TERAI FORESTS OF NEPAL
2010-2012

April 2014

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2010 - 2012

FOREST RESOURCE ASSESSMENT NEPAL

DEPARTMENT OF FOREST RESEARCH AND SURVEY
MINISTRY OF FORESTS AND SOIL CONSERVATION
GOVERNMENT OF NEPAL

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Foreword

In Nepal, the first national-level forest inventory (NFI) was conducted in the early sixties by the then Forest Resources Survey Office under the Department of Forests with the technical and financial support from the USAID. Similarly, the second NFI was accomplished by the Department of Forest Research and Survey (DFRS) in the nineties with the technical and financial support from the Government of Finland (GoF). Now, the third NFI is in progress with the support of the GoF, undertaken jointly by the DFRS and the Forest Resource Assessment (FRA) Nepal Project (2010-2014). The current work is being conducted on the basis of the five physiographic regions viz. the Terai, the Churia, the Middle-hills, the High Mountains and the High Himal.

This report presents the results of the Terai forest resource assessment conducted during 2010-2012. The Terai report which is comprehensive in nature not only provides information on growing stock and biomass, but also on non-timber forest products, biodiversity and soil carbon content.

The results of the study indicate that the forest resources of the Terai region have been depleted as compared to the results of the previous inventories. Appropriate measures have to be initiated in order to improve this scenario.

I would like to express my thanks to the FRA Nepal Validation Committee Members for assuring the quality of this report, the Government of Finland for providing both technical as well as financial support to accomplish the forest resource assessment, and all those involved in the FRA Nepal field inventory, mapping and in preparation of this report. I hope this report will be useful in planning and managing the invaluable Terai forest resources.

Ganesh R. Joshi, PhD
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Sahas Man Shrestha
Director General

Abbreviations

approx.	approximately
BEF	Biomass Expansion Factor
BRDF	Bidirectional Reflectance Distribution Function
C	Carbon
CAI	Current Annual Increment
CCSP	Concentric Circular Sample Plot
CDR	Central Development Region
CF	Community Forest
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO_2	Carbon dioxide
DBH	Diameter at Breast Height (1.3 m)
DFRS	Department of Forest Research and Survey
DNPWC	Department of National Parks and Wildlife Conservation
DoF	Department of Forests
DPR	Department of Plant Resources
FF	Fine Fraction
FRA	Forest Resource Assessment
FRS	Forest Resources Survey (1964)
FWDR	Far-western Development Region
GIS	Geographic Information System
GoN	Government of Nepal
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
KS	Khair-Sissoo
LRMP	Land Resources Mapping Project
MFSC	Ministry of Forests and Soil Conservation
NFI	National Forest Inventory (1991)
NPWC	National Parks and Wildlife Conservation
NTFP	Non-timber Forest Product
OC	Organic Carbon
PA	Protected Area
RE MSS	RapidEye Multi-spectral Scanner
REDD	Reducing Emissions from Deforestation and Forest Degradation
RS	Remote Sensing
SOC	Soil Organic Carbon
SOP	Standard Operating Procedure
STMH	Sal-Terai Mixed Hardwood
Tg	Teragram (1 Tg = 1×10^{12} g)
TMH	Terai Mixed Hardwood
WDR	Western Development Region

Glossary

Above-ground biomass	Above-ground biomass refers to the biomass of trees and saplings (≥5cm DBH) above the soil. It includes dead wood but not stumps.
Alpha diversity	The diversity within a particular area or ecosystem, usually expressed by the number of species (species richness) in that ecosystem. It is the mean number of species per plot.
Appendix I (CITES)	A list of species whose trade in wild specimens is restricted except for registered scientific research.
Appendix II (CITES)	A list of species that are not necessarily now threatened with extinction but that may become so unless their trade is closely controlled.
Appendix III (CITES)	A list of species whose trade at least one member country has requested other CITES parties for assistance in controlling.
Below-ground biomass	The biomass of trees and saplings (≥5cm DBH) contained within live roots and stumps.
Biodiversity	The variety of plant and animal species in the Terai Physiographic Region.
Biomass	The biological material derived from living or recently living organisms. It includes both the above- and below-ground biomass of trees and saplings.
Broken	A tree whose top or trunk has been cut or broken.
Bulk density	Soil mass per unit volume, expressed in g/cm^3.
Canopy	The cover of branches and foliage formed by tree crowns.
Canopy cover/Closure	The percentage of ground covered by the vertical projection of the foliage of plants.
Carbon pool	Major components (above-ground, below-ground, and soil carbon) of carbon per unit area.
Climber	Any plant which grows by trailing or climbing stems or runners.
Co-dominant	A tree with a medium-sized crown at the level of the general canopy which receives full light from above and at least from one side.
Cull tree	A malformed tree which yields no merchantable logs.
Current Annual Increment (CAI)	It is the increment, which a tree or a crop puts on in a single year.
Dead unusable	A dead tree that cannot be used, even as firewood.
Dead usable	A dead tree that can be used as firewood or for another purpose.
Debris	Fallen dead trees and the remains of large branches (<10 cm diameter) on the forest floor
Dominance (Do)	Measure of the relative importance of a plant species with respect to the degree of influence that the species exerts on the other components
Dominant	A tree whose crown is larger than average and lies at or above the level of the general canopy and receives full light from above and from more than one side.

Dominant species	Species that dominate (comprise > 60% of the basal area) an ecological community (e.g. forest).
Ecosystem	A community and its physical environment at a given time.
Fodder	Tree foliage fed to livestock.
Forest	An area of land at least 0.5 ha and a minimum width/length of 20 m with a tree crown cover of more than 10% and tree heights of 5 m at maturity.
Frequency	The occurrence of a species within a unit area.
Growing stock	The sum of all trees by number or volume or biomass growing within a unit area.
High-quality sound tree	Live tree which will yield saw logs at least 6 m long at present or in the future.
Intermediate	A tree whose crown is smaller than average, reaches the general level of the canopy but not above it, and receives some direct light from above but little, if any, from the side.
Land cover	The physical material covering the surface of the earth.
Land use	The arrangements, activities and inputs people undertake on an area with a certain land-cover type to produce, change or maintain it.
Litter	Dead plant materials such as leaves, bark, needles, and twigs that have fallen to the ground.
Non-timber forest products	Useful substances, materials and/or commodities obtained from forests which do not require harvesting (logging) trees
Other Land	All land that is not classified as Forest or other wooded land.
Other Wooded Land (OWL)	Land not classified as forest spanning more than 0.5 ha, having at least 20 m width and with a canopy cover of trees between 5% and 10%; trees should be higher than 5 m or able to reach 5 m *in situ*. or The canopy cover of trees less than 5% but the combined cover of shrubs, bushes and trees more than 10%; includes area of shrubs and bushes where no trees are present.
Precision	Refers to the size of deviations in the estimate of a population parameter in repeated application of a sampling procedure. Standard errors and confidence limits are commonly quoted to quantify precision.
R^2 (R squared)	Indicates how well real data points fit a line or curve generated by a model.
Remote Sensing (RS)	The acquisition of data, such as total forest area, forest type, canopy cover and height, from sensors aboard aircrafts or space-based platforms.
Root Mean Square Error (RMSE)	A measure of the differences between values predicted by a model and the values actually observed of the parameter being estimated.
Sal Forest	A forest in which Sal (*Shorea robusta*) comprises more than 60% of the basal area.
Sal Terai mixed hardwood forest (STMH)	A forest in which Sal comprises 33-60% of the basal area and other associated species are present.

Shannon diversity index ($\bar{H}$)	A commonly used diversity index that takes into account both the abundance and evenness of species present in the community.
Shrub	An area occupied by woody perennial plants, generally 0.5-5.0 m at maturity, and often without definite stems or crowns.
Sound Tree	A live tree not qualified as class 1 but with at least one 3 m saw log or two 1.8 m saw logs.
Stratification	Division of an area into homogenous units based on climate, physiography, vegetation, or other characteristics.
Stump	The remnant of a cut or fallen tree.
Suppressed	A tree with a crown that is smaller than normal for a tree of its age and size. It receives little or no direct sunlight and shows signs of retarded growth resulting from competition with dominant trees.
Terai Mixed Hardwood (TMH)	A forest whose composition in the canopy layer is so mixed that none of the species has over 60% basal area.
Understory	A tree with a crown that is below the level of the general canopy and receives little or no direct sunlight though it does not show signs of suppressed or retarded growth.
Wall-to-wall mapping	Mapping that covers an entire area.

Executive Summary

The Forest Resource Assessment (FRA) Nepal Project (2010-2014) was designed to provide comprehensive, up-to-date national-level forest resource information for use in national forest policy development and strategic forestry sector decision-making. The FRA's final design was based on an internationally accepted systematic sampling design and the national data needs assessed in 2010. The "Terai Forests of Nepal 2010-2012" report presents the findings of the FRA conducted in the Terai Physiographic Region during 2010-2012 using RapidEye Satellite Images of February and March 2010/11. This report provides data on the distribution, extent, species composition, soils and biodiversity of Terai forests; discusses forest change; and provides estimates of timber volumes and carbon storage. In addition, it discusses the occurrence and utility of non-timber forest products (NTFPs).

The term "Terai" refers to the Terai Physiographic Region of Nepal as defined Land Resource Mapping Project (LRMP). It occupies 2,016,998 ha of the total land area of the country. It is located in a sub-tropical climatic zone characterised by hot and humid summers, intense monsoon rain, and dry winters. The maximum monthly mean temperature, 35-40°C falls in April/May and the minimum, 14-16 °C, in January. In recent years, population growth rate of 1.75%, the highest in the nation, have resulted in heavy pressure on the forest resources of the region.

Forest-cover maps were prepared using RapidEye MSS Satellite Imagery (Level 1b) as well as FRA field inventory data, secondary images and forest-cover data from land-use maps (Land Resource Mapping Project) and topographical base maps. Remote Sensing data interpretation was verified in the field.

To map forest cover, images were segmented and classified as Forest, Other Land (non-forest) and Other Wooded Land (OWL) including shrub using automated object-based image analysis based on four spectral properties: the mean pixel values of green, near-infrared and red-edge bands; the derived normalised difference vegetation index; the principal components; and the homogeneity texture of the near-infrared band. Forest and non-forest areas were distinguished by defining a 'containment membership function' for threshold values for all four of these properties. In order to reduce residual errors and improve classification accuracy, classified Forest, Other Land (non-forest) and OWL areas were re-interpreted using visual post-classification.

To conduct the forest inventory, field sample clusters were selected systematically at the nodes of 4 km × 4 km square grids placed across the nation. Of the total 1,281 clusters, 334 clusters were in the forest stratum and the remaining 947 clusters in the non-forest (OWL and Other Land) stratum. Among the 224 sub-plots within the 56 forest clusters, 179 were in forest areas; 45 were not. Tree stands measurements, biodiversity assessments, and soil samplings were carried out on all of these sub-plots as well as the 124 sub-plots of the 31 non-forest clusters. Each sample plot comprised four concentric circles of different radii, each used to measure trees with a different DBH range.

The results of the FRA Terai forest-cover mapping were compared with the independent ground samples (n = 861) to verify the map. The field-observed land-cover classes (Forest, OWL, and Other Land) were compared with the land cover classified using RapidEye Satellite Images. The overall accuracy was 97.9%; with 98.6% producer's accuracy and 99.3% users' accuracy. Cohen's kappa (κ) was 0.82 (standard error = 0.03), indicating a high reliability of forest-cover classification. Based on the forest cover mapping, 20.41% (411,580 ha) of the total area of the Terai Physiographic Region was found to be covered by forests and 0.47% (9,502 ha) of the region was found to be under the OWL. Thus, the forests and the OWL together were found to possess 20.88% (421,082 ha) of the total land area in the Terai Region. Based on the analysis, the Terai forest was found to have declined by 16,500 ha within the last 9 years from 2001 to 2010. Similarly, the forest cover loss was found to be about 32,000 ha within the last 19 years from 1991 to 2010. The annual rate of decrease in forest cover was found to be 0.44% and 0.40% during the periods of 2001-2010 and 1991-2010 respectively.

The proportions of the Terai forest in Nepal's five development regions were 30.93% in the Far-Western, 20.80% in the Mid-Western, 11.47% in the Western, 23.13% in the Central, and 13.66 % in the Eastern Development Regions, respectively.

Per hectare stem volume was 167.42 m^3 on forest land, 30.59 m^3 on OWL, and 10.55 m^3 on Other Land. Sal (*Shorea robusta*) forests had the highest stem volume density (208.68 m^3/ha) followed by Sal-Terai Mixed Hardwood (STMH) forests (183.33 m^3/ha) and TMH forests (131.59 m^3/ha). Khair-Sissoo (KS) forests had the least (67.29 m^3/ha) tree stem volume. The average number of stems per hectare was 583 and the basal area per hectare, 18.38 m^2. The air-dried above-ground biomass of the Terai forests was 202.64 t/ha and the below-ground biomass, 6.09 t/ha. Per hectare air-dried and oven-dried biomass were estimated to be 208.73 t/ha and 189.75 t/ha respectively. The total air-dried biomass and oven-dried biomass in the Terai forests were estimated to be 85.9 and 78.1 million tons respectively. The largest stocks of soil organic carbon (SOC) was found in Sal and TMH forests; together, they contained 97% of the soil carbon stocks. The total carbon stock was 50.68 Tg (123.14 C t/ha) in the Terai forests.

Altogether, 380 floral species were inventoried in the Terai. Among them 164 species were trees belonging to 115 genera and 51 families; 72 species belonging to 62 genera and 34 families of shrubs; 109 species belonging to 85 genera and 49 families of herbs; and 30 species of climbers and 5 species of epiphytic plants belonging to 16 families and 25 genera. A total of 370 different species of flora and fauna were found to be used to derive NTFPs in the Terai Region. The assessment also found that the Terai Forests were highly disturbed by livestock grazing, tree cutting, other human induced damage, sapling and pole cutting, tree lopping and forest fires.

Slightly more than 10% of the forest sample sub-plots (n =19) were selected for re-measurement to assure quality. On the basis of repeated measurements, the average number of trees per hectare differed from 1,061 to 1,059.5, and the average basal area per hectare ranged from 23.0 m^2 to 23.1 m^2. The differences between those measurements were not found statistically significant when independent sample t-test (P-value=0.96) was applied.

The assessment found that the Terai forests were highly disturbed by livestock grazing, tree cutting, sapling and pole cutting, and forest fires

Main Results

Forest and Other Wooded land

- Out of the total land area (2,016,998 ha) of the Terai Physiographic Region, forest covers 411,580 ha (20.41%) and Other Wooded Land (OWL) covers 9,502 ha (0.47%). Forest and OWL, together, cover 20.88% of the total land area of the Terai region.
- About 76.45% (314,660 ha) of the total forest in the Terai are outside the Protected Areas (PAs) followed by 16.97% (69,847 ha) forests inside the PAs, and 6.58% (27,074 ha) forests in the Buffer Zones.
- The forest area in the Terai decreased by 32,000 ha with annual rate of 0.40% in the last 19 years from 1991 to 2010.
- Similarly, the forest area in the Terai decreased by 16,500 ha with annual rate of 0.44 % in the last nine years from 2001 to 2010.
- The Terai forest area increased in Banke, Nawalparasi, and Siraha districts between 2001 and 2010 while the remaining 15 districts showed negative trend. Forest-cover loss was highest in Kailali, Bardiya and Kapilvastu districts during 1991- 2010 as well as during 2001- 2010.
- Forest land was found to have been converted into: i) cultivation (62%), ii) others e.g. barren land (15%), iii) river-beds owing to changes in river courses (15%), OWL (4%) and grassland (4%).

