed and community forests; (ii) Sensitize political parties/leaders, media and general public about the importance of scientific forest management, and (iii) Enhance technical capacity of government forestry staff and CFUGs through appropriate training and provision of necessary equipment and logistics.	(i) Provide financial and technical supports to CFUGs and DFOs for piloting scientific forest management at a few sites; (ii) Collaborate with suitable civil society organizations (e.g. NFA, NEFEJ) in raising awareness of politicians, media and general public on the necessity of scientific forest management; (iii) Organize refresher training to DFO and PA staff on technical aspects of forest management, and (iv) Provide technical and financial support to CFUGs to prepare (or revise) and implement community forest operational plans based on the principles of sustainable forest management

Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
	Financial constraints	(i) Improve coordination amongst MoFSC, National Planning Commission (NPC) and Ministry of Finance for promoting policy-planning linkages so that there is adequate budgetary allocation for forestry research and development; (ii) Lobby to optimally account for forest values during evaluation of contribution from forestry sector in government planning procedures, and (iii) Take proactive approach in raising funds from external sources (donors, INGOs).	Extend possible financial and in-kind supports to MoFSC for forestry research, development, and management.
	Weak and inappropriate regulatory systems	(i) Formulate and implement a uniform policy, guidelines and reporting systems regarding harvest and sales of forest products from community forests and government-managed forests, and (ii) Review and, if necessary, revise regulatory system (e.g. related to private forestry).	
	Blurred tenure and forest use rights	(i) Define or clarify property rights in different forest management regimes (particularly government-managed forests), and (ii) Raise awareness of the local people about the property right arrangements.	Support the government in raising awareness of local people about the property right arrangements.
	Lack of or poor coordination and cooperation among key stakeholders	(i) Enhance coordination and cooperation among relevant agencies, and (ii) Create consensus between MoFSC and relevant civil society organizations (e.g. FECOFUN) on major issues.	Facilitation to improve cooperation between MoFSC and FECOFUN, and FECOFUN and NTNC for improved conservation and sustainable management of forests.
	Increased market accessibility and commercialization	Strengthen regulatory system and law enforcement to control illegal collection and trade of forest products.	Provide logistical and financial supports to DFOs to enhance law enforcement.
	Inefficient forest products harvesting, distribution and marketing systems	(i) Develop and disseminate more efficient forest utilization technologies (e.g. to reduce damage and waste associated with conventional logging; wastage in wood processing); (ii) Promote technologies that enhance fuelwood efficiency (e.g. biobriquette, improved stoves); (iii) Investigate gaps and deficiencies in current forest products collection, distribution and marketing systems (including value-chain analysis of main products) and address them, and (iv) Enhance technical capacity of government forestry staff, CFUGs, and TCN staff through appropriate training and provision of necessary equipment and logistics.	(i) Provide financial and technical support to relevant agencies (e.g. Forest Research and Survey Department) to develop and disseminate appropriate forest utilization technologies; (ii) Pilot and promote use of more efficient wood technologies (e.g. particle board), and (iii) Collaborate with credible NGOs to promote fuelwood efficient technologies (e.g. biobriquette, improved stoves) where appropriate and feasible.
Infrastructure Development (Unregulated construction of schools, hospitals, electric transmission lines, rural roads, water storage tanks etc. In forestland)	Drive to economic development	(i) Look for alternative sites outside forests for construction of new infrastructure, and (ii) Substitute the forestland used by national priority projects.	
	Disregard of forestry legislation by other government agencies	(i) Sensitize DDC, VDC and other district and local level authorities to forestry related planning issues, and (ii) Enhance accountability mechanisms for planning and approval of development projects.	Raise awareness about the consequences of deforestation among the relevant government agencies, DDCs, VDCs, affected communities and amongst the general public.
	Conflicting sectoral policies and legislations	Identify and address inconsistencies and conflicts between forestry and other sector policies and legislations.	
	Poor inter-agency coordination and cooperation	(i) Improve coordination and cooperation of relevant agencies related to planning and execution of development projects, and (ii) Establish integrated local level planning and monitoring systems for district and local level infrastructure projects.	Facilitate and technically support to develop and implement integrated local level planning and monitoring systems for district and local level infrastructure projects