Growing Stock

- The total number of stem (≥ 5cm DBH) in Terai forest was 240.12 million (583.40 stems/ha) and total stem volume was estimated to be 68.91 million m^3 (167.42 m^3/ha).
- The regeneration in the Terai forest was found to be satisfactory; the average number of seedlings (height < 1.3 m) per hectare being 29,649 (median 21,287) and saplings (< 5 cm DBH) being 1,662 (median 995).
- The Terai forest contained 50.66 Tg (123.14 t/ha) of Carbon excluding seedlings and saplings of tree species as well as shrub species having less than 5 cm DBH, climbers, fine roots, grasses (including bamboos) and herbs.
- The main tree species in terms of proportion of stem volume were Sal (*Shorea robusta*) with 91.72 m^3/ha (54.8%) and followed by Asna (*Terminalia alata*) 19.43 m^3/ha (11.6%).
- The timber volumes up to 10 cm top and up to 20 cm top diameters in the Terai forest were 50.20 million m^3 (121.98 m^3/ha) and 41.85 million m^3 (101.68 m^3/ha) respectively.
- Altogether, 1.03 million (4.31 trees/ha) of standing dead trees having 1.77 m^3 (2.51 m^3/ha) stem volume were estimated in the Terai forest.
- The total volume of dead wood lying inside the Terai forest was estimated to be 2.63 million m^3 (6.39 m^3/ha).
- During the last five years (2007-2012), a total of 2.46 million m^3 (5.97m^3/ha) stem volume were removed from the Terai forest.
- The level of accuracy at 95% confidence level for estimating stem volume per ha in the Terai forest was found to be 11.8%; the standard error of mean being 6.02%.

Biodiversity

- The most dominant tree species of the Terai forest are Sal (*Shorea robusta*) and shrub species are Bhanti (*Ardisia solanacea*), Dhaiyaro (*Woodfordia fruticosa*); the most common herbs being Boke Ghas (*Ageratum conyzoides*), Mothe (*Cyperus rotundus*) and Kalo Musli (*Curculigo orchioides*).
- Out of the total 65 mammal species found in the Terai forest, eight are enlisted as 'Endangered' in IUCN Red List and 15 are legally protected under the NPWC Act, 1973 of Nepal.
- Altogether, 370 different species of NTFPs (flora 329 and fauna 41) are used for different purposes; the most common medicinal flora are Amala (*Phyllanthus emblica*), Harro (*Terminalia chebula*), Bel (*Aegle marmelos*) and Pipla (*Piper longum*).

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1. INTRODUCTION

The Forest Resource Assessment (FRA) Nepal Project (2010-2014) was designed to provide comprehensive, up-to-date national-level forest resource information for use in national forest policy development and strategic forestry sector decision-making. It used a well-established inventory design (the systematic sampling of cluster plots) and took into account national data needs as assessed in 2010. This report, “Terai Forests of Nepal 2010-2012,” is a comprehensive presentation of the results of the FRA conducted in the Terai Physiographic Region.

By establishing a national network of permanent forest sample plots, the FRA Nepal has made it possible to conduct the sort of continuous forest inventory necessary for a) calculating annual increment; b) determining annual allowable harvest; c) monitoring forest carbon flux; d) monitoring forest health; e) monitoring the impacts of climate change on forests; and f) monitoring the sustainability of broadly applied forest management practices.

The FRA was based on RapidEye Satellites Images taken in February and March 2010/11 and a field inventory conducted in 2010 and 2011 together with quality assurance work conducted up to 2012. This report provides data on the distribution, extent, species composition, soils and biodiversity of the Terai Forests; discusses forest change; and provides estimates of timber volumes and carbon storage. In addition, it discusses the occurrence and utility of non-timber forest products (NTFPs).

The FRA incorporated rigorous quality assurance to ensure accurate and reliable information. The data provided in this report is also available on-line at www.franepal.org through the FRA Nepal Open Source Forest Information System (OSFIS). This system, which is kept up-to-date, should be considered the authoritative source in the case of any minor discrepancies.

1.1. The Environment of the Terai Forests

1.1.1. Physical Environment of the Terai

Spatial Extent of the Terai

The term “Terai” refers to the Terai Physiographic Region of Nepal. It occupies 2,016,998 ha[1] of the total land area of the country. In terms of geomorphology, it consists of gently sloping recent and post-Pleistocene alluvial deposits which form a piedmont plain south of the Himalayan. It is bordered by the Indian Gangetic plain in the south and the Churia Physiographic Region in the north. It extends from 80° 4’ 30” to 88° 10’ 19” east longitudes; and from 26°21’ 53” to 29° 7’ 43” north latitudes (Figure 1). Its elevation varies from 63 m to 330 m above mean sea level, and is sloped gently at rates of 2-10 m per kilometre (LRMP, 1986).

The Terai is divided into three sub zones: the Bhabar, the Terai and the Southern Terai (Jackson, 1994). The Bhabar is a narrow stretch of recent alluvial and colluvial fan deposits at the foot of the Churia Hills, which consists of thick deposits of gravel, pebbles and boulders, mixed with sand and silt. The alluvial and colluvial fans in the Bhabar coalesce into piedmont slopes and merge with the main Terai in the south, which is formed by sediments deposited by braided rivers. The Terai is the area where the water which has drained into the gravels of the Bhabar reappears again at the surface whereas the Southern Terai is an extension of the Gangetic Plains.

Soils

Most soils in the Terai are alluvial deposits. Alluvium is unconsolidated material deposited by rivers. The nature of the alluvium depends on the parent materials from which it has been derived, and so it may vary in texture from sand to clay (Jackson, 1994). The soils in the Bhabar, in contrast, generally consist of coarse sand, gravels and boulders. According to ISRIC (2009), Terai soils can be classified as i) Calcaric Fluvisol, ii) Gleysols and iii) Phaeozems. Calcaric Fluvisol is found near rivers (Figure 2) and Gleysols in areas where there is permanent and temporary wetness near the surface. Phaeozems

[1] The official area statistics of the Terai Physiographic Region is 2,011,300 ha, Survey Dept. 2001.

have a thick, dark topsoil rich in organic matter, and show evidence of the removal of carbonates. They are loamy textured, dark brown, calcarious and drought-prone soils.

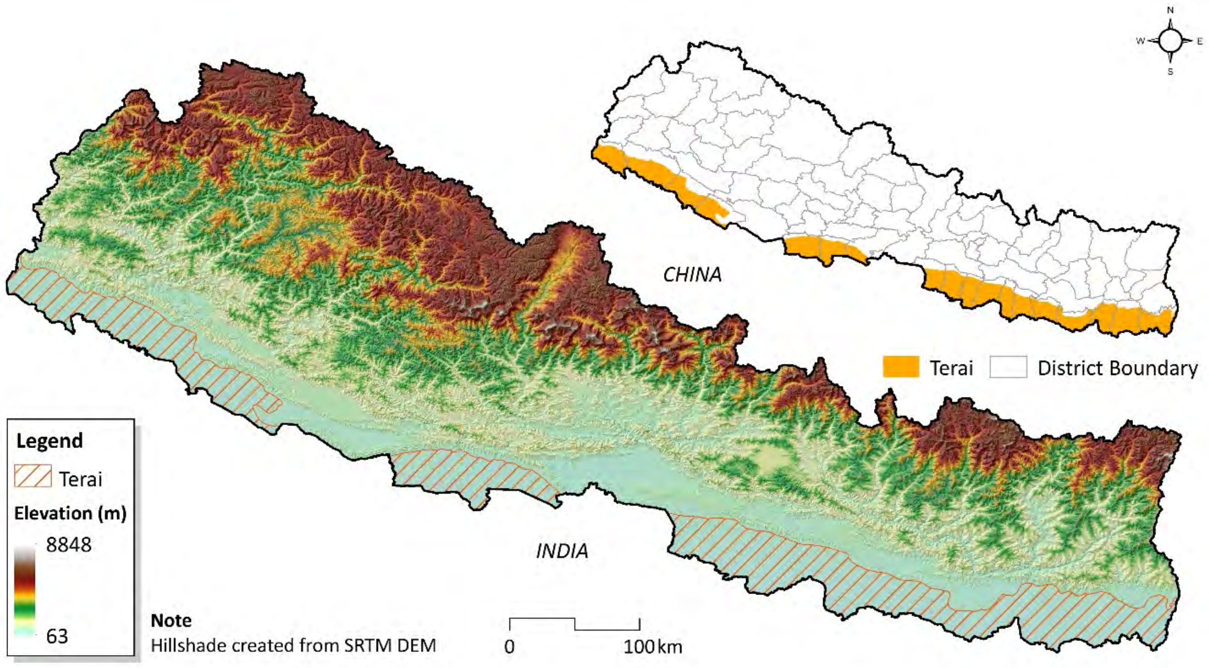


Figure 1. Spatial extent of the Terai in Nepal

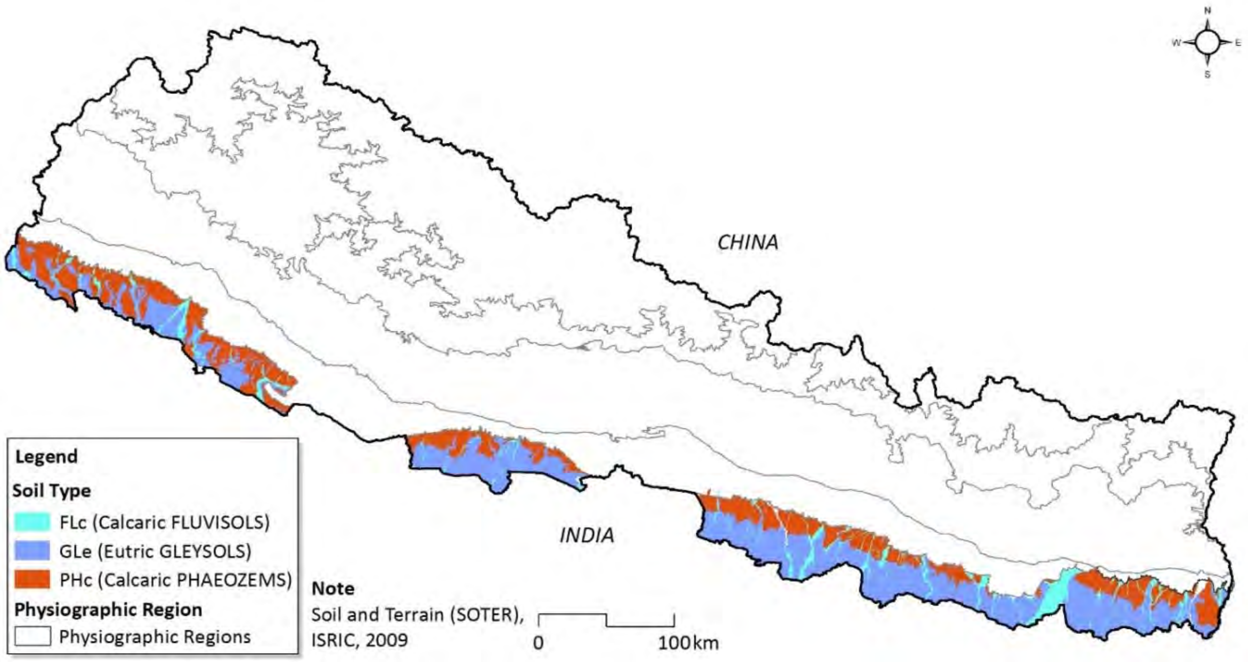


Figure 2. Soils in the Terai

Climate

The Terai is located in a sub-tropical climatic zone characterised by hot and humid summers, intense monsoon rain, and dry winters. The maximum monthly mean temperature, 35-40 °C falls in April/May and the minimum, 14-16 °C, in January (Jackson, 1994).

The total annual rainfall decreases from 2,680 mm to 1,138 mm from east to west, and the mean monthly precipitation ranges from 8 mm in November to 535 mm in July[2]. While 80% of the total rainfall occurs in the monsoon season (June-September), some rainfall also occurs during the pre-monsoon (March-May) and the post-monsoon (October-November) seasons and a few showers may also occur during the winter (December-February). Total annual precipitation over the last 30 years has increased by an average of 4 mm/year in the Terai; while it has increased in the Eastern and Central development regions, it has decreased elsewhere. The mean annual temperature is increasing across the Terai at the rate of 0.029^{o}C/year in the Far-West and 0.049^{o}C/year in the East and Mid-West. All four seasons are also warming up (Jones *et al.*, 2004).

Drainage

The Terai is drained by numerous rivers and streams. The largest of them are the Koshi in the east, the Gandaki in the centre, and the Karnali and the Mahakali in the west, all originating from the Himalaya or beyond (Figure 3). As the rivers cross the hills and the Churia Region, they start depositing huge sediments along their banks in the Terai Region. The deposition process creates multiple channels (of the rivers). Every year during monsoon season, most of the rivers are swollen up causing flash floods in the Terai Region due to their shallow beds. One of the biggest concerns is the tendency of minor and major rivers to change their courses due to flooding events (Carson *et al.*, 1986).

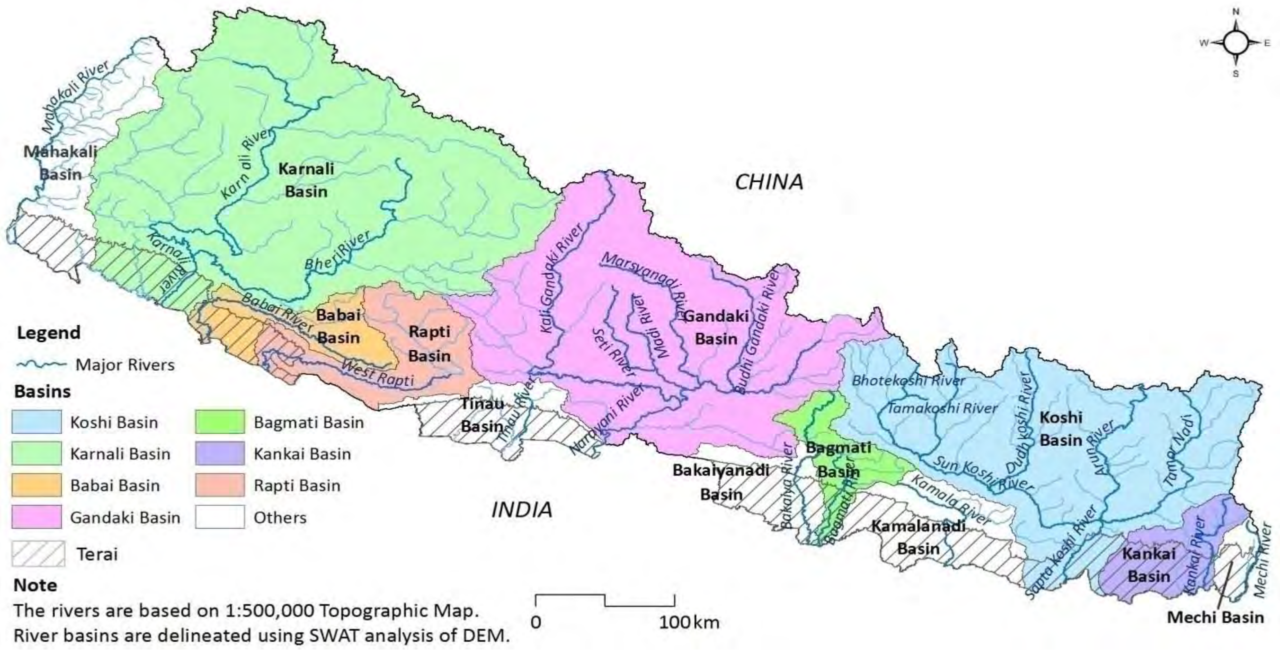


Figure 3. River basins and drainage of Nepal

1.1.2. Historical Background of the Terai Forests

Before 1957, Terai forests were controlled by Rana rulers together with their relatives and followers, and subject to much misuse, degradation and deforestation of the forests. In 1957, forests throughout the nation were nationalised, making them open-access resources. Degradation and deforestation continued (Ostrom, 1990). The coverage of Terai forests declined almost to 60% within half-century from 1927 to 1977 as the rates of conversion of forests to farmlands and farmlands to urban areas increased (Matthews *et al.*, 2000). In 1972, to counter the widespread losses in forest quality and quantity, the Government of Nepal (GoN) enacted the National Parks and Wildlife Conservation Act, which provided for managing forest areas with ecological, biological, cultural and scenic values by establishing protected areas (PAs) to conserve different wildlife species and their habitats. So far, 94,512 ha of forest in the Terai are PAs. In 1976, it adopted the National Forestry Plan, which categorised

[2]Based on data from 22 meteorological stations in the Terai (Department of Hydrology and Meteorology, 1979–2009).

major constraints on effective forest management and proposed policies to tackle them, including the restoration of degraded sites, the development of technology and the promotion of public co-operation. This plan ultimately led to the initiation of the Community Forestry (CF) Programme under the Panchayat Forest Rules and Panchayat Protected Forest Rules of 1978. The CF management system was formally recognised in the Forest Act of 1993 and Forest Rules of 1995, which provided for the eight different management regimes (Table 1).

Table 1. Legal status of the Terai forests

Management regime	Ownership/User rights	Management authority
Private	Individuals and organisations	Individuals and organisations
National		
Government-managed	GoN	DoF
Collaborative	GoN (users' groups have partial use rights)	State agencies and users' groups
Community	Users' groups (land ownership: GoN)	Local communities/users' groups
Leasehold	Leaseholder (land ownership: GoN)	Leaseholder
Religious	Users' groups (land ownership: GoN)	Local communities/users' groups
Protected	GoN	DoF
Protected Areas*	GoN	DNPWC
Buffer-zone CFs*	Users' groups (land ownership: GoN)	Local communities/users' groups

*Categorised according to NPWC Act of 1972

1.1.3. Population

The rapid growth of the population of the Terai in recent years at the annual rate of 1.75%, the highest rate in the nation, has place growing and heavy pressure on the forest resources of the region.

In 2011 the total population of Nepal was 26,494,504. The greatest proportion, 50.3% were living in the Terai, where the population density soared to 392 persons per square kilometre (Table 2; CBS, 2012). One of the main reasons for the high rate of population growth in the Terai is internal migration from the hills and mountains to escape the severe climate and challenging agricultural conditions and to more easily access job opportunities and health and education services.

Table 2. Population in different physiographical regions of Nepal from 1971 to 2011

Population parameter	Year	Physiographic regions				Total population
		Mountain	Hill	Terai	Total	
Population (%)	1971	9.9	52.5	**37.6**	100.0	**11,555,983**
	1981	8.7	47.7	**43.6**	100.0	**15,022,839**
	1991	7.8	45.5	**46.7**	100.0	**18,491,097**
	2001	7.3	44.3	**48.4**	100.0	**23,151,423**
	2011	6.7	43.0	**50.3**	100.0	**26,494,504**
Density per sq. km.	1971	22.0	99.0	**127.8**	78.5	**11,555,983**
	1981	25.1	116.8	**192.7**	102.2	**15,022,839**
	1991	27.9	137.3	**253.6**	125.6	**18,491,097**
	2001	33.0	167.0	**330.0**	157.0	**23,151,423**
	2011	34.0	186.0	**392.0**	180.0	**26,494,504**

Source: CBS, 1991, 2001 and 2012.

2. FOREST INVENTORIES

2.1. Previous Forest Inventories in the Terai

The first national-level forest inventory was carried out in the 1960s. Since then, several forms of FRA activities have been carried out in different periods, each different in terms of purpose, scale, scope, design and technology used. The FRA Nepal (2010–2014) is the third and most recent national-level forest resource inventory conducted.

2.1.1. Forest Resources Survey (1963–67)

The first national-level forest inventory was conducted between 1963 and 1967 with the support of the USAID (FRS, 1967). It covered the Terai, Inner Terai, Churia Hills, and southern faces of the Mahabharat Range but excluded most of the Chitwan Division, which was inventoried separately. Similarly, all the inaccessible forests were also not inventoried. After classifying forests as either commercial or non-commercial, the survey focused on collecting data only from the commercial forests, primarily regarding timber stock/estimate, and domestic consumption of wood products. In terms of methodology, it was based on the visual interpretation of aerial photographs (1953–58 and 1963–64), mapping, and a field inventory. The inventory provided the first comprehensive assessment of commercial forests in the i) Terai and adjoining areas and ii) the Hilly Regions.

District-level inventories (1968 onwards)

District-level forest inventories have been conducted since 1968 in most Terai districts in order to assess growing stock and prepare district-level forest management plans.

2.1.2. Land Resources Mapping Project (1977–79)

The LRMP was a whole-country assessment conducted from 1977 to 1979 using a variety of methods, including the interpretation of aerial photographs taken between 1977 and 1979, land survey, topographic maps and ground verification. It focused on mapping land cover and land use, producing forest-cover maps and assessing the type, size and crown cover of forests. Both high- and low-altitude forests were mapped by crown cover (0–10%, 10–40%, 40–70%, and 70–100%) and scrubland was also mapped separately. Each forest was defined on the basis of the dominant species and forest type (coniferous, hardwood, or mixed). Land-use maps at the scale of 1:50,000 were produced using aerial photographs at the scale 1:12,000.

2.1.3. Forest Resources and Deforestation in the Terai (1978/79–1990/91)

The DFRS (then the Forest Survey and Statistics Division directly under the MFSC), with support from the FINNIDA, evaluated forest resources and deforestation in the Terai from 1978/79 to 1990/91 using 1991 Landsat TM (28.5 m spatial resolution) Satellite Imagery. It covered all 20 districts within the Terai (3.4 million ha) but excluded PAs from its results (Table 3).

2.1.4. National Forest Inventory (1987–1998)

The Second National Forest Inventory was conducted by the DFRS with support from the Government of Finland from 1987 to 1998. It updated data on forest coverage and change as well as forest statistics for all the accessible forests excluding PAs using 1991 Landsat TM Satellite Images for the Terai and aerial photographs taken in 1989-1992 (DFRS, 1999) for the hills. In the hills, photo-point sampling was used to estimate forest area as well as to carry out forest inventory in the field. Forest land was defined as an area of at least one hectare with a crown cover of 10% or more. According to this study, Terai forests covered 545,900 ha (FORESC, 1993).

2.1.5. Wide-area Tropical Forest Resources Survey (2000)

In 2000/2001, the DFRS carried out a wide-area tropical forest resources survey of the entire nation using Satellite Imagery (Landsat TM images taken in 1998/99 and Indian RS images taken in 1999/2000) in technical collaboration with the Japan Forest Technical Association (JAFTA). It analysed land use, forest distribution, forest type, and conditions with the aim of providing the information required to prepare forest management plans. According to the JAFTA (2001), the total forest area of six different types of forest (Sal, TMH, upper mixed hardwood (UMH), Chir pine, Blue pine and Fir/Hemlock/Spruce/Cedar) was 5.51 million ha and that of shrub, 1.28 million ha.

Table 3. Changes in forest land cover in Terai districts from 1978/79 to 1990/91

SN	District	1978/79 data Plains (ha)	1991 data Plains (ha)	% change
1	Kanchanpur	51,000	38,600	-24
2	Kailali	109,900	93,800	-15
3	Bardiya	44,100	38,800	-12
4	Banke	72,800	63,100	-13
5	Dang	38,000	36,400	-4
6	Kapilvastu	54,300	46,600	-14
7	Rupandehi	25,600	16,000	-37
8	Nawalparasi	33,900	25,600	-25
9	Chitwan	20,900	18,500	-12
10	Parsa	25,700	23,200	-10
11	Bara	38,200	35,400	-7
12	Rautahat	25,400	24,100	-5
13	Sarlahi	15,900	13,800	-14
14	Mahottari	12,800	9,400	-26
15	Dhanusha	2,000	2,600	+31
16	Siraha	4,100	4,300	+5
17	Saptari	5,100	3,300	-34
18	Sunsari	14,800	11,100	-25
19	Morang	31,900	26,700	-16
20	Jhapa	19,100	15,000	-22
	Total	**645,300**	**545,900**	**-15**

2.1.6. Forest Cover Change in the Terai Districts (2005)

In 2005, the Department of Forests (DoF) conducted a study of forest-cover change in the 20 Terai districts using Landsat 1990/91 and Landsat 2000/01 Satellite Images and classifying land according to six main categories (forest, degraded forest, grass land, barren land, water bodies, and other land. Ground verification was done between September and November 2004. According to the DoF (2005), the total forest cover in the Terai districts (including the Churia Hills) was 37% (1.3 million ha). Seven districts—Dang, Nawalparasi, Chitwan, Mahottari, Sarlahi, Rautahat and Saptari had more forest cover than the other districts. The annual rate of deforestation in all 20 Terai districts was -0.06%, excluding PAs.

3. METHODOLOGY

3.1. The Terai Forest Resource Assessment

The FRA Nepal combined both field-based assessment and the interpretation of RS Images, later field-verified. The different methods adopted are described below.

3.1.1. Forest Inventory

The inventory design adopted was based largely on methods developed by Kleinn (1994) and finalised collaboratively by international and regional FRA experts and DFRS staff. The design was created during the first year and tested in the field in three trial inventories and training sessions. After each test, the method was revised to improve its functionality. The variables measured were selected based on the suggestions made during a national-level data needs assessment workshop held with FRA data partners in Nepal (Annex 1).

3.1.2. Sampling

Two-phase systematic sampling was adopted. In the first phase sampling, a 4 km × 4 km grid was superimposed on a high-resolution RapidEye (5m × 5m) Satellite Images covering the entire country with the help of Google Earth images and topographic maps, yielding, altogether 9,180 clusters (grid-cells). Each cluster consisted of six concentric circular sample sub-plots laid out and interpreted visually. Altogether, 55,358 sample plots within 9,180 clusters were laid out throughout Nepal. In the Terai Physiographic Region, 7,533 such sample plots in 1,281 clusters were visually interpreted using standardised procedures in the first phase sampling (FRA Nepal, 2010) (Figure 4). The sub-plots were 150 m apart in the north-south direction and 300 m apart in the west-east direction. Starting in the southwest of far-western Nepal, the clusters were systematically numbered from south to north and west to east.

In the second phase, only four sub-plots were considered; the two middle sub-plots in the north-south direction (plots 2 and 5) were eliminated because of the general homogeneity of the Terai forests. Hence, in the second phase field sampling, only four sub-plots of each cluster were taken into account and measured accordingly. Altogether, 1,281 clusters were divided into two strata in which the first stratum had at least one sub-plot out of four interpreted as forest-plots during the first phase, and the second stratum (i.e. zero forest) contained no forest-plots that had been interpreted as forest-plots in the first phase.

During the second phase, the field sample clusters were selected systematically at the nodes of the 4 km×4 km square grids. Of the total 1,281 nodes, 334 clusters were found to be in the first stratum while the remaining 947 clusters were in the second stratum. From the 334 clusters in the forest stratum, every 6th cluster was selected so as to have altogether 56 forest clusters allocated for the Terai Region (Figure 5); starting from a randomly selected cluster among the first six nodes. Similarly, the other clusters were selected systematically from the non-forest stratum too. Every 30th node was selected so as to have 31 non-forest clusters for additional measurement.

Among the 224 sub-plots within the 56 forest clusters, 179 sub-plots were found to be in the forest area in course of field inventory. However, 175 sub-plots were measured and the remaining 4 sub-plots could not be measured because of dense rattan and creeks. Out of the remaining 45 sub-plots, 5 were found to be in Other Wooded Land (OWL) and 40 were in Other Land cover type, including rivers and agricultural land.

In the case of zero forest clusters, all the sub-plots within the sample clusters were also measured so as to verify those in the field and also to assess the number of trees present within those sub-plots even if those were in non-forest areas (stratum two).

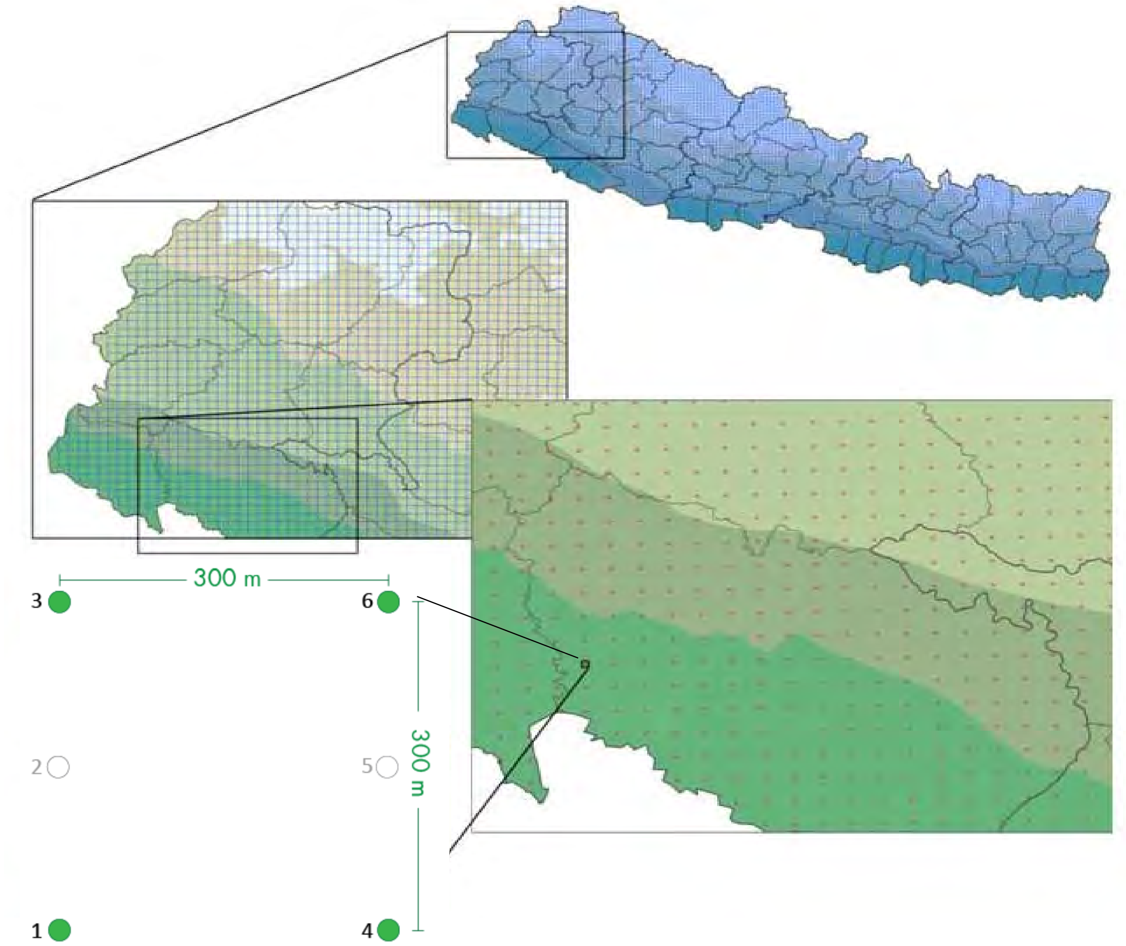
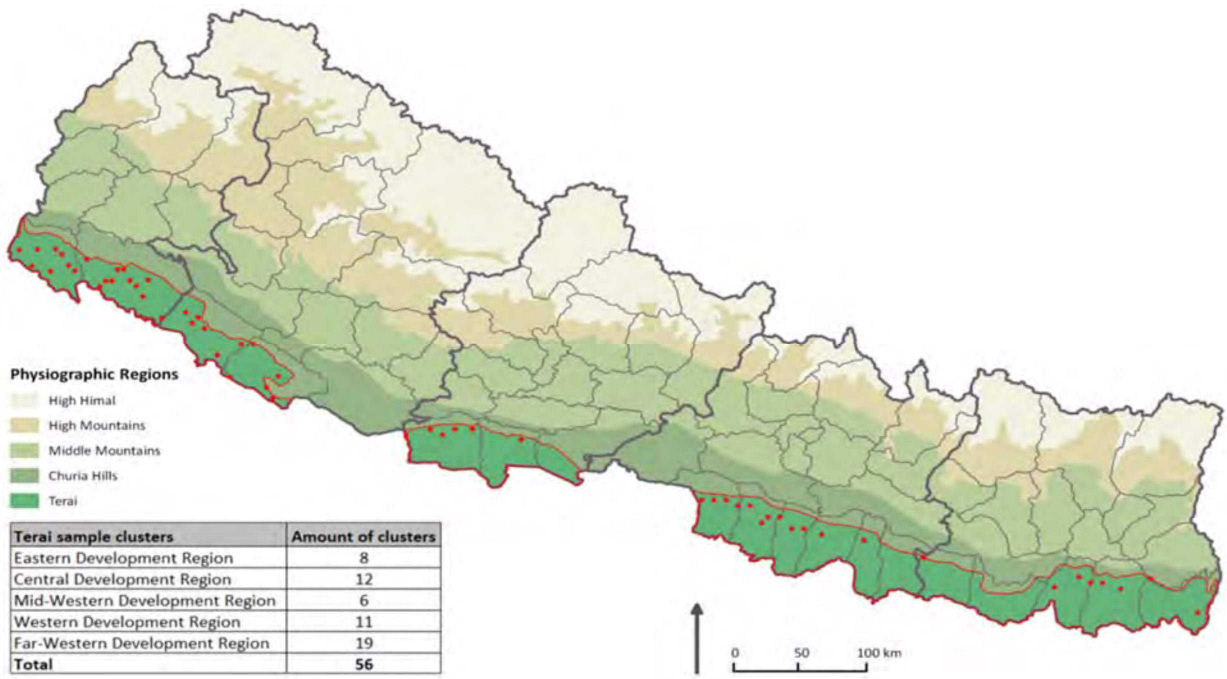