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Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
	Failure of the government planning procedures to optimally account for forest values	(i) Mainstream environment in development planning at all levels; (ii) Sensitize policy-makers and planners to forestry related planning issues, and (iii) Lobby to optimally account for forest values during evaluation of contribution from forestry sector in government planning procedures.	Help the MoFSC to develop strategy and guidelines for optimally accounting forest values. Can collaborate with other relevant programs/projects [e.g. Multi Stakeholder Forestry Program (MSFP)].
	Political backing to the development projects and/or interference in law enforcement	(i) Enhance political awareness through sensitization of political parties and influential politicians on the issue, and (ii) Identify and implement safeguards against political interference.	Collaborate with MoFSC and suitable civil society organizations to sensitize political parties and influential politicians on the issue.
	Inadequate law enforcement capacity of DFOs	(i) Enhance law enforcement capacity of DFOs through: (a) provision of adequate financial and human resources, (b) designing and implementing effective monitoring and evaluation system at different levels, and (c) introducing transparent reward and punishment systems for DFO staff and local user groups. (ii) Enhance political will to enforce law through appropriate sensitization. (iii) Fully and compulsorily implement EIA/IEE provisions for all projects that use forestland. (iv) Improve coordination and cooperation among different law-enforcement agencies (DFO, police, armed police, army).	Extend possible financial and logistical supports to DFOs for enhancing their law enforcement capacities.
	Variable influence and power among different ministries	(i) Improve coordination amongst MoFSC, NPC, and other ministries by setting up a cabinet mechanism; (ii) Activate the Parliamentary Committee on Natural Resources in favor of forest conservation, and (iii) Lobby to optimally account for forest values during evaluation of contribution from forestry sector, and government planning procedures	
Forest Encroachment for Resettlement and Urban Expansion	Increased demand for land for resettlement, new settlements and urban expansion	(i) Discourage unlawful settlements and urban expansion by strengthening law enforcement and addressing impunity, and (ii) Provide alternative land outside forest boundaries for new settlements and urban expansion.	
	Weak law enforcement	(i) Enhance law enforcement to control encroachment through: (a) clear directives and support from MoFSC, (b) provision of adequate financial and human resources to district and field level offices, (c) designing and implementing effective monitoring and evaluation system at different levels, and (d) introducing transparent reward and punishment system for government staff and local user groups. (ii) Enhance political will to enforce law through appropriate sensitization, and (iii) Improve coordination and cooperation among different law-enforcement agencies (DFO, police, armed police, army).	(i) Extend logistical and financial supports to DFOs to enhance law enforcement, and (ii) Collaborate with DFO to reforest reclaimed sites
	Political interference	Identify and implement safeguards against political interference.	
Agricultural Expansion (Permanent and Shifting Cultivation)	High reliance on agriculture (due to very limited alternative options for living and ever increasing demand for food)	(i) Generate local off-farm income generating opportunities; (ii) Provide skill development training for landless and poor; (iii) Replace shifting cultivation by ecologically and economically more beneficial land use system (e.g. SALT); (iv) Increase productivity of agricultural lands through: (a) abating further fragmentation, (b) reforming land distribution system, (c) promoting better agricultural practices, and (d) provision of necessary agricultural inputs in time.	(i) Help promote off-farm income generating activities (e.g. NTFP-based forest enterprises, and tourism based on local culture and environment); (ii) Provide skill-development training and support for vocational education to landless, poor and marginalized local people for off-farm employment; (iii) Collaborate with DoF to replicate the successful leasehold forestry model in other shifting cultivation areas, and (iv) Promote suitable land use practices (e.g. agroforestry) that can increase agricultural production and improve food security through diversification of products.
	Land scarcity		

Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
	Weak law enforcement	(i) Enhance law enforcement to control agricultural expansion in forestland through: (a) clear demarcation, mapping, and regular monitoring of forest boundaries, (b) provision of adequate financial and human resources to district and field level offices, (c) introducing transparent reward and punishment systems for government staff and local user groups, (d) identifying and implementing safeguards against political interference. (ii) Reclaim and restore the forestland (through reforestation with suitable native species or protection and management of natural regeneration). (iii) Promote community based forest management regimes (community forestry; leasehold forestry).	(i) Provide logistical and financial supports to DFOs to enhance law enforcement; (ii) Extend financial and technical supports to DFOs for reforestation of reclaimed forestland, and (iii) Collaborate with DFOs to expand community based forest management regimes (community forestry; leasehold forestry).
	Political backing	Sensitize political parties/politicians on the issue and acquire political support to discourage conversion of forest to other use.	
	Cultural factors (continuation of inherited modes of farming practices)	(i) Raise awareness of local communities about consequences of deforestation; (ii) Support development of shifting cultivator communities by (a) protecting their rights with respect to forest products (e.g. medicinal herbs), and (b) increasing their access to education, health services, electricity, drinking water etc.	(i) Raise awareness of local communities about the negative effects of deforestation (ii) Extend possible financial and technical support for integrated development of marginalized shifting cultivator communities.
Forest Fire	Deliberate (to enhance growth of new grass, clear shifting cultivation plots, and track wild animals for hunting)	(i) Increase awareness and local participation in forest fire control and management; (ii) Review and strengthen legislative arrangements and enhance their enforcement to discourage deliberate forest fires; (iii) Replace shifting cultivation practices by more suitable land use practices (e.g. leasehold forestry), and (iv) Promote stall feeding practice and discourage free grazing in forests.	(i) Extend necessary financial and technical supports to raise awareness about forest fire through media and other means; (ii) Provide technical and financial supports to DFOs to prepare and implement strategies and plans for controlling forest fires in different forest management regimes, and (iii) Provide technical and financial supports to CFUGs and DFOs to prepare and implement sustainable forest management. This should be done by also taking into consideration of fire management in the context of changing climatic conditions and need for undertaking effective mitigation measures.
	Accidental (due to extended drought; carelessness)	(i) Prepare and implement strategies and plans for controlling climate-induced forest fires and mitigating the effects in different physiographic zones and forest management regimes, and (ii) Implement sustainable forest management by also taking into consideration of fire management in the context of changing climatic conditions and need for undertaking effective mitigation measures.	
	Capacity gaps	(i) Develop effective mechanisms for forest fire monitoring, early warning and control; (ii) Provide training and necessary equipment to frontline forest fire fighters, and (iii) Institutionalize forest fire monitoring and control systems at different levels by involving all key stakeholders.	
Overgrazing	High number of inferior breed livestock	Collaborate among Ministry of Agriculture, Ministry of Finance, and MoFSC to gradually replace the poor quality livestock with improved breeds through improving access of the farmers/herders to breeding programs and financial mechanisms.	
	Limited availability of alternative fodder	(i) Promote fodder production in community-managed forests, waste lands and agricultural lands, and (ii) Develop or enhance fodder reserves (e.g. silage and hay) for use during slack periods.	

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Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
	Lack of or limited alternative source of income	(i) Create off-farm income generation opportunities through: (a) establishment of green enterprises, (b) promotion of tourism, (c) non-forestry employment opportunities through increased investment in those areas, and (d) vocational education.	Help promote off-farm income generating activities (e.g. NTFP-based forest enterprises, and tourism based on local culture and environment)
	Cultural factor (continuation of inherited modes of life style)	(i) Raise awareness of local communities about the environmental consequences of overgrazing and prospects for improving livelihoods through alternative practices, and (ii) Promote stall-feeding where feasible.	Raise awareness of local communities about the environmental consequences of overgrazing and prospects for improving livelihoods through alternative practices.
Invasion of Alien Plant Species	Forest degradation due to overgrazing, frequent forest fires, and excessive harvest of products	Abate forest degradation by adopting the measures to address overgrazing, forest fires, and excessive harvest (see above).	
	Weak quarantine and detecting capacity	Enhance quarantine and detecting capacity of custom and quarantine departments,	Provide training and logistical supports to enhance quarantine and detecting capacity of custom and quarantine departments.
	Lack of early warning and monitoring systems	Set up invasive alien species early warning and monitoring systems.	Extend financial and technical supports to the government to set up invasive alien species early warning and monitoring systems.
	Absence of appropriate legislation, strategy and action plan	Formulate a separate legislation, strategy and action plan for control and management of invasive alien species.	
	Lack of knowledge about control and utilization of invasive species	(i) Conduct survey on distribution, spatial extent and damage by invasive alien species; (ii) Conduct research on control and possible utilization of invasive alien species, and implement the findings, and (iii) Sensitize concerned authorities on their roles and responsibilities to control invasion and spread of invasive alien species.	Conduct survey and research on control and possible utilization of invasive alien species, and support MoFSC to implement the findings.
Landslides	Faulty land use and land management systems	(i) Prepare and implement participatory land evaluation and land use planning systems, and (ii) Promote appropriate land use and land management systems (e.g. SALT for sloping land).	(i) Promote participatory land evaluation and land use planning systems, and (ii) Pilot appropriate land use and land management systems (e.g. SALT for sloping land)
	Climate change (e.g. excessive rainfall)	Identify and adopt measures to mitigate the effects of climate change.	Provide technical and financial support to prepare district climate change effects mitigation and adaptation strategies and action plans. Can collaborate with MSFP and other relevant projects/programs.
	Natural factors		
Recreation (e.g. picnicking)	Increased demand for recreation by the young generation	Create alternative recreation facilities for people of different age and interest.	
	Lack of access to cheap alternative recreation facilities		
	Free access to government-managed forests	Regulate entry and use of forestland for recreation by establishing and implementing appropriate regulatory measures (including the “dos” and “don’ts”).	

* Includes a few small patches of Terai in Chitwan and Nawalparasi Districts

Annex 6.2: Drivers of Deforestation and Forest Degradation in the Midhills

Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
Infrastructure Development (Unplanned and unregulated construction of rural roads, schools etc.)	Drive to economic development	(i) Look for alternative sites outside forests for construction of new infrastructure, and (ii) Substitute the forestland used by national priority projects.	
	Disregard to forestry legislation by other government agencies	(i) Sensitize DDC, VDC and other district and local level authorities to forestry related planning issues, and (ii) Enhance accountability mechanisms for planning and approval of development projects.	Raise awareness about the consequences of deforestation among the relevant government agencies, DDCs, VDCs, affected communities and amongst the general public.
	Conflicting sectoral policies and legislations	Identify and address inconsistencies and conflicts between forestry and other sector policies and legislations.	
	Poor inter-agency coordination and cooperation	(i) Improve coordination and cooperation of relevant agencies related to planning and execution of development projects, and (ii) Establish integrated local level planning and monitoring systems for district and local level infrastructure projects.	Facilitate and technically support to develop and implement integrated local level planning and monitoring systems for district and local level infrastructure projects.
	Failure of the government planning procedures to optimally account for forest values	(i) Mainstream environment in development planning at all levels; (ii) Sensitize policy-makers and planners to forestry related planning issues, and (iii) Lobby to optimally account for forest values during evaluation of contribution from forestry sector in government planning procedures.	Help the MoFSC to develop strategy and guidelines for optimally accounting forest values. Can collaborate with other relevant programs/projects (e.g. MSFP).
	Political backing to the development projects and/or interference in law enforcement	(i) Enhance political awareness through sensitization of political parties and influential politicians on the issue, and (ii) Identify and implement safeguards against political interference.	Collaborate with MoFSC and suitable civil society organizations to sensitize political parties and influential politicians on the issue.
	Inadequate law enforcement capacity of DFOs	(i) Enhance law enforcement capacity of DFOs through: (a) provision of adequate financial and human resources, (b) designing and implementing effective monitoring and evaluation system at different levels, and (c) introducing transparent reward and punishment systems for DFO staff and local user groups; (ii) Enhance political will to enforce law through appropriate sensitization; (iii) Fully and compulsorily implement EIA/IEE provisions for all projects that use forestland, and (iv) Improve coordination and cooperation among different law-enforcement agencies (DFO, police, armed police, army).	Extend possible financial and logistical supports to DFOs for enhancing their law enforcement capacities.
	Variable influence and power among different ministries	(i) Improve coordination amongst MoFSC, NPC, and other ministries by setting up a cabinet mechanism; (ii) Activate the Parliamentary Committee on Natural Resources in favor of forest conservation, and (iii) Lobby to optimally account for forest values during evaluation of contribution from forestry sector, and government planning procedures.	
Over and Unsustainable Harvest of Forest Products from Government-Managed Forests	High forest dependency for household energy and timber	Reduce forest dependency through: (a) development and promotion of non-conventional energy sources, (b) promotion of alternatives to construction timber, (c) promotion of agroforestry and private forestry through favorable policies and supports, and (d) improving access to technologies that enhance woodfuel efficiency.	(i) Promotion of non-conventional energy sources (such as biogas, solar energy, hydropower) in collaboration with relevant government and non-government agencies; (ii) Support the development of agro-forestry and private forestry, and (iii) Promotion of technologies that enhance woodfuel efficiency (e.g. bio-briquette, improved stoves).