Figure 4. FRA cluster/sample plot design and layout of concentric circular sample plot (CCSP)



Terai sample clusters	Amount of clusters
Eastern Development Region	8
Central Development Region	12
Mid-Western Development Region	6
Western Development Region	11
Far-Western Development Region	19
Total	**56**

Figure 5. Distribution of permanent sample clusters in the Terai Region

3.1.3. Sample Plot Design

Each sample plot had four concentric circles of different radii, which were used to measure trees with different DBH (Figure 6) as indicated below:

- trees having 30 cm DBH or more enumerated within a 20 m radius plot (area: 1256.6 m^2)
- trees having 20-29.9 cm DBH enumerated within a 15 m radius plot (area:706.9 m^2)
- trees having 10-19.9 cm DBH enumerated within a 8 m radius plot (area:201.0 m^2)
- trees having 5-9.9 cm DBH enumerated within a 4 m radius plot (area: 50.3 m^2)

Other sub-plots were established to assess the status of seedlings, saplings, shrubs and herbs other than trees. More particularly, seedlings, saplings and shrubs were measured in four circular sub-plots, each with a radius of 2 m, located 10 m away from the centre of the plot in each of the four cardinal directions (north, east, south and west). Species-wise stem counting and mean height estimations were done for tree and shrub species having DBHs less than 5 cm. Information on non-woody vascular plants was collected from four 1 m^2 square plots, each located 5 m away from the centre in the four cardinal directions. Dead and decaying wood was assessed in a circular plot with a radius of 10 m from the plot centre. Based on field observations, 15 categories of natural and anthropogenic forest disturbances were assessed in terms of their occurrence and intensity (high, medium, low) on sub-plots with 20 m radius. The presence of mammals was assessed using footprints, scat, calls and markings inside and outside each sub-plot as teams moved from one sub-plot to the next. Information related to the faunal diversity and ethno-botanical uses of different NTFPs were obtained through social surveys conducted in villages near the clusters.

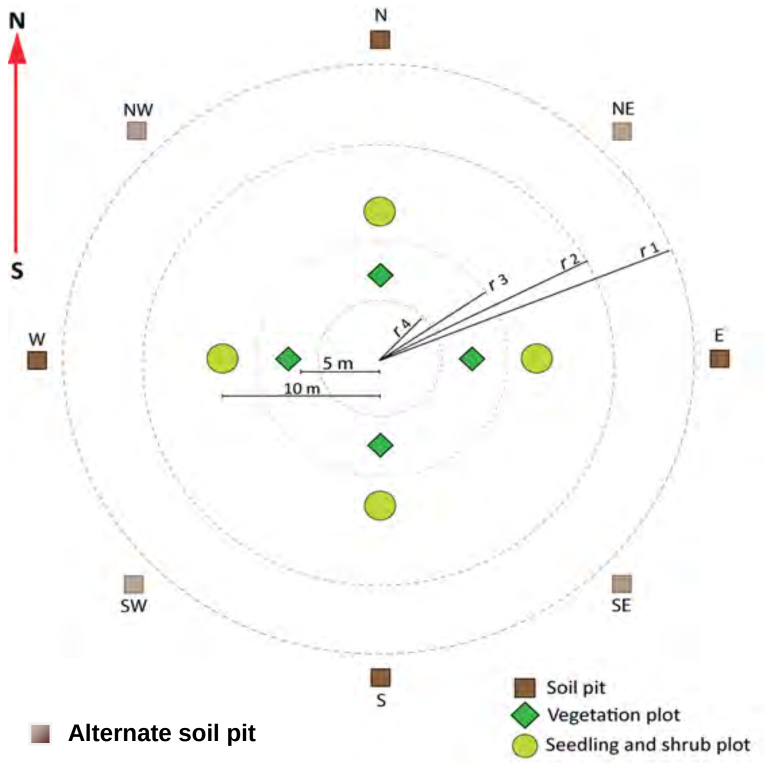


Figure 6. Layout of concentric circular plot with supplementary sub-plots used

3.2. Tree Resources on Other Land

Information regarding the tree resources on Other Land were obtained by measuring all the sub-plots of the 31 non-forest clusters selected from the non-forest stratum of Phase I sampling as well as the sub-plots of the forest clusters falling outside forests. Altogether, 160 sub-plots were assessed. The plot design and resource assessment methods were exactly the same as in the case of forest-plots.

3.3. Quality Assurance of Forest Inventory Data

Slightly more than 10% of the total allocated sub-plots for forest inventory were systematically selected and re-measured for assuring the quality of the forest inventory field measurement, providing feedback to the crew members and thereby improving the FRA Nepal Field Manual.

3.4. Tree Height Modelling

The total height of trees is an important predictor of essential forest parameters such as volume and biomass but its measurement for all trees under forest conditions can be time consuming and impractical. For this reason, height models were prepared for tree species and species groups in the Terai Region using the data collected from the sample trees (every fifth tree) and additional ones as necessary to fill data gaps within each sample plot.

A non-linear mixed-model approach was used to establish the relationships between the DBHs and total heights of trees using the *Lmfor* package in R Software (Mehtatalo, 2012). As indicated below, different models were developed using those non-linear functions most suitable for different species groups (Annex 2):

- The *Wykoff* function for *Shorea robusta*.
- The *Curtis* function for species such as *Cleistocalyx operculata, Dillenia pentagyna*, and *Schleichera oleosa*.
- The *Meyer* function for species such as *Buchanania latifolia*, *Lagerstroemia parviflora*, and *Anogeissus latifolius*.
- The *Naslund* function for species such as *Trewia nudiflora, Terminalia alata, Syzygium cumini, Mangifera indica,* and *Lannea coromandelica.*

In addition, species with only a few sample trees were grouped according to their families, genera and existing height-diameter observations, and models were developed for each of these groups.

A model for predicting tree DBH from stump diameter was also developed so that the volume and biomass of trees that had been felled could be estimated (Annex 3).

3.5. Volume and Biomass Estimation

Tree volume estimation: The volume equations developed by Sharma and Pukkala (1990) and the biomass models prescribed in the MoFSC (1988) were used to estimate the volume and biomass of standing trees. The air-dried biomass values obtained using these equations were converted into oven-dried biomass values using a conversion factor of 0.91(Chaturvedi, 1982; Kharal and Fujiwara, 2012) and a carbon-ratio factor of 0.47 (IPCC, 2006).

The following allometric equation (Equation 1) developed by Sharma and Pukkala (1990) was used to estimate tree volumes over bark:

Equation 1. Tree volume

$$\ln(v) = a + b \ln(d) + c \ln(h)$$

where,

ln = Natural logarithm to the base 2.71828.

V = Volume (dm^3) = exp [a + b×ln(DBH) + c×ln(h)]

d = DBH in cm

h = Total tree height in m

a, b and c are coefficients depending on species

Values were divided by 1000 to convert them into cubic meters.

The regression parameters of Equation 1 are presented in Table 4.

Table 4. Species-specific coefficients used for calculating the volumes of individual trees

SN	Species	Local name	a	b	c	S_f
1	*Acacia catechu*	Khair	-2.3256	1.6476	1.0552	0.12
2	*Adina cordifolia*	Haldu	-2.5626	1.8598	0.8783	0.14
3	*Anogeissus latifolius*	Banjhi	-2.272	1.7499	0.9174	0.11
4	*Dalbergia sissoo*	Sissoo	-2.1959	1.6567	0.9899	0.12
5	*Syzygium cumini*	Jamun	-2.5693	1.8816	0.8498	0.12
6	*Hymanodictyon excelsum*	Bhurkul	-2.585	1.9437	0.7902	0.11
7	*Lagerstroemia parviflora*	Botdhainro	-2.3411	1.7246	0.9702	0.14
8	*Michelia champaca*	Champ	-2.0152	1.8555	0.763	0.14
9	*Shorea robusta*	Sal	-2.4554	1.9026	0.8352	0.13
10	*Terminalia alata*	Asna	-2.4616	1.8497	0.88	0.12
11	*Trewia nudiflora*	Gutel	-2.4585	1.8043	0.922	0.12
12	Miscellaneous in Terai	-	-2.3993	1.7836	0.9546	0.16

The actual volumes of broken trees were estimated using a taper curve equation developed by Heinonen *et al.* (1996).

Tree stem biomass estimation: Tree-stem biomass was calculated using Equation 2 and species-specific wood-density values (Table 5).

Equation 2. Tree stem biomass

$$\text{Stem biomass} = \text{Vol} \times \text{density}$$

where,

Vol = Stem volume in cubic meters
Density = Air-dried wood density

Table 5. Stem wood-density of Terai trees

SN	Species	Local name	Air-dried density (kg/m^3)
1	*Acacia catechu*	Khair	960
2	*Adina cordifolia*	Haldu/Karma	670
3	*Albizzia* spp.	Siris	673
4	*Anogeissus latifolius*	Banjhi	900
5	*Bombax ceiba*	Simal	368
6	*Dalbergia sissoo*	Sissoo	780
7	*Syzygium cumini*	Jamun	770
8	*Lagerstroemia parviflora*	Botdhainro	850
9	*Litsea monopetala*	Kutmiro	610
10	*Michelia champaca*	Champ	497
11	*Shorea robusta*	Sal	880
12	*Terminalia alata*	Asna/Saj	950
13	*Trewia nudiflora*	Gutel	452
14	Miscellaneous	-	674

Source: Sharma and Pukkala, 1990.

Tree branch and foliage biomass estimation: Separate branch-to-stem and foliage-to-stem biomass ratios for *D. sissoo, S. robusta* and the other TMH species mentioned in the MoFSC (1988) for small (DBH < 28 cm), medium (DBH 28 – 53 cm) and large (DBH > 53 cm) trees were used to estimate branch and foliage biomass from stem biomass (Table 6). Dead trees were not taken into account for this estimate.

Table 6. Branch-to-stem and foliage-to-stem biomass ratios of the trees

SN	Species	Local name	Branch-to-stem			Foliage-to-stem		
			Small	Medium	Large	Small	Medium	Large
1	*Dalbergia sissoo*	Sissoo	0.684	0.684	0.684	0.01	0.01	0.01
2	*Shorea robusta*	Sal	0.055	0.341	0.357	0.062	0.067	0.067
3	Other TMH species	-	0.4	0.4	0.4	0.07	0.05	0.04

The total biomass of individual trees was estimated using Equation 3.

Equation 3. Individual tree total biomass

Total biomass = Stem biomass + branch biomass + foliage biomass

Tree stump and coarse root biomass estimation: It was calculated using Equation 4 (Altrell *et al.*, n.d.), which assumes a cylindrical stump and a coarse root biomass, which is half the biomass of the above-ground stump.

Equation 4. Stump volume estimation

$$Vol_{stump} = (D_{sh}^2)/4 \times H_{stump} \times \pi \times F_{stump}$$

where,
D_{sh} = Stump diameter (at stump height or at 1.3 m if stump height exceeds DBH)
H_{stump} = Stump height
F_{stump} = Stump form factor 1.5 (stump form factors range from 1.3 to 2.0)

Area estimates based on Phase 2 forest inventory sampling

Area estimation and the associated error were derived as suggested by Korhonen (2006). Phase 2 field work revealed large deviations between the Phase 1 visual interpretation and the Phase 2 field classifications, so land-use classes and estimates of forest type proportions were derived using both the Phase 1 and Phase 2 samples and Equation 5.

Equation 5. Proportional area coverage estimation

$$p_k = \sum_h \frac{n_h'}{n'} \frac{n_k}{n_h},$$

where,
n_k = number of phase 2 sample units falling in category k

The area of any category k was estimated using Equation 6.

Equation 6. Area coverage estimation

$$A_k = p_k\, A = \sum_h \frac{n_h^{'}}{n^{'}} \frac{n_{hk}}{n_h} A,$$

where,
n_{hk} = number of Phase 2 sample plots falling in category *k* within sampling stratum *h*

3.6. Analysis of Remote Sensing Data

Forest-cover maps were prepared using RapidEye MSS Satellite Imagery (Level 1b, radiometrically corrected), secondary images (Google Earth images, Landsat TM etc.), ancillary maps (LRMP and Topographical maps) and the FRA Nepal field inventory data.

3.6.1. Geometric and Atmospheric Correction of the Satellite Images

The RapidEye Level 1b imagery (22 scenes acquired in February and March 2010/11) was ortho-rectified using Toutin's Model (Toutin, 2004), with ground control points and a high-resolution digital elevation model. The ground control points were collected using road and river features from Topographical Base Map Data. The digital elevation model was generated using contours and spot levels from Topographical Base Map Data. Independent check points were collected to assess the level of accuracy (Figure 7). The planimetric accuracy of the ortho-rectified images was 9.81 m (≈1.96 pixels RMSE) for the 1,355 ground-control points collected for 48 RapidEye scenes covering the entire nation.

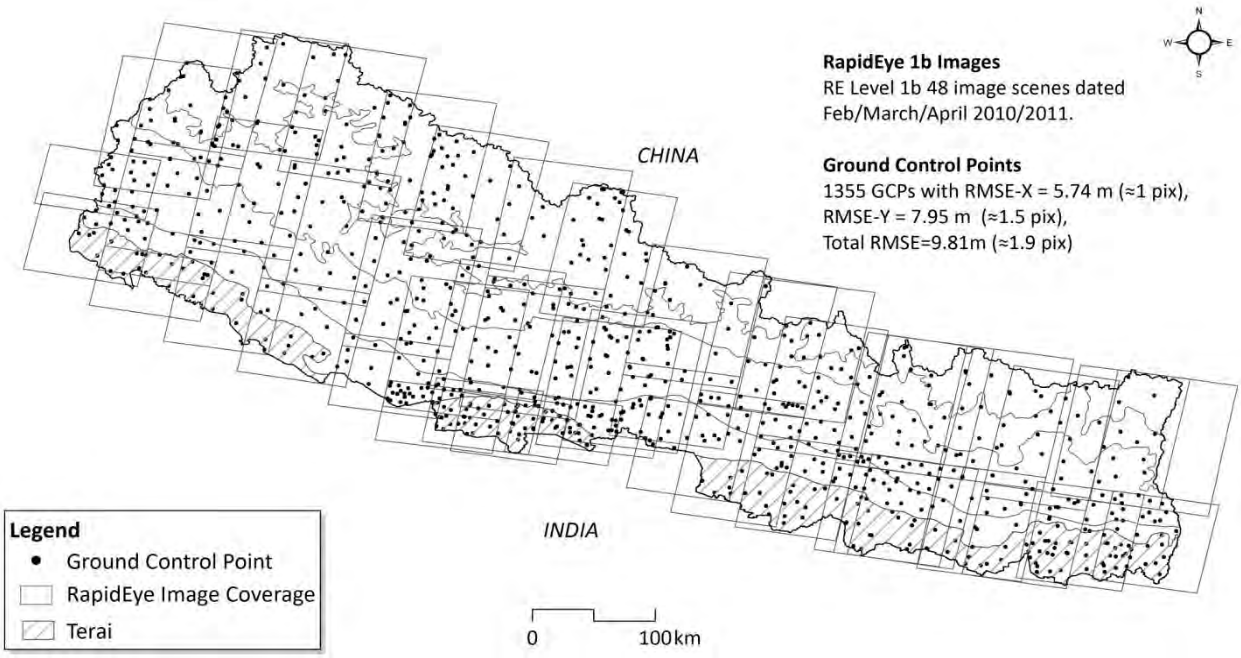


Figure 7. RapidEye Image tiles and ground-control points used for mapping

Atmospheric corrections were made to minimise the effects of atmospheric haze in the images, but neither topographical normalisation nor Bidirectional Reflectance Distribution Function corrections were made due to the flat terrain in the Terai.

3.6.2. Forest Cover Mapping

Images were classified by applying an automated method of object-based image analysis method (Baatz and Schape 2000) on images segmented using eCognition software (Version 8). Four spectral properties were considered: i) the mean pixel values of green, near-infrared and red-edge bands; ii) the derived Normalised Difference Vegetation Index; iii) the principal components; and iv) the homogeneity texture of the near-infrared band. Forest and non-forest areas were distinguished by defining a 'containment membership function' for threshold values for all four properties. In order to reduce residual errors and to improve classification accuracy, interactive visual on-screen post-classification interpretation was carried out on the classified forest and non-forest areas and Google Earth images were referred to. The accuracy of the forest-cover map was assessed by comparing the areas classified as forest cover with field-verified samples (n = 861) and independently with Phase 1 sampling (n = 7533).

Forest-cover change (1991-2010): The FRA Terai forest-cover mapping results (2010) along with the gain and the losses were compared with the results of the 1991 and 2001 as mentioned in the DoF (2005).

3.6.3. Biodiversity Analysis

The lists of flora and fauna species obtained from the field sample plots and social surveys were verified using various sources, including *Medicinal Plants of Nepal* (DPR, 2007), *Flora of Nepal* (www.eflora.org), Suwal and Verheugt (1995); Bhuju *et al*., 2007; Baral and Shah, 2008; and Jnawali *et al.,* 2011, and an annotated list was prepared.

Detrended Analysis (Hill and Gauch, 1980) with default options in CANOCO Version 4.5 (terBraak and Smilauer, 1998, 2002) was used to identify the compositional gradient length in standard deviation units of plots. All ordination diagrams were produced using CANODRAW Version 4.5 (terBraak and Smilauer, 2002).

Tree species frequency (the proportion of sampling units containing a given species) was calculated using Equation 7.

Equation 7. Tree species frequency

$$f = (\frac{n_i}{N}) \times 100$$

where,
f_i = Frequency of species *i*,
n_i = Number of sub-plots in which species *i* occurred, and

N = Total number of sub-plots studied

Alpha diversity (α) was calculated using Equation 8.

Equation 8. Alpha diversity

α = Total number of all species/Total number of plots

Beta diversity was calculated using Equation 9.

Equation 9. Beta diversity:

Beta (β) diversity = total species richness/average species richness

$$\beta = \frac{\mathrm{N}}{\alpha} - 1$$

where,
β = Beta diversity
N = Number of species encountered
α = Alpha diversity

The Shannon-Weaver diversity index was used to calculate species diversity as shown in Equation 10**.**

Equation 10. Shannon-Weaver diversity index

$$\overline{H} = -\sum_{i=1}^{s}(p_i)(ln\ (p_i))$$

where,

$\overline{H}$ = Shannon-Weaver index of diversity (for trees and shrubs)
P_i = Proportion of total number of individual of species *i* (i.e. n_i/N)
S = Total number of individual species
n_i = Number of individual species *i*, ranging from 1to S.
N = Total number of all species
ln = Natural logarithm

3.6.4. Forest Soil Assessment

The FRA Nepal Project carried out multiple site characterizations and sampling of soil for the determination of Soil Organic Carbon (SOC) stocks in the top 30 cm soil layer. This was the first time SOC was calculated during forest inventories conducted in Nepal.

Analysis of Forest Soil Carbon

Multiple site categorisations and soil sampling were accomplished so as to determine SOC stocks in the top 30 cm soil layer. The soil characteristics recorded in the field including organic C-content, bulk density and stoniness were utilized in estimating the SOC stocks in the 0-30 cm topsoil layer. The results were used to estimate the overall forest C-stock together with the standing biomass estimates obtained from the tree stand measurements and the biomass models.

3.6.5. Preparation of Composite Samples of Litter, Woody Debris and Soil in the Field

Soil Sampling Locations

Soil sampling was conducted along the periphery of each CCSP established for forest inventory (Figure 6). The soil pits were dug 21 metres away from the CCSP-centre towards the four cardinal directions (N, E, S, and W). A composite sample of litter, woody debris, and soil was collected separately from each CCSP; except from the points that were located in the croplands, steep slopes (>100%), rocky areas, river banks, roads and water bodies. In the case of the inaccessible cardinal points, the sub-cardinal points (N-E, S-E, S-W, and N-W) were used as substitutes for collecting the samples of litter, debris and soils from at least three sample points within the forest stand. Similarly, in the case of the CCSPs falling under two or more forest stands, the samples of the litters, debris and soils were collected establishing at least three soil pits within each stand.

Litter and Woody Debris Sampling

After locating the soil pits on the ground, litter and debris fractions were collected from 1 m^2 circular plots on the surface of each soil pit before digging. Litter and woody debris from all the four sub-plots were collected separately to make their composite samples (Figure 8). In the case of the pits without any litter or woody debris, '0' value was recorded for the pit so as to estimate a correct average litter and debris mass per unit area.

The total composite fresh masses of both the litter and debris were weighed in the field to an accuracy of 1.0 g. As the total volumes of both litter and debris collected from the 4 m^2 area (the total of four 1 m^2 plots) was very large, small representative sub-samples were taken so that their dry mass could be determined in the laboratory.

Determination of Soil Characteristics

The 40 cm deep soil-pits that were dug for collection of soil samples were used for determination of soil characteristics in the field. Soil profiles were inspected by observing the soil-pit walls so as to determine soil texture and stoniness using the FAO Guidelines (2006).

Figure 8. Left: Litter and debris samples being collected; Right: A soil-sampling pit

3.6.6. Soil Sampling

Soil samples were collected from the soil pits dug outside the peripheries of all the CCSPs. At each cardinal direction, 21 m away from the CCSP-centre, soil pits of appropriate size were dug within 2 m × 2 m area so as to collect undisturbed soil samples. The undisturbed soil samples were collected using a Cylindrical Corer having 40 mm diameter (37 mm diameter at its cutting-edge) and 100 mm length; the volume of each soil sub-sample being 107.5 cm^3.

Composite soil samples from three layers: 0-10 cm, 10-20 cm, and 20-30 cm depths (Figure 9) were collected in separate plastic bags for each layer. The fresh mass of the composite sample was determined with the accuracy of 1 gram. The soil samples from three layers were collected separately in the polythene bags from the field and brought to the laboratory; the samples were kept separately in order to facilitate the assessment of the within-site variability of SOC.

Determination of Stoniness

The relative volume occupied by stones in soil was estimated ocularly by observing the soil pit-walls and using the FAO Guidelines (2006).

3.6.7. Analyses in the Laboratory

Determination of Physical Parameters

The composite samples of soil, litter and woody debris were analysed in the DFRS Soil Laboratory. SOC was calculated from dry soil bulk density (g/cm^3) and the proportion of soil organic carbon. Dry bulk density of the fine soil fraction (< 2mm) was determined from the volumetric composite samples in order to calculate the soil organic carbon stock in each 10 cm deep layer down to 30 cm below from the soil surface. Pebbles, gravels, and stones >2 mm were removed from the soil samples before analysis. All the particles less than 20 mm in diameter found in the volumetrically cored samples were eliminated to calculate the bulk density of the fine fraction.

The coarse fraction was separated using a 2 mm sieve, and its volume was measured using water displacement method so as to calculate the bulk density of the fine fraction. The fine fraction that passed through the sieve was homogenized, and analysed for OC%. The overall 0-30 cm soil layer SOC stock (t/ ha) was derived by multiplying the OC% with the fine fraction bulk density of the respective sample, and it was further corrected with the proportion of large stones estimated for the 30 cm deep soil layer. The correction was applied using average values of SOC (t/ha) and average stone volume of the strata reported in the results. Results of the each 10 cm layers kept separate in analyses were summed in order to obtain SOC store in the fine fraction of 0-30 cm soil layer.

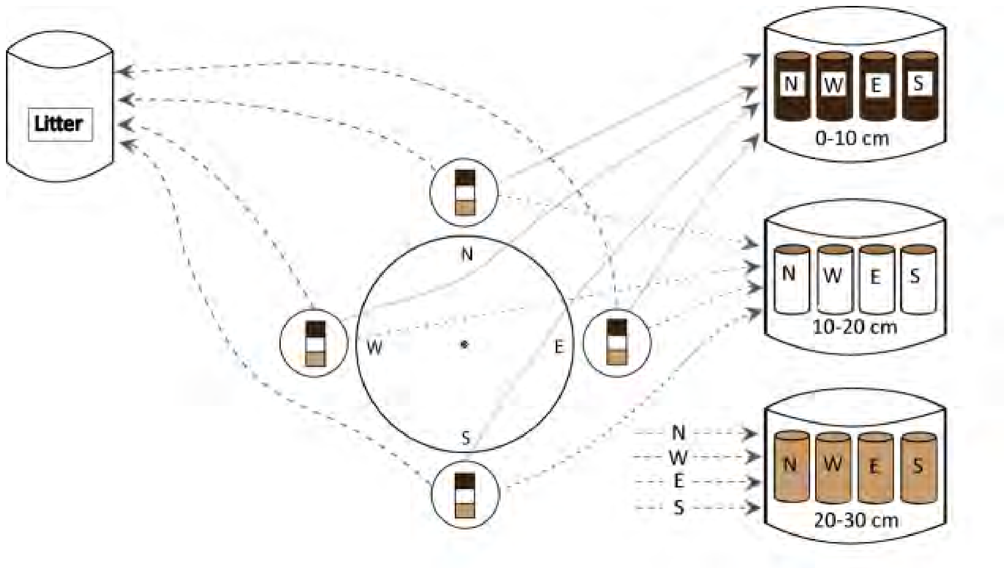


Figure 9. Collection of composite samples of litter, debris and soil from a plot

Litter, Woody Debris, and Soil Carbon

The preparation of the samples and the SOC analysis followed the procedures detailed in the Laboratory SOP (FRA Nepal, 2011), as summarized below. Litter and woody debris were not analysed for OC%, but a constant carbon content of 50% (Pribyl, 2010) was applied together with an estimate of dry mass/m^2. Oven dry weight of the litter and woody debris was estimated by multiplying the ratio of oven-dry weight to fresh weight of the litter and woody debris subsamples.

Before oven drying to achieve a constant weight and moisture content, the soil samples brought from the field to the DFRS laboratory were first air dried until those were fully stabilized. Walkley-Black Wet Combustion Method (Walkley and Black, 1934) together with titration was applied in the analysis of the proportion of OC% in the soil. As this method can recover only about 77 % of SOC, a correction factor of 1.33 was applied to determine the actual amount of SOC. An excel application was produced in order to collect all laboratory calculations and to help to organize and speed up the laboratory calculations. The application also calculated the carbon stocks of litter, woody debris, and soil fine fraction.

3.6.8. Quality Assurance of SOC Analysis

In order to validate the soil carbon analytical methodology, an inter-laboratory comparison on soil total organic carbon analysis between the DFRS Soil Laboratory and the Metla Soil Laboratory (Finland) was conducted by the ICI Nepal-Vietnam Project. The Walkley-Black Wet Combustion Method is used in the DFRS Soil Laboratory, while the OC% (or TOC) in the same soil samples were analyzed using dry combustion and LECO CHN Analyzer in the Metla Soil Laboratory. If the sample contains inorganic carbonates, dry combustion methods such as LECO may overestimate OC as it analyses the CO_2 emitted from the sample burned at high temperature. So, additional steps were taken in the Metla Soil Laboratory so as to eliminate the carbonates (CO_3), which were removed using Hydrochloric Acid. The chlorides, harmful for the analyzer, were washed out with water (Westman *et al.* 2006).

Both laboratories reached consistent results, which indicated that there was no need for additional correction coefficients or changes in procedures. The soils contained a range of OC, but the OC% values were not evenly distributed over all concentration levels. While the low value range (from 0 to ca. 3 % of OC) shows good agreement between the different analyses, similar conclusion was not possible for the high value range (>3% of OC) because only one such observation was included in the data set (Figure 10). The single high value that similarly emerged in the results of both FRA replicates of analyses could indicate a slight under-estimation by the Walkley-Black Method. In order to recognize a possible

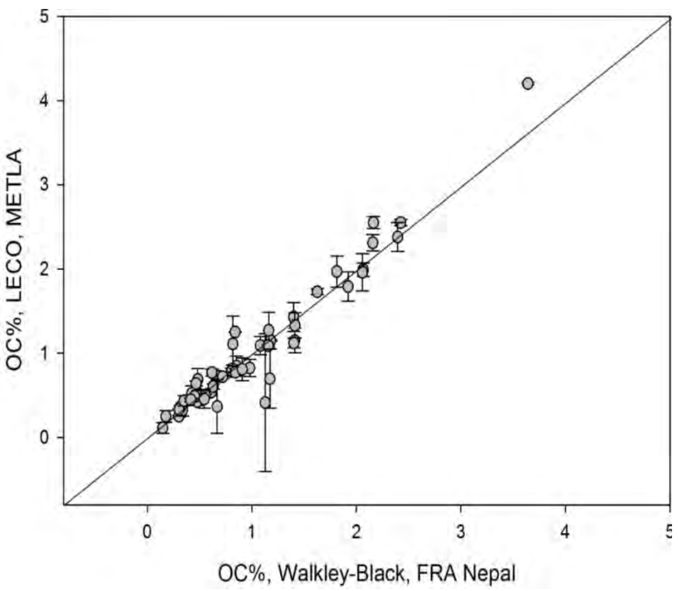


Figure 10. Comparison of OC% from soil samples

systematic bias in the cases of high OC%, more comparisons should be made with samples of the high OC content for Churia and Mid-hills physiographic regions.

3.6.9. Estimation of Mean and Standard Error

The results of soil, litter and debris carbon content were all calculated using ratio estimates (Cochran, 1977) in order to account for intra-cluster correlations due to more pronounced similarities among nearby than among distant clusters.

4. TECHNICAL CHALLENGES AND LIMITATIONS

4.1. Forest Inventory

The FRA Nepal methodology was designed to collect national-level data on tree volume and biomass with 95% confidence of being within plus or minus 10% of the actual value. The confidence levels for sub-populations such as individual development regions and physiographic zones were naturally anticipated to be lower (FRA Nepal, 2010).

The use of systematic sampling causes a problem: it cannot estimate variance without bias. Although it slightly over-estimates both variance and sampling errors, this bias is well known and has never prevented any other country from using systematic sampling.

Sampling errors can be assessed accurately only if estimated values are distributed normally and there is no bias. Besides these distortions, other sources of inaccuracy include errors in identifying species, taking field measurements, entering field results in the database, and deriving and calculating mathematical formulae. There are also errors in the estimates of areas used to convert average density values to total values for the Terai as a whole.

Temporal analysis of forest parameters in the absence of long-established permanent sample plots is extremely difficult. One example of the problems to be faced is that all values being compared are subject to errors that may be large in comparison with any change in the measured populations. The FRS (1967) has provided data for Terai plains outside PAs and whilst this may have roughly similar forests only very generic analysis of apparent trends is possible. The inventory data analysis was relied on the biomass equations developed by Sharma and Pukkala (1990) which were developed using the data measured in 1960s. In addition, there were insufficient species specific wood densities available for the tree species. Stem to branch and foliage biomass ratios were available for important tree species. The biomass values obtained from the biomass tables only give air-dry biomass values. Due to these limitations, it was difficult for precise estimation of above- and below-ground wood biomass and carbon content in the Terai Forests.

4.2. Remote Sensing

4.2.1. Visual Interpretation in Phase 1 Plot Sampling

Using on-screen visual interpretation as a pre-processing step makes it possible for an interpreter to easily integrate the different characteristics (e.g. surface texture) of objects visible in an image and profit from direct knowledge of the context. Compared to digital classification methods, there is little need for specialized software. The challenges of this approach are listed below.

- The images interpreted in 2010 were partly from 2003–2005, and so land cover changes in the intervening years could have caused discrepancies with fieldwork results.
- Google Earth Images might have significant geometrical distortions which can lead to misinterpretation of the boundaries between two land cover types, and visual interpretation might have human error on land cover classification.