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Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
	Poverty and very limited livelihood alternatives	<ul style="list-style-type: none"> (i) Promote sustainable green microenterprises and other off-farm income generating activities to enhance rural livelihoods and income; (ii) Integrate poverty reduction and livelihoods strategy with forest management strategy (in community and leasehold forests); (iii) Promote PES and REDD+ as means of income generation by forest-dependent local communities; (iv) Increase non-forestry employment opportunities for poor and marginalized communities through increased investment in those areas; (v) Provide vocational education to landless, poor and marginalized local people; (vi) Make small farmers more competitive by helping them overcome market, capital, technical, and management problems, and (vii) Review and, if necessary, revise regulatory system. 	<ul style="list-style-type: none"> (i) Help establishing NTFPs and agriculture based microenterprises in suitable locations; (ii) Building capacities of CFUGs and forestry staff for MRV system related to REDD; (iii) Supporting implementation of PES/ REDD+ in selected sites (iv) Providing skill-development training and supporting for vocational education to poor and marginalized local people; (v) Supporting establishment of multi-purpose private nurseries (including forest trees, NTFPs, horticulture sp.), and (vi) Promoting more suitable agricultural land use practices (e.g. agroforestry) that can enhance household income and food security.
	Weak law enforcement and overall forestry sector governance	<ul style="list-style-type: none"> (i) Enhance law enforcement to combat illegal logging and other illegal activities through: (a) provision of adequate financial and human resources to district and field level offices, (b) designing and implementing effective monitoring and evaluation system at different levels (c) introducing transparent reward and punishment systems for government staff and local user groups, and (d) identifying and implementing safeguards against political interference (ii) Control bribery, corruption and impunity; (iii) Enhance political awareness and will through sensitization of political parties and influential politicians on forestry governance issues; (iv) Increase awareness on forestry legislation, coordination and cooperation amongst government law enforcement agencies (e.g. police, armed police, army), and (v) Expand community based forest management where appropriate. 	<ul style="list-style-type: none"> (i) Provide logistical support to DFOs and warden offices to enhance law enforcement; (ii) Help improve CFUGs' organizational and management capacities, and (iii) Help expand community based forest management systems, especially in remote areas where law enforcement is difficult.
	Increased demands for forest products	<ul style="list-style-type: none"> (i) Increase productivity of forestland (particularly of community and government-managed forests) through scientific management; (ii) Reduce demand for the forest products through: (a) population growth control, and (b) promotion of alternatives. 	<ul style="list-style-type: none"> (i) Provide financial and technical supports to CFUGs and DFOs for piloting scientific management of selected forests; (ii) Provide technical and financial supports to CFUGs to prepare (or revise) and implement community forest management plans based on the principles of sustainable forest management (by balancing protection with active forest management), and (iii) Awareness raising campaigns to promote suitable and sustainable alternatives to construction timber (e.g. bamboo, steel, aluminum).

Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
	Lack of scientific forest management	(i) Develop and implement scientific forest management in community and government-managed forests; (ii) Sensitize political parties/leaders, media and general public about the importance of scientific forest management, and (iii) Enhance technical capacity of government forestry staff and CFUGs through appropriate training and provision of necessary equipment and logistics.	(i) Provide financial and technical supports to CFUGs and DFOs for piloting scientific forest management at a few sites; (ii) Collaborate with suitable civil society organizations (e.g. NFA, NEFEJ) in raising awareness of politicians, media and general public on the necessity for scientific forest management; (iii) Organize refresher training to DFO staff on technical aspects of forest management, and (iv) Provide technical and financial supports to CFUGs to prepare (or revise) and implement community forest operational plans based on the principles of sustainable forest management (by balancing protection with active forest management).
	Financial constraints	(i) Improve coordination amongst MoFSC, NPC and Ministry of Finance for promoting policy-planning linkages so that there is adequate budgetary allocation for forestry research and development; (ii) Lobby to optimally account for forest values during evaluation of contribution from forestry sector in government planning procedures, and (iii) Take proactive approach in raising funds from external sources (donors, INGOs).	Extend possible financial and in-kind supports to MoFSC for forestry research, development, and management.
	Weak and inappropriate regulatory systems	(i) Formulate and implement a uniform policy, guidelines and reporting systems regarding harvest and sales of forest products from community forests and government-managed forests, and (ii) Review and, if necessary, revise regulatory system (e.g. related to private forestry).	
	Blurred tenure and forest use rights	(i) Define or clarify property rights in different forest management regimes (particularly government-managed forests), and (ii) Raise awareness of the local people about the property right arrangements.	Support the government in raising awareness of local people about the property right arrangements.
	Lack of or poor coordination and cooperation among key stakeholders	(i) Enhance coordination and cooperation among relevant agencies, and (ii) Create consensus between MoFSC and relevant civil society organizations (e.g. FECOFUN) on major issues.	Facilitation to improve cooperation between MoFSC and FECOFUN, and FECOFUN and NTNC for improved conservation and sustainable management of forests.
	Increased market accessibility and commercialization	Strengthen regulatory system and law enforcement to control illegal collection and trade of forest products.	Provide logistical and financial supports to DFOs to enhance law enforcement.
	Inefficient forest products harvesting, distribution and marketing systems	(i) Develop and disseminate more efficient forest utilization technologies (e.g. to reduce damage and waste associated with conventional logging; wastage in wood processing); (ii) Promote technologies that enhance fuelwood efficiency (e.g. bio-briquette, improved stoves); (iii) Investigate gaps and deficiencies in current forest products collection, distribution and marketing systems (including value-chain analysis of main products) and address them, and (iv) Enhance technical capacity of government forestry staff, CFUGs, and TCN staff through appropriate training and provision of necessary equipment and logistics.	(i) Provide financial and technical supports to relevant agencies (e.g. Forest Research and Survey Department) to develop and disseminate appropriate forest utilization technologies; (ii) Pilot and promote use of more efficient wood technologies (e.g. particle board), and (iii) Collaborate with credible NGOs to promote fuelwood efficient technologies (e.g. bio-briquette, improved stoves) where appropriate and feasible.

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Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
Agricultural Expansion (Permanent and Shifting Cultivation)	High reliance on agriculture (due to very limited alternative options for living and ever increasing demand for food)	(i) Generate local off-farm income generating opportunities; (ii) Provide skill development training for landless and poor; (iii) Replace shifting cultivation by ecologically and economically more beneficial land use system (e.g. SALT), and (iv) Increase productivity of agricultural lands through: (a) abating further fragmentation, (b) reforming land distribution system, (c) promoting better agricultural practices, and (d) provision of necessary agricultural inputs in time.	(i) Help promote off-farm income generating activities (e.g. NTFP-based forest enterprises, and tourism based on local culture and environment); (ii) Provide skill-development training and support for vocational education to landless, poor and marginalized local people for off-farm employment; (iii) Collaborate with DoF to replicate the successful leasehold forestry model in other shifting cultivation areas, and (iv) Promote suitable land use practices (e.g. agroforestry) that can increase agricultural production and improve food security through diversification of products.
	Land scarcity		
	Weak law enforcement	(i) Enhance law enforcement to control agricultural expansion in forestland through: (a) clear demarcation, mapping, and regular monitoring of forest boundaries, (b) provision of adequate financial and human resources to district and field level offices, and (c) introducing transparent reward and punishment systems for government staff and local user groups; (iii) Reclaim and restore the forestland (through reforestation with suitable native species or protection and management of natural regeneration), and (iv) Promote community based forest management regimes (community forestry; leasehold forestry).	(i) Extend financial and technical supports to DFOs for reforestation of reclaimed forestland, and (ii) Collaborate with DFOs to expand community based forest management regimes (community forestry; leasehold forestry).
	Cultural factors (continuation of inherited modes of farming practices)	(i) Raise awareness of local communities about consequences of deforestation, and (ii) Support development of shifting cultivator communities by (a) protecting their rights with respect to forest products (e.g. medicinal herbs), and (b) increasing their access to education, health services, electricity, drinking water etc.	(i) Raise awareness of local communities about the negative effects of deforestation, and (ii) Extend possible financial and technical supports for integrated development of marginalized shifting cultivator communities.
Forest Fire	Deliberate (to enhance growth of new grass, clear shifting cultivation plots, and track wild animals for hunting)	(i) Increase awareness and local participation in forest fire control and management; (ii) Review and strengthen legislative arrangements and enhance their enforcement to discourage deliberate forest fires; (iii) Replace shifting cultivation practices by more suitable land use practices (e.g. leasehold forestry), and (iv) Promote stall feeding practice.	(i) Extend necessary financial and technical supports to raise awareness about forest fire through media and other means; (ii) Provide technical and financial supports to DFOs to prepare and implement strategies and plans for controlling forest fires in different forest management regimes, and (iii) Provide technical and financial supports to CFUGs and DFOs to prepare and implement sustainable forest management. This should be done by also taking into consideration fire management in the context of changing climatic conditions and need for undertaking effective mitigation measures.
	Accidental (due to extended drought; carelessness)	(i) Prepare and implement strategies and plans for controlling climate-induced forest fires and mitigating the effects in different physiographic zones and forest management regimes, and (ii) Implement sustainable forest management by also taking into consideration fire management in the context of changing climatic conditions and need for undertaking effective mitigation measures.	
	Capacity gaps	(i) Develop effective mechanisms for forest fire monitoring, early warning and control; (ii) Provide training and necessary equipment to frontline forest fire fighters, and (iii) Institutionalize forest fire monitoring and control systems at different levels by involving all key stakeholders.	
Invasion of Alien Plant Species	Forest degradation due to frequent forest fires, excessive harvest of products	Abate forest degradation by adopting the measures to address forest fires and excessive harvest (see above).	
	Weak quarantine and detecting capacity	Enhance quarantine and detecting capacity of custom and quarantine departments.	Provide training and logistical supports to enhance quarantine and detecting capacity of custom and quarantine departments.