4.3. Forest Cover Mapping

Remote Sensing-based mapping of vegetation and its types is a challenging task. The challenges are further elevated due to the terrain and climatic conditions of Nepal. With scientific and technically sound approach and appropriate remote sensing materials with the support of reliable and extensive ground samples, multi-source mapping of vegetation/forest can be achieved with certain degree of accuracy and reliability. The FRA mapping works also faced several technical limitations and challenges during the mapping of forest/non-forest in the Terai. The limitations encountered during the mapping process were:

- Image acquisition months and their variability (December, February, March and April) have attributed to different atmospheric conditions in the images, thus creating challenges in atmospheric corrections and normalization for automated image analysis. This may have attributed to certain errors in forest cover mapping.

- The images were acquired during the months of December, February, March and April when some deciduous trees defoliate; therefore, classification and analysis of such forest cover e.g. *Shorea robusta* and *Tectona grandis* was challenging (Figure 11). Secondary images and maps were used as reference for classification, which however, may not have completely removed the errors.

Figure 11 Photographs of a defoliated teak plantation

- Due to spatial heterogeneity of the forest stands and fuzziness of their boundary limits, errors might have been introduced in classification and delineation of such forest stands (Figure 12).
- Atmospheric correction (for BRDF and topographic normalization) was not done for the Terai Region due to relatively flat terrain. Only haze corrections and cloud masking were done. Smoke areas due to forest fires in the Western Terai could not be done due to non-availability of secondary set of RapidEye Satellite Images. This may have introduced some errors in classification in the Far-western Terai. Secondary information and images were used to minimize the errors as far as possible.
- The assessment of plantation forest in the interpretation process was limited due to the spatial resolution of RapidEye Satellite Images. Therefore, Google Earth images and secondary information from the Department of Forests have been used to map the boundaries of government managed plantation forests in the Terai. Only Sagarnath and Ratuwamai Plantation Forests have been mapped from the available secondary data and satellite images. Other plantation areas have not been specifically mapped due to the limitations in the scope of works. However, the forest cover areas in these plantations are incorporated in the wall-to-wall Terai Forest Cover map.
- Mapping of encroached forested areas have not been undertaken due to the limitations of the FRA works.

4.4. Multi-temporal Analysis

The forest cover change analysis in this study indicates the trends of change and their locations rather than changed area statistics due to the following limitations:

Spatial Resolution

The spatial resolution of the images used for forest cover change analysis was different (Landsat 28.5m vs RapidEye 5m resolution), therefore minimum mapping units were different resulting in generalization.

Spectral Difference

Seasonal variations at the time of image acquisition could have led to variations in change analysis.

Positional Accuracy

Due to possible errors in geometric correction (attributed to different satellite geometry and sources of control points), planimetric displacement of multi-temporal forest cover maps may have resulted in errors in assessment of gain and loss of forest cover.

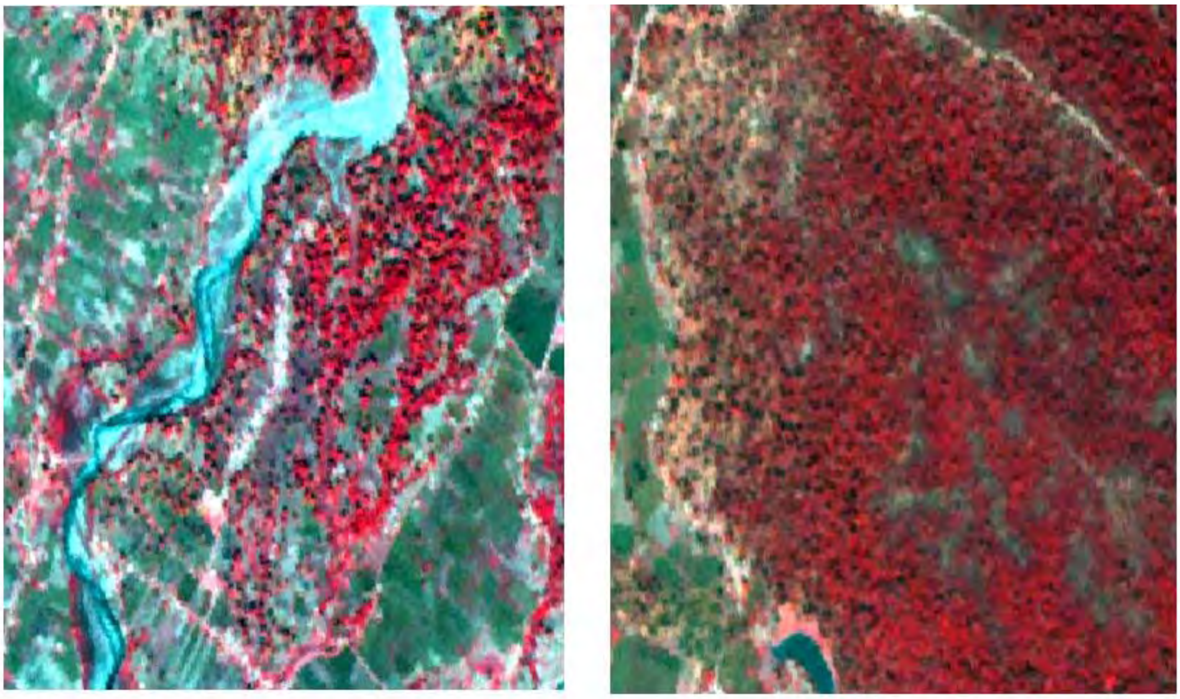


Figure 12 Undefined (fuzzy) boundaries of forest areas

4.5. Biodiversity Assessment

The main limitation of the biodiversity assessment was the very low sampling intensity (0.007%), which meant that sparsely distributed species might have been missed. The species richness values included information about woody plants, climbers, epiphytes, parasites and large mammals but those of herbaceous plants and other taxa might be erroneous because such species are seasonal. The study mainly focused on higher taxa, so the FRA methodology might not be appropriate for assessing biodiversity in detail.

4.6. Soil Analysis

Soil sampling was done only in the sample plots that were designed for national-level forest inventory. Therefore, it might not have represented all the micro-site variabilities within the Terai Region. As a result, the confidence intervals of the estimates were appeared to be wide.

5. RESULTS OF THE TERAI FOREST RESOURCE ASSESSMENT

5.1. Area Statistics

5.1.1. Land Cover in the Terai

Based on the forest cover mapping, 20.41% (411,580 ha) of the total area of the Terai Region was found to be covered by forests and 0.47% (9,502 ha) of the region was found to be under the OWL. Thus, the forests and the OWL together were found to possess 20.88% (421,082 ha) of the total land area in the Terai Region (Table 7).

Table 7. Terai land cover class

SN	Land cover class	Area (ha)	Area (%)
1	Forest	411,580	20.41
2	Other Wooded Land (OWL) :		
	- *Tree Crown Cover (5 - 10 %)*	5,572	0.28
	- *Shrub*	3,930	0.19
	OWL sub-total	9,502	0.47
3	Other Land	1,595,916	79.12
	Grand Total (Forest + OWL + Other Land)	**2,016,998**	**100.00**

Forests are concentrated within eastern, central, western, mid-western and far-western clusters. The wall-to-wall forest cover is presentd in the Figure 13 and the district-wise forest-cover map of the Terai is presented in Annex 4.

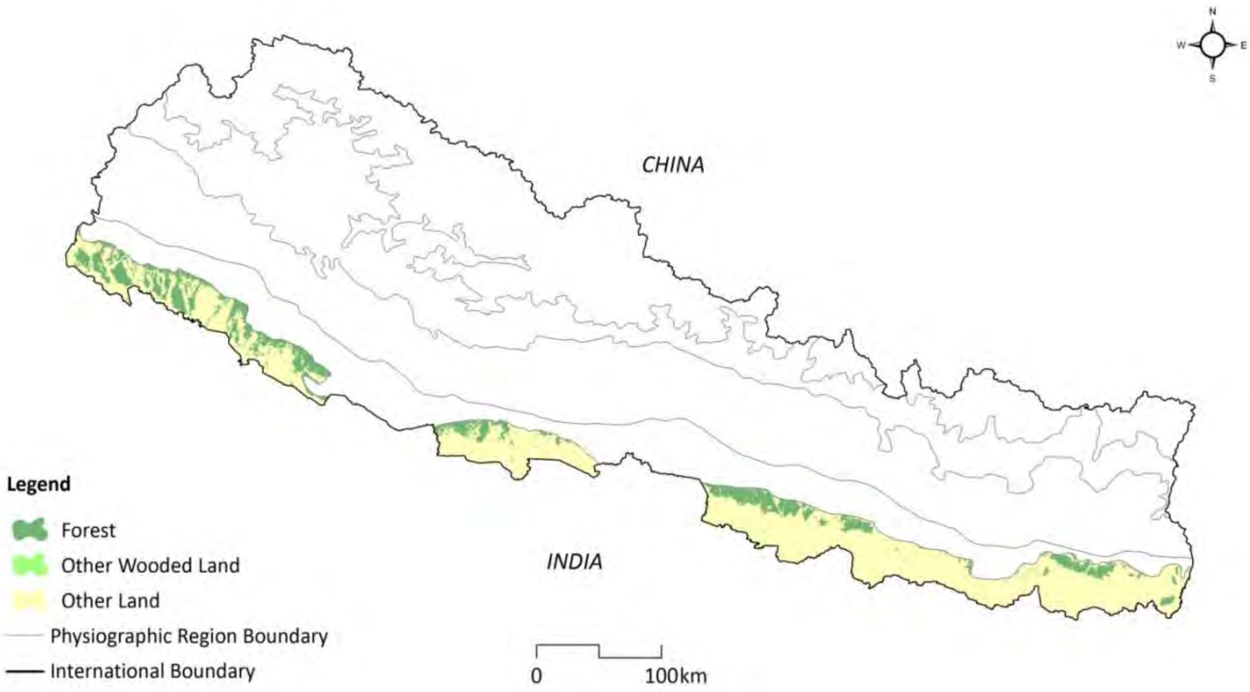


Figure 13. Distribution of Terai Forests

5.1.2. Forest Cover in the Terai

Terai Forest Land Covers Inside and Outside PAs

About 76.45% of the total forest (314,660 ha) in the Terai are outside PAs, 16.97% (69,847 ha) forests in PAs, and 6.57% (27,074 ha) in Buffer Zones (Table 8).

Table 8. Terai forest area under PAs and outside PAs (ha)

Development Region	Outside PAs	Buffer Zones	Inside PAs	Total Area	Percentage
Eastern	56,012	0,002	0,206	56,220	13.66
Central	77,718	4,285	13,216	95,219	23.13
Western	47,209	0,000	0,000	47,209	11.47
Mid-Western	36,099	18,008	31,511	85,618	20.80
Far-Western	97,622	4,778	24,914	127,314	30.93
Grand Total	**314,660**	**27,074**	**69,847**	**411,580**	**100.00**
%	**76.45**	**6.58**	**16.97**	**100.00**	

Proportion of Forest Types

Out of the total 224 sub-plots (56 clusters @ 4 sub-plots/cluster), 175 sub-plots were within the forest with four different forest types (KS/SK, Sal, TMH and STMH). Majority of the sub-plots were within the Terai Mixed Hardwood (46.86%) and Sal (45.71%) forests which indicated that the Terai Forests were dominated by these forests (Table 9).

Table 9. Proportions of forest types

Forest types	No. of sub-plots	Proportion (%)
KS/SK	5	2.86
Sal	80	45.71
TMH	82	46.86
STMH	8	4.57
Total	**175**	**100.00**

Proportion of Development Status

In terms of development status, small saw-timber stands occupied more forest land (37.14%) than other categories. It was followed by large saw-timber stands (32.57%) and pole-timber stands (24.57%). Forest stands of seedlings and saplings occupied the smallest proportion (5.71%) of forest land (Table 10).

Table 10. Proportions of forest stand with different development status

Stand development status	No. of sub-plots	Proportion of forest area (%)
Seedling and sapling stand (<12.5 cm DBH)	10	5.71
Pole timber stand (12.5–25.0 cm DBH)	43	24.57
Small saw timber stand (25.0–50.0 cm DBH)	65	37.14
Large saw timber stand (>50.0 cm DBH)	57	32.57
Total	**175**	**100.00**

Proportion of Canopy Closure

Forty-eight percent of forest stands were well stocked, 37.14% moderately stocked and 14.86% poorly stocked (Table 11).

Table 11. Proportional representation of forest stands according to canopy closures

Canopy closure	No. of sub-plots	Proportion (%)
Poorly stocked forest (10–39.9% canopy closure)	26	14.86
Moderately stocked forest (40–69.9% canopy closure)	65	37.14
Well-stocked forest (≥70% canopy closure)	84	48.00
Total	**175**	**100.00**

5.1.3. Change in Forest Cover from 1978/79 to 2010/11

The forest area in the Terai declined by 16,500 ha in the last nine years from 2001 to 2010 and by 32,000 ha in the last 19 years from 1991 to 2010 (Table 12). The annual rate of decrease in forest cover was 0.44% during the last nine years from 2001 to 2010 and was 0.40% during the last19 years from 1991 to 2010/11. The substantial forest-cover losses were found to be in Kapilvastu, Bardia and Kailali districts between 2001 and 2010.

Table 12. Forest-cover change in the Terai between 1978/79 and 2010/11 ('000 ha)

Development region	District	LRMP 1984	DoF 1991	DOF 2001	FRA 2010/11	Rate of change	
						1991-2010/11	2001-2010/11
Far-Western	Kanchanpur	71.9	58.1	57.5	56.2	-0.18	-0.25
	Kailali	96	79.2	73.2	71.2	-0.56	-0.31
Mid-Western	Bardiya	53.6	50.6	47.7	46.6	-0.43	-0.24
	Banke	48.6	38.8	37.3	39	0.03	0.48
Western	Kapilvastu	34	43.3	40.8	37.5	-0.76	-0.95
	Rupandehi	12.3	7.8	6.7	6.5	-0.93	-0.31
	Nawalparasi	7.2	3.2	3.2	3.2	0.02	0.2
Central	Parsa	24.5	25.5	25.9	24.6	-0.19	-0.6
	Bara	32.9	32.6	32.2	30.8	-0.29	-0.49
	Rautahat	22	20.2	20.3	18.6	-0.43	-0.96
	Sarlahi	15.1	13.3	13.9	11.5	-0.74	-2.07
	Mahottari	10.8	9.5	10	9.4	-0.04	-0.61
	Danusha	0.2	0.3	0.5	0.3	-0.76	-5.7
Eastern	Saptari	2.4	2.7	2.1	2	-1.39	-0.12
	Siraha	0.4	2	1.7	2.1	0.39	2.57
	Sunsari	16.9	15.4	14.9	14.2	-0.45	-0.57
	Morang	30.9	24.2	23.7	23.5	-0.16	-0.09
	Jhapa	12.3	13.4	13.2	11	-1.06	-2.03
	Total	**492.1**	**440.1**	**424.6**	**408.1**	**-0.4**	**-0.44**

Note: The area calculation was based on 18 district boundaries clipped with the Terai Physiographic Region boundaries. As the previous inventories did not include the Terai parts of Ilam (938 ha) and Udayapur (2,508 ha) districts, they were excluded from this comparison.