Drivers	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
	Lack of early warning and monitoring systems	Set up invasive alien species early warning and monitoring systems.	Extend financial and technical supports to the government to set up invasive alien species early warning and monitoring systems
	Absence of appropriate legislation, strategy and action plan	Formulate a separate legislation, strategy and action plan for control and management of invasive alien species.	
	Lack of knowledge about control and utilization of invasive species	(i) Conduct survey on distribution, spatial extent and damage by invasive alien species; (ii) Conduct research on control and possible utilization of invasive alien species, and implement the findings, and (iii) Sensitize concerned authorities on their roles and responsibilities to control invasion and spread of invasive alien species.	Conduct survey and research on control and possible utilization of invasive alien species, and support MoFSC to implement the findings.
Landslides	Faulty land use and land management systems	(i) Prepare and implement participatory land evaluation and land use planning systems, and (ii) Promote appropriate land use and land management systems (e.g. SALT for sloping land).	(i) Provide technical and financial supports to prepare and implement participatory land evaluation and land use planning systems, and (ii) Pilot appropriate land use and land management systems (e.g. SALT).
	Climate change (e.g. excessive rainfall)	Identify and adopt measures to mitigate the effects of climate change.	Provide technical and financial support to prepare district climate change effects mitigation and adaptation strategies and action plans. Can collaborate with MSFP and other relevant projects/ programs.
	Natural factors		
Forest Encroachment for Settlement and Urban Expansion	Increased demand for land	(i) Discourage unlawful settlements and urban expansion by strengthening law enforcement and addressing impunity, and (ii) Provide alternative land outside forest boundaries for new settlements and urban expansion.	
	Weak law enforcement	(i) Enhance law enforcement to control encroachment through: (a) clear directives and support from MoFSC, (b) provision of adequate financial and human resources to district and field level offices, (c) designing and implementing effective monitoring and evaluation system at different levels, and (d) introducing transparent reward and punishment system for government staff and local user groups; (ii) Enhance political will to enforce law through appropriate sensitization, and (iii) Improve coordination and cooperation among different law-enforcement agencies (DFO, police, armed police).	(i) Extend logistical and financial supports to DFOs to enhance law enforcement, and (ii) Collaborate with DFO to reforest reclaimed sites.
	Political interference	Identify and implement safeguards against political interference.	

Annex 6.3: Drivers of Deforestation and Forest Degradation in the High Mountains

Driver	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
Over and Unsustainable Harvest of Forest Products	High forest dependency for household energy and timber	Reduce forest dependency through: (a) development and promotion of non-conventional energy sources, and (b) improving access to technologies that enhance woodfuel efficiency.	(i) Promotion of non-conventional energy sources (such as biogas, solar energy and hydropower) in collaboration with relevant government and non-government agencies, and (ii) Promotion of technologies that enhance woodfuel efficiency (e.g. bio-briquette, improved stoves).
	Poverty and very limited livelihood alternatives	(i) Promote sustainable green microenterprises and other off-farm income generating activities to enhance rural livelihoods and income; (ii) Integrate poverty reduction and livelihoods strategy with forest management strategy (in community, leasehold, and buffer zone forests); (iii) Promote PES and REDD+ as means of income generation by forest-dependent local communities; (iv) Increase non-forestry employment opportunities for poor and marginalized communities through increased investment in those areas; (v) Provide vocational education to landless, poor and marginalized local people; (vi) Make small farmers more competitive by helping them overcome market, capital, technical, and management problems, and (vii) Review and, if necessary, revise regulatory systems.	(i) Help establish NTFPs and agriculture based microenterprises in suitable locations; (ii) Building capacities of CFUGs and forestry staff for MRV system related to REDD; (iii) Supporting implementation of PES/ REDD+ in selected sites, and (iv) Providing skill-development training and supporting for vocational education to poor and marginalized local people.
	Weak law enforcement and overall forestry sector governance	(i) Enhance law enforcement to combat illegal logging and cross-border smuggling of timber through: (a) provision of adequate financial and human resources to district and field level offices, (b) designing and implementing effective monitoring and evaluation system at different levels, and (c) introducing transparent reward and punishment systems for government staff and local user groups; (ii) Increase political awareness and will through sensitization of political parties and influential politicians on forestry governance issues; (iv) Increase awareness on forestry legislation, coordination and cooperation amongst government law enforcement agencies (e.g. police, armed police, army), and (v) Expand community based forest management where appropriate	(i) Provide logistical and financial supports to DFOs and warden offices to enhance law enforcement; (ii) Help improve CFUGs' organizational and management capacities, and (iii) Help expand community based forest management systems, especially in remote areas where law enforcement is difficult.
	Lack of scientific forest management	(i) Develop and implement scientific forest management in government-managed and community forests; (ii) Sensitize political parties/leaders, media and general public about the importance of scientific forest management, and (iii) Enhance technical capacity of government forestry staff and CFUGs through appropriate training and provision of necessary equipment and logistics.	(i) Provide financial and technical support to CFUGs and DFOs for piloting scientific forest management at a few sites; (ii) Collaborate with suitable civil society organizations (e.g. NFA, NEFEJ) in raising awareness of politicians, media and general public on the necessity for scientific forest management; (iii) Organize refresher training to DFO staff on technical aspects of forest management, and (iv) Provide technical and financial supports to CFUGs to prepare (or revise) and implement community forest operational plans based on the principles of sustainable forest management.

Driver	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
	Financial constraints	(i) Improve coordination amongst MoFSC, NPC and Ministry of Finance for promoting policy-planning linkages so that there is adequate budgetary allocation for forestry research and development; (ii) Lobby to optimally account for forest values during evaluation of contribution from forestry sector in government planning procedures, and (iii) Take proactive approach in raising funds from external sources (donors, INGOs).	Extend possible financial and in-kind supports to MoFSC for forestry research, development, and management.
	Weak and inappropriate regulatory systems	Formulate and implement a uniform policy, guidelines and reporting systems regarding harvest and sales of forest products from community forests and government-managed forests.	
	Blurred tenure and forest use rights	(i) Define or clarify property rights in government-managed forests; and (ii) Raise awareness of the local people about the property right arrangements.	Support the government in raising awareness of local people about the property right arrangements.
	Lack of or poor coordination and cooperation among key stakeholders	(i) Enhance coordination and cooperation among relevant agencies (e.g. DFO and Annapurna Conservation Area (ACA)), and (ii) Create consensus between MoFSC and relevant civil society organizations (e.g. FECOFUN) on major issues.	Facilitation to improve cooperation between MoFSC and FECOFUN, and FECOFUN and NTNC for improved conservation and sustainable management of forests.
	Increased market accessibility and commercialization	Strengthen regulatory system and law enforcement to control illegal collection and trade of forest products.	Logistical and financial supports to DFOs to enhance law enforcement.
	Inefficient forest products harvesting and utilization system	(i) Develop and disseminate more efficient forest utilization technologies (e.g. to reduce damage and waste associated with conventional logging; wastage in wood processing); (ii) Promote technologies that enhance fuelwood efficiency; (iii) Investigate gaps and deficiencies in current forest products collection and distribution systems and address them, and (iv) Enhance technical capacity of government forestry staff and CFUGs through appropriate training and provision of necessary equipment and logistics.	(i) Provide financial and technical supports to relevant agencies (e.g. Forest Research and Survey Department) to develop and disseminate appropriate forest utilization technologies; (ii) Pilot and promote use of more efficient wood technologies (e.g. particle board), and (iii) Collaborate with credible NGOs to promote fuelwood efficient technologies (e.g. bio-briquette, improved stoves) where appropriate and feasible.
Infrastructure Development (Unregulated construction of rural roads, schools etc.)	Drive to economic development	(i) Look for alternative sites outside forests for construction of new infrastructure, and (ii) Substitute the forestland used by national priority projects.	
	Disregard to forestry legislation by other government agencies	(i) Sensitize DDC, VDC and other district and local level authorities to forestry related planning issues, and (ii) Enhance accountability mechanisms for planning and approval of development projects.	Raise awareness about the consequences of deforestation among the relevant government agencies, DDCs, VDCs, affected communities and amongst the general public.
	Conflicting sectoral policies and legislations	Identify and address inconsistencies and conflicts between forestry and other sector policies and legislations.	
	Poor inter-agency coordination and cooperation	(i) Improve coordination and cooperation of relevant agencies related to planning and execution of development projects, and (ii) Establish integrated local level planning and monitoring systems for district and local level infrastructure projects.	Facilitate and technically support to develop and implement integrated local level planning and monitoring systems for district and local level infrastructure projects.