The results of a comparison of different GIS layers are presented in Figure 14

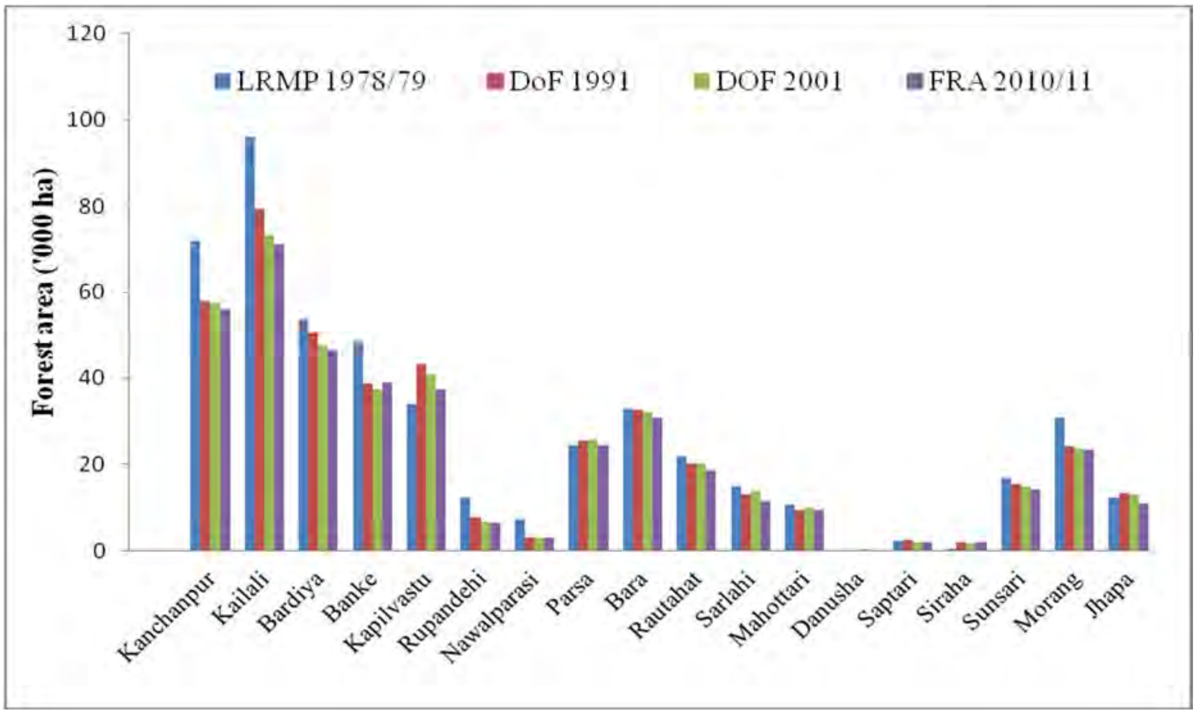


Figure 14. District-wise forest-cover change in the Terai between 1978/79 and 2010/11

Changes in forest cover between 2001 and 2010 showed positive trends in Banke, Nawalparasi, and Siraha districts but a negative trend in the other 15 districts. Forest-cover loss was highest in Kailali, Bardiya and Kapilvastu districts during both the last nine years and the last 19 years. The large areas (polygons) associated with forest-cover change were verified by comparing Google Earth, Landsat and RapidEye Images to confirm gains and losses (Figure 15).

An analysis of forest-cover loss in the Terai (Table 13) showed that the major reason for forest loss was conversion to agriculture. Changes of watercourses have also played a major role in forest-cover changes in several districts, including Sunsari and Bara, where they accounted for 65% and 46% of forest loss respectively. The gradual degradation of open forest canopy to OWL was also significant.

5.1.4. Spatial Analysis of Forest Gain and Losses between 1991 and 2010/11

The degree of ecological connectivity between and within the four forest clusters (far- and mid-western, western, central, and eastern) (Figure 15) decreased over time as river channels, major roads and population centres continued to fragment them. The Koshi, Bagmati, Narayani, west Rapti, Babai, Karnali and Mahakali are the major river systems that interrupt forest continuity. The East-West Highway and the roads connecting the Indian border also break up the clusters and have led to the development of major population centres in the cities of Biratnagar, Birgunj, Bhairawa, Nepalgunj, Dhangadhi and Mahendranagar, all of which have eroded connectivity within the forest clusters.

Table 13. Forest land converted to other land-cover categories between 1991 and 2010/11

Development Region	District	Agriculture (%)	Infra-structure (%)	Water-influenced changes (%)	Grassland (%)	OWL (%)	Others (%)
Far-western	Kanchanpur	73.5	0.8	12.8	6.5	3.9	2.6
	Kailali	63.6	0.3	14.3	1.6	13.3	6.9
Mid-western	Bardiya	59.5	0.1	13.7	4	21.8	0.9
	Banke	44.1	4.8	9.6	5.5	33.4	2.5

Development Region	District	Agriculture (%)	Infra-structure (%)	Water-influenced changes (%)	Grassland (%)	OWL (%)	Others (%)
Western	Kapilvastu	58.1	0.1	8.9	4.8	20.2	8
	Rupandehi	82.1	0	2.9	4.8	7.5	2.6
	Nawalparasi	50	1.7	4.6	29.5	9.9	4.3
Central	Parsa	76.1	0	17.9	0.3	0	5.7
	Bara	31.7	0	46.5	0.7	21.1	0
	Rautahat	64	0	35.1	0.4	0.5	0
	Sarlahi	89.9	0	9.6	0.4	0.1	0
	Mahottari	62.2	0	14.9	4.4	18.5	0
	Dhanusha	29.8	0	0	0	70.2	0
Eastern	Saptari	92.1	0	0	2.3	0	5.6
	Siraha	54.5	0	19.7	7.6	18.2	0
	Sunsari	32.5	0	64.9	2.5	0.1	0
	Morang	66.8	0	17.4	5.9	6.1	3.8
	Jhapa	51.8	0	5	7.3	33.9	2

Forest loss over the 19 years occurred primarily along the edges of major forest blocks. At the same time, some small forest blocks were lost entirely and a few forest enclaves were expanded.

The Far-western Forest Cluster

The forest areas of this cluster are located between the Karnali River and Nepal's western border, the Mahakali River. Some fall partly in Shuklaphanta Wildlife Reserve. Unlike other clusters, this cluster is connected to forests in India, particularly the Dudhwa National Park and the major forest blocks of Pilibhit in Uttar Pradesh. On the west of the Karnali River, forests are connected both along the northern border of the Terai and in the central regions (Figure 15). Most of the forest losses between 1991 and 2010/11 appeared to have been along the forest edges, which were converted to agriculture. Forests of this cluster were mostly found to have increased in Shripur VDC of Kanchanpur district and Durgauli VDC of Kailali district, but decreased in Sandepani and Masuriya VDCs within Shuklaphanta Wildlife Reserve, Kanchanpur district (Annex 5).

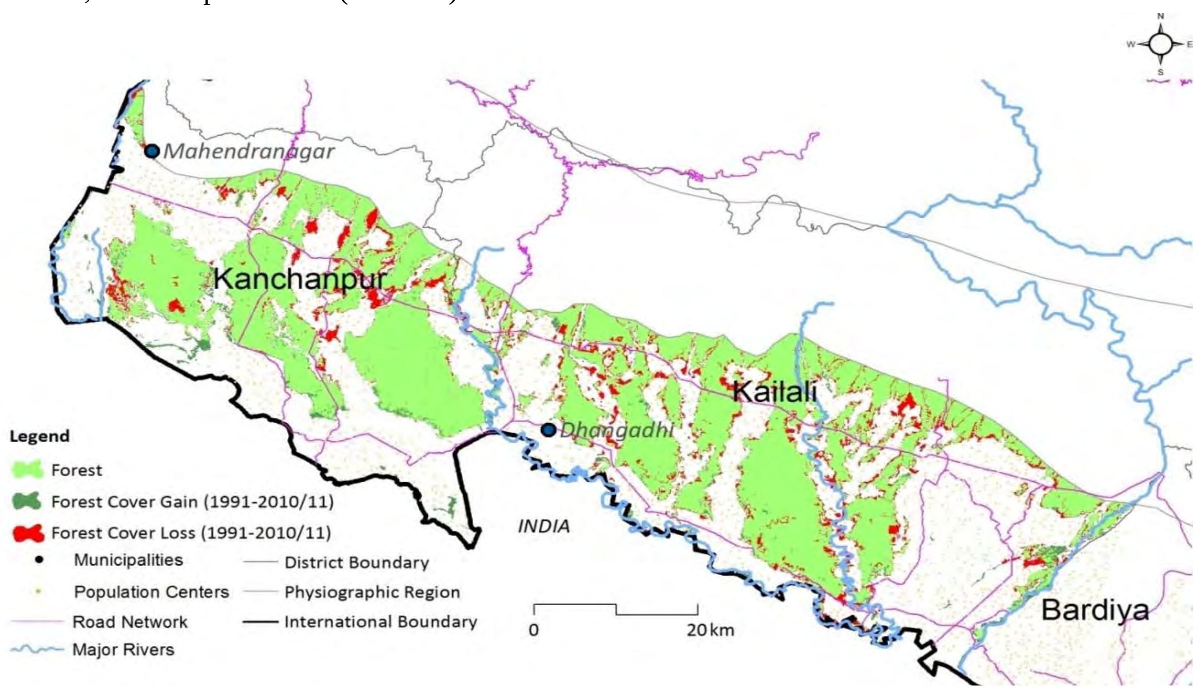


Figure 15. Forest gain and loss in the far-western forest cluster

The Mid-western Forest Cluster

Forest areas located between the Rapti and Karnali Rivers constitute the mid-western forest cluster. They lie partly in two PAs, the Banke and Bardiya National Parks. The forests of this forest cluster are connected only in the north. Most of the forest losses between 1991 and 2010/11 were along the forest edges, which were converted to agriculture (Figure 16). Forests were found to be increased in Rajapur, Sanoshri, Motipur and Sorhawa VDCs of Bardiya district; and Naubasta, Udarapur and Baizapur VDCs of Banke district. On the other hand, the forests of this cluster were mostly found to be decreased in Kamdi VDC of Banke district, and Dhadhwar VDC and Gulariya Municipality of Bardia district (Annex 5).

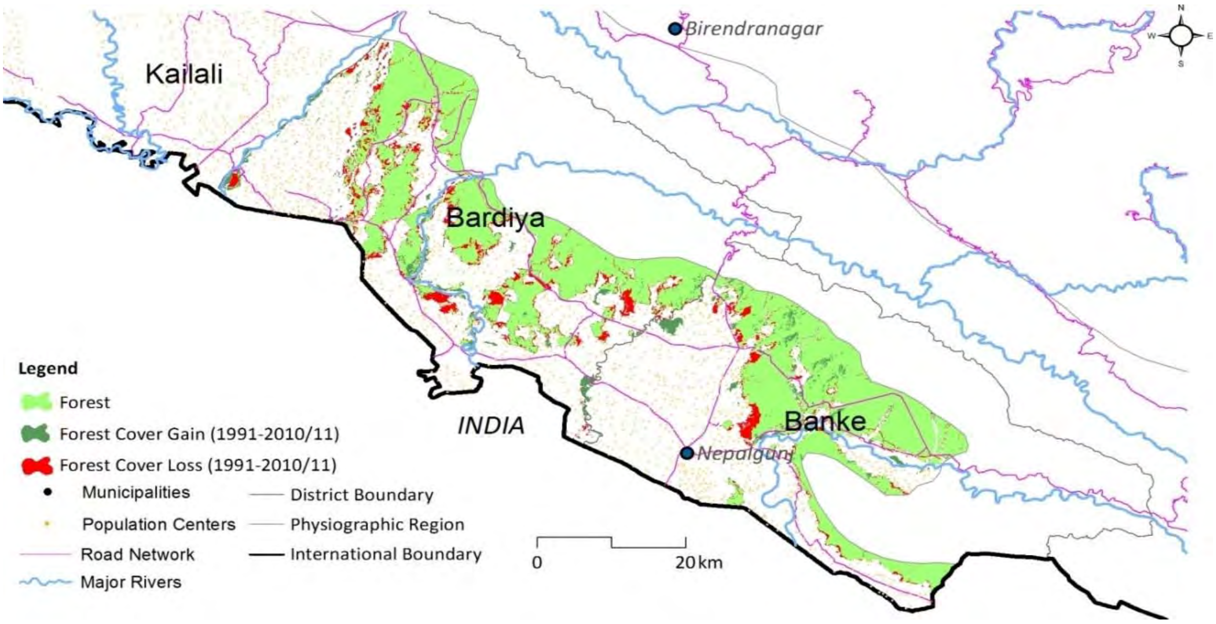


Figure 16. Forest gain and loss in the mid-western forest cluster

The Western Forest Cluster

The western cluster extends from the Rapti River in the west to the Narayani River in the east. Small, scattered and unconnected forest blocks are located in the eastern part of the forest cluster and the cities of Taulihawa, Bhairahawa, Butwal and Sunawal at the centre. On the west of Butwal, there are large forest blocks with some connectivity between them. However, this connectivity is threatened by the expansion of the settlements inside these blocks. The western part of these blocks is contiguous with the forest in the Churia Hills in Kapilvastu district. The East-West Highway and the Butwal-Sunauli and Bhairahawa-Kapilvastu roads are the major road connections in this block (Figure 17). Forest cover decreased in Chanai/Birpur, Shirapur and Barkulpur VDCs of Kapilvastu district as well as Gajedi and Kerwani VDCs of Rupandehi district but increased in Lumbini Development Area of Rupandehi district (Annex 5).

The Central Forest Cluster

This cluster extends from Nirmalbasti, Parsa district, in the west to the Koshi River in the east and lies in the northern part of the Terai Region. Moving from east to west, the area between the Koshi River and Bardibas includes numerous unconnected small forest blocks as well as the large blocks of Pansera, Mirchaiya, and Lahan, while the area between Bardibas and Lalbandi has only one block in the north. The area between Lalbandi and the Bagmati River includes many unconnected blocks, including the two largest, Barathawa and Netragunj. Finally, the area between the Bagmati River and Nirmalbasti includes a forest block in the north, part of which lies in Parsa Wildlife Reserve. The municipalities of Birgunj, Kalaiya, Gaur and Janakpur are the main population centres in this block and its main road connections are the East-West Highway and the Pathlaiya-Birgunj, Birgunj-Kalaiya, and Dhalkebar-Janakpur roads (Figure 18).

Forest loss was most apparent along the forest edges except in Sarlahi, where some major forest blocks were lost. Forest cover in this cluster decreased most in Shankarpur and Karmaiya VDCs of Sarlahi district; Santapur VDC of Rautahat district; and Laksminiya VDC of Mahottari district. Increases were found in Bhaktipur VDC of Sarlahi and Belgachhi VDCs of Mahottari district (Annex 5).