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Driver	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
	Failure of the government planning procedures to optimally account for forest values	(i) Mainstream environment in development planning at all levels; (ii) Sensitize policy-makers and planners to forestry related planning issues, and (iii) Lobby to optimally account for forest values during evaluation of contribution from forestry sector in government planning procedures.	Help the MoFSC to develop strategy and guidelines for optimally accounting forest values. Can collaborate with other relevant programs/projects (e.g. MSFP).
	Political backing to the development projects and/or interference in law enforcement	(i) Enhance political awareness through sensitization of political parties and influential politicians on the issue, and (ii) Identify and implement safeguards against political interference.	Collaborate with MoFSC and suitable civil society organizations to sensitize political parties and influential politicians on the issue.
	Inadequate law enforcement capacity of DFOs	(i) Enhance law enforcement capacity of DFOs through: (a) provision of adequate financial and human resources, (b) designing and implementing effective monitoring and evaluation system at different levels, and (c) introducing transparent reward and punishment systems for DFO staff and local user groups; (ii) Enhance political will to enforce law through appropriate sensitization; (iii) Fully and compulsorily implement ELA/IEE provisions for all projects that use forestland, and (iv) Improve coordination and cooperation among different law-enforcement agencies (DFO, police, armed police, army).	Extend possible financial and logistical supports to DFOs for enhancing their law enforcement capacities.
	Variable influence and power among different ministries	(i) Improve coordination amongst MoFSC, NPC, and other ministries by setting up a cabinet mechanism; (ii) Activate the Parliamentary Committee on Natural Resources in favor of forest conservation, and (iii) Lobby to optimally account for forest values during evaluation of contribution from forestry sector, and government planning procedures.	
Forest Fire	Deliberate (to enhance growth of new grass, and track wild animals for hunting)	(i) Increase awareness and local participation in forest fire control and management; (ii) Review and strengthen legislative arrangements and enhance their enforcement to discourage deliberate forest fires, and (iii) Promote stall feeding practice and discourage free grazing in forests.	(i) Extend necessary financial and technical supports to raise awareness about forest fire through media and other means; (ii) Provide technical and financial supports to DFOs to prepare and implement strategies and plans for controlling forest fires in different forest management regimes, and (iii) Provide technical and financial supports to CFUGs and DFOs to prepare and implement sustainable forest management. This should be done by also taking into consideration fire management in the context of changing climatic conditions and need for undertaking effective mitigation measures.
	Accidental (due to extended drought; carelessness)	(i) Prepare and implement strategies and plans for controlling climate-induced forest fires and mitigating the effects in different forest management regimes (ii) Implement sustainable forest management by also taking into consideration fire management in the context of changing climatic conditions and need for undertaking effective mitigation measures	
	Capacity gaps	(i) Develop effective mechanisms for forest fire monitoring, early warning and control; (ii) Provide training and necessary equipment to frontline forest fire fighters, and (iii) Institutionalize forest fire monitoring and control systems at different levels by involving all key stakeholders.	

Driver	Underlying Causes	Strategic Approaches and Actions	What Can the Hariyo Ban Program Do?
Agricultural Expansion	High reliance on agriculture	(i) Generate local off-farm income generating opportunities; (ii) Provide skill development training for landless and poor, and (iii) Increase productivity of agricultural lands through: (a) abating further fragmentation, (b) reforming land distribution system, (c) promoting better agricultural practices, and (d) provision of necessary agricultural inputs in time.	(i) Help promote off-farm income generating activities (e.g. NTFP-based forest enterprises, and tourism based on local culture and environment), and (ii) Provide skill-development training and support for vocational education to landless, poor and marginalized local people for off-farm employment.
	Weak law enforcement	(i) Enhance law enforcement to control agricultural expansion to forestland through: (a) clear demarcation, mapping, and regular monitoring of forest boundaries, (b) provision of adequate financial and human resources to district and field level offices, (c) introducing transparent reward and punishment systems for government staff and local user groups, and (ii) Promote community based forest management regimes (community forestry; leasehold forestry).	(i) Provide logistical and financial support to DFOs to enhance law enforcement, and (ii) Collaborate with DFOs to expand community based forest management regimes (community forestry; leasehold forestry).
	Commercialization of products (e.g. apple)	(i) Prepare and implement land use planning, and (ii) Enhance law enforcement.	
Overgrazing	High number of inferior breed livestock (mainly goats and sheep)	Collaborate among Ministry of Agriculture, Ministry of Finance, and MoFSC to gradually replace the poor quality livestock with improved breeds through improving access of the farmers/herders to breeding programs and financial mechanisms.	
	Limited availability of alternative fodder	(i) Promote fodder production in community-managed forests, waste lands and agricultural lands, and (ii) Develop or enhance fodder reserves (e.g. silage and hay) for use during slack periods.	
	Lack of or limited alternative source of income	(i) Create off-farm income generation opportunities through: (a) establishment of green enterprises, (b) promotion of tourism, (c) non-forestry employment opportunities through increased investment in those areas, and (d) vocational education.	Help promote off-farm income generating activities (e.g. NTFP-based forest enterprises, and tourism based on local culture and environment).
	Cultural factor (continuation of inherited modes of life style)	(i) Raise awareness of local communities about the environmental consequences of overgrazing and prospects for improving livelihoods through alternative practices, and (ii) Promote stall-feeding where feasible.	Raise awareness of local communities about the environmental consequences of overgrazing and prospects for improving livelihoods through alternative practices.
Landslides	Faulty land use and land management systems	(i) Prepare and implement participatory land evaluation and land use planning systems, and (ii) Promote appropriate land use and land management systems (e.g. SALT for sloping land).	(i) Provide technical and financial supports to prepare and implement participatory land evaluation and land use planning systems, and (ii) Pilot appropriate land use and land management systems (e.g. SALT for sloping land).
	Climate change (e.g. excessive rainfall)	Identify and adopt measures to mitigate the effects of climate change.	Provide technical and financial support to prepare district climate change effects mitigation and adaptation strategies and action plans. Can collaborate with MSFP and other relevant projects/ programs.