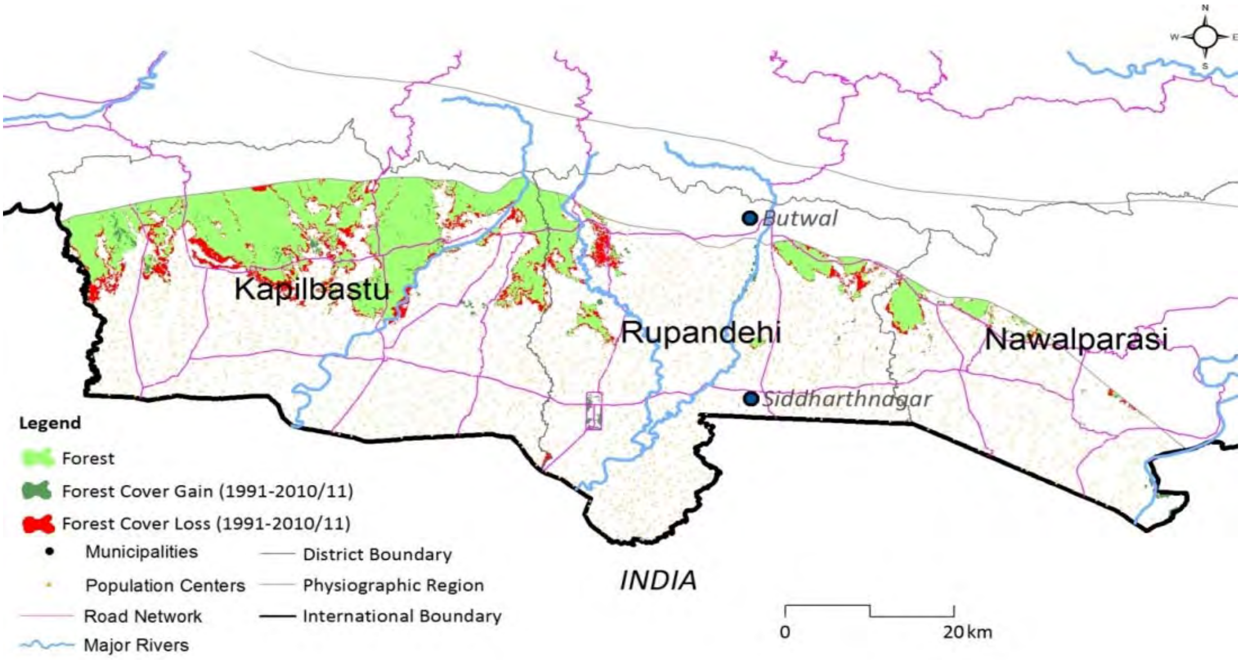


Figure 17. Forest gain and loss in the western forest cluster

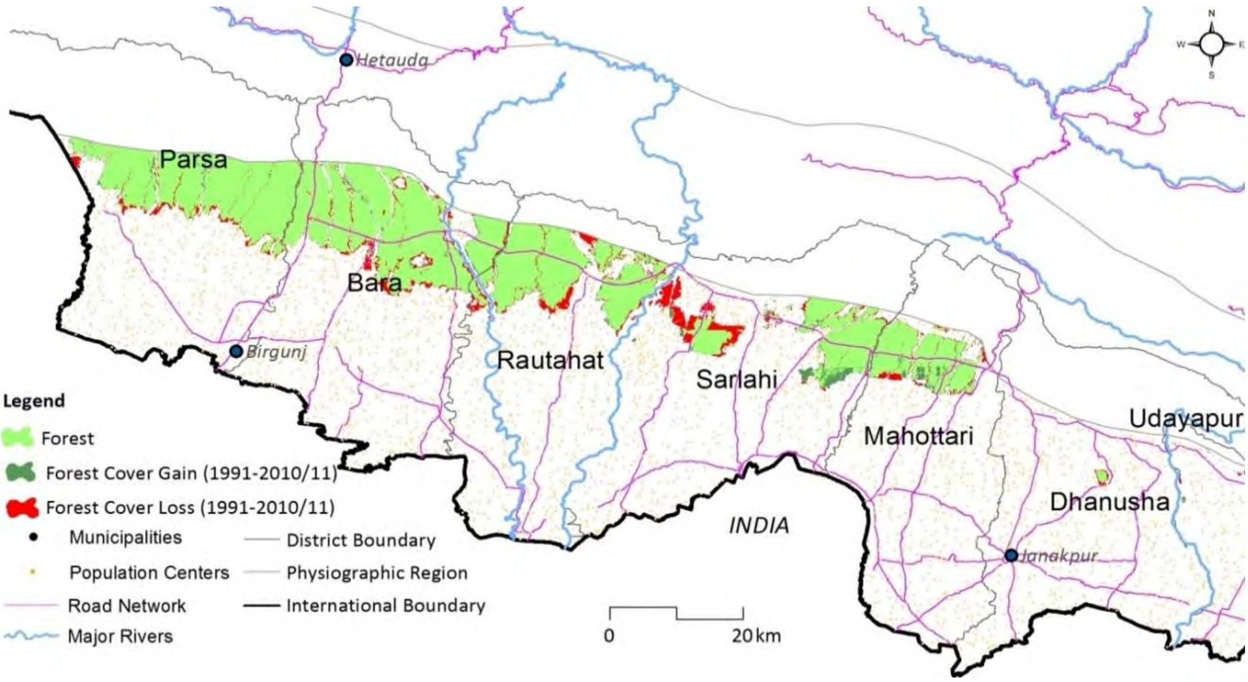


Figure 18. Forest gain and loss in the central forest cluster

The Eastern Forest Cluster

The eastern forest cluster lies on the east of the Koshi River. There are three main blocks of forest - Goldhap, Charaali, and Dhulabari - but there is no connectivity between Charaali and Dhulabari. The Madhumalla-Satasidham forest strip lies in the western part of this block. The western part of this strip, from Urlabari to Barahakshetra, includes a sizable forest block once known as “Charkoshe Jhadi” as well as other smaller, unconnected blocks, including Tapeswari, Koshi Tappu Wildlife Reserve, Mahendranagar, and Thoksila. Biratnagar, Itahari, Chandragadhi, and Damak municipalities are the main population centres in this block and its main road connections are the East-West Highway, Dharan-Dhankuta, and Mechi Highways and the Itahari-Biratnagar, and Charaali-Prithvinagar roads. Although the forest is not contiguous, the eastern part of this block is used as migratory route by wild elephants coming from north east India, mainly Mahananda Wildlife Sanctuary in North Bengal (Das, 2013).

Forest loss was most apparent along forest edges and near the Koshi River in Sunsari district (Figure 19). Forest cover decreased most in Koshi Tappu Wildlife Reserve of Sunsari district, Indrapur VDC of Morang district, and Shantinagar and Lakhanpur VDCs of Jhapa district while increased most in Barahakshetra VDC of Sunsari district (Annex 5).

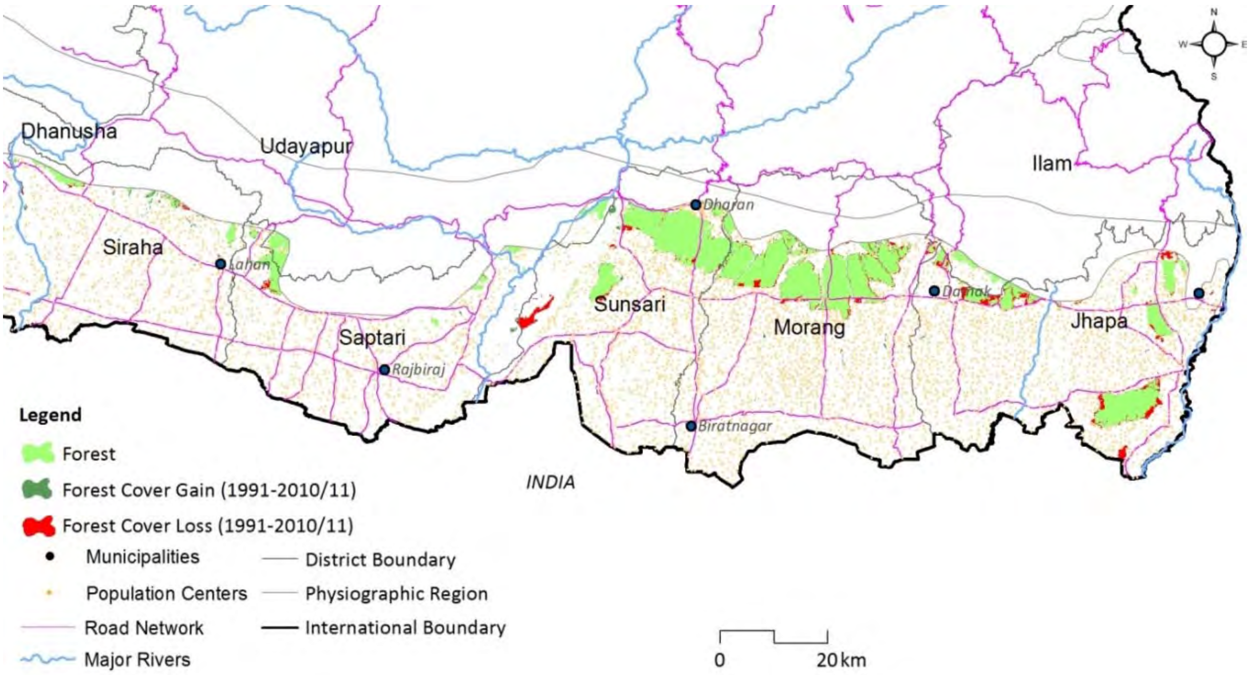


Figure 19. Forest gain and loss in the eastern forest cluster

5.1.5. Accuracy Assessment

The results of the FRA Terai forest-cover mapping were compared with the independent ground samples (n = 861) for verification. The comparison of the field-observed land-cover classes (forest, OWL, and Other Land) with those classified using RapidEye Images were 97.91% accurate. Cohen’s Kappa (κ) was 0.82 (standard error = 0.03), a value indicating a high reliability of forest cover classification (Table 14).

Table 14. Error matrix of forest cover map using independent ground verification samples

Classified class	**Land-cover class (ground truth)**				**Users' Accuracy (%)**	**Commission Error (%)**
	Forest	**OWL**	**Other Land**	**Total**		
Forest	799	5	1	805	99.25	0.75
OWL	4	13		17	76.47	23.53
Other Land	7	1	31	39	79.49	20.51
Total	810	19	32	861		
Producer's accuracy (%)	98.64	68.42	96.88			
Omission error (%)	1.36	31.58	3.13			
Overall Accuracy				**97.91%**		

Cohen's kappa = 0.82; Kappa standard error = 0.03

The classifications were also compared with the Phase 1 samples (n = 7533). The comparison provided the overall accuracy of 97.1% together with 93.0% and 65.6% producer's accuracies for forest cover and other wooded land respectively; the Cohen's Kappa (κ) being 0.92 (standard error = 0.01). The results of the above two comparisons showed that the Forest/Other Land classification in the Terai complied with the required standards (FRA Nepal, 2014).

5.2. Terai Forest Inventory Results 2010/12

5.2.1. Number of Stems

Number of Stems (DBH ≥ 5 cm)

The total number of stem (≥ 5cm DBH) in Terai forest was 240.12 million. Number of stems per/ha (DBH ≥ 5 cm) was approx. 583 in the Forest land, slightly more than 50 in the OWL and about 50 in the Other Land (Table 15).

Table 15. Number of stems per ha by land-cover classes

Land-cover class	**No. of sub-plots**	**No. of stems/ha**
Forest Land	175	583.40
OWL	5	50.31
Other Land	160	49.59

Dominant trees comprised the highest number of stems per ha. There were about four standing dead trees per ha in the Terai forests (Table 16). During the last five years, 31 trees/ha were removed from the Terai forests.

Table 16. Number of stems per ha according to crown classes

Tree status	**Crown class**	**No. of stems/ha**
Live trees	Dominant	153.10
	Co-dominant	145.09
	Intermediate	143.23
	Suppressed	67.41
	Understory	34.60
	Broken	39.98
Sub Total		**583.40**
Standing dead trees	Dead usable*	3.93

Dead unusable	0.38
Sub-total	**4.31**
Dead wood	N/A

**Tree stems that can be used at least for firewood*

In terms of number of stems per hectare, *Shorea robusta* was the most prominent species (188.16/ha), followed by *Terminalia alata* (63.38/ha). Similarly, the average weighted DBH of *Adina cordifolia* was found to be the largest (88.6 cm) followed by *Syzygium cumini* (56.2 cm). Likewise, the average weighted height of *Adina cordifolia* was found to be 27.8 m followed by *Terminalia alata* with 24.5 m (Table 17).

Table 17. Characteristics of common tree species

SN	Scientific Name	Average no. of stems/ha	Average weighted[1] DBH (cm)	Average weighted[1] height (m)
1	*Shorea robusta*	188.16	52.3	23.8
2	*Terminalia alata*	63.38	55.7	24.5
3	*Anogeissus latifolius*	21.68	42.6	21.5
4	*Mallotus philippensis*	63.16	20.4	10.1
5	*Adina cordifolia*	3.35	88.6	27.8
6	*Lagerstroemia parviflora*	28.22	28.4	15.4
7	*Syzygium cumini*	10.51	56.2	19.1
8	*Terminalia bellirica*	4.48	47.3	22.0
9	*Lannea coromandelica*	2.80	46.4	19.5
10	*Buchanania latifolia*	27.12	20.6	11.8
	Other species	170.54		
	Total	**583.40**		

In terms of diameter classes, mature trees (≥50 cm) per hectare was around 22 in numbers. Similarly, small saw-timber (20-50 cm) was 85, pole (10-20 cm) was 167 and the sampling (5-10 cm) was 309 (Table 18).

Table 18. Species and DBH class-wise number of stems/ha in Terai Forest

SN	Scientific Name	DBH Class (cm)				
		5-10	**10-20**	**20-50**	**≥ 50**	**Total**
1	*Shorea robusta*	86.40	56.84	31.69	13.23	188.16
2	*Terminalia alata*	42.06	13.07	5.65	2.59	63.37
3	*Anogeissus latifolius*	11.37	5.68	3.72	0.91	21.68
4	*Adina cordifolia*	1.14	0.28	1.07	0.86	3.35
5	*Syzygium cumini*	4.55	2.56	2.72	0.68	10.51
6	*Mallotus philippensis*	35.24	20.18	7.70	0.05	63.17
7	*Lagerstroemia parviflora*	13.64	9.38	5.02	0.18	28.22
8	*Terminalia bellirica*	1.14	0.85	2.12	0.36	4.47
9	*Lannea coromandelica*	0.00	0.28	1.93	0.59	2.80
10	*Buchanania latifolia*	14.78	8.24	4.10	0.00	27.12
	Other species	98.90	50.04	19.20	2.42	170.55
	Total	**309.22**	**167.40**	**84.92**	**21.87**	**583.40**

[1] Weighted on the basis of basal area

In terms of species and quality, per hectare number of stems was approx. 154 in Quality Class 1 (High-quality sound tree) and Quality Class 2 (Sound tree) and about 276 in Quality Class 3 (Cull tree). *Shorea robusta* was found to have highest number of stems per hectare in all three quality classes followed by *Terminalia alata*. *Mallotus philippensis* was found to have the highest stems per hectare in Quality Class 3 among all the species (Table 19).

Table 19. Species and Quality class wise Number of stems/ha in Terai Forest

SN	Scientific Name	Number of Stems/ha			
		Quality-1	**Quality-2**	**Quality-3**	**Total**
1	*Shorea robusta*	88.54	74.93	24.68	188.15
2	*Terminalia alata*	22.66	13.40	27.32	63.38
3	*Anogeissus latifolius*	4.66	5.12	11.91	21.69
4	*Adina cordifolia*	1.73	0.89	0.73	3.35
5	*Syzygium cumini*	2.07	2.75	5.68	10.50
6	*Mallotus philippensis*	0.16	5.27	57.73	63.16
7	*Lagerstroemia parviflora*	8.92	4.64	14.66	28.22
8	*Terminalia bellirica*	2.11	1.80	0.57	4.48
9	*Lannea coromandelica*	1.41	0.84	0.55	2.80
10	*Buchanania latifolia*	3.25	10.52	13.36	27.13
	Other species	18.17	33.84	118.53	170.54
	Total	**153.68**	**154.00**	**275.72**	**583.40**

Number of stems (DBH < 5 cm)

Regeneration in the Terai forests was excellent. The number of seedlings (height <1.3m) were about 30,000 per ha whereas the number of saplings (height >1.3m, and diameter <5cm DBH) were approx. 1,700 per ha. *Shorea robusta* was the dominant species of seedlings (over 18,000/ha) and sapling (over 300/ha) (Table 20).

Table 20. Species composition of seedlings and saplings

SN	Scientific Name	Seedlings (No./ha)	Saplings (No./ha)	Total (No./ha)
1	*Shorea robusta*	18,686	358	19,044
2	*Mallotus philippensis*	1,975	341	2,316
3	*Syzygium cumini*	1,003	77	1,080
4	*Terminalia alata*	886	99	985
5	*Sapium insigne*	631	64	695
6	*Trewia nudiflora*	613	51	664
7	*Diospyrus tomentosa*	495	8	503
8	*Acacia catechu*	115	44	159
9	*Dalbergia sissoo*	7	14	21
	Miscellaneous	5,241	606	5,847
	Total	**29,649**	**1,662**	**31,311**

In Khair-Sissoo Forests, *D. sissoo* was the dominant sapling species (nearly 500 saplings/ha) and *Acacia catechu* the dominant seedling species (nearly 300 seedlings/ha). In Sal Forest, *S. robusta* was the dominant species in terms of both seedlings (about 28,000 /ha) and saplings (about 500 /ha). In both the TMH and STMH forests, *S. robusta* dominated seedlings, while among saplings the dominant species were *Mallotus philippensis* and *Terminalia alata* respectively (Table 21).

Forest regeneration was found excellent in all the forest types except in the Khair-Sissoo Forest. However, the seedlings were found higher in the forest stands with the denser crown cover owing to intensive human interference, similar results were reported by Sapkota *et al.*, (2009). On the other hand, the number of seedlings were found highest in the stands of mature forest (large-sawtimber and small-sawtimber stands) which could be due to the presence of sufficient number of seed-producing trees in the stands.

Table 21. Species composition of seedlings and saplings in different forest types

Scientific name	KS/SK		Sal		STMH		TMH	
	Sp	**Sd**	**Sp**	**Sd**	**Sp**	**Sd**	**Sp**	**Sd**
Acacia catechu	80	279	52	10	0	0	39	218
Dalbergia sissoo	477	80	0	10	0	0	0	0
Diospyrus tomentosa	0	0	5	676	0	0	12	395
Mallotus philippensis	0	0	321	1,721	0	25	415	2,533
Sapium insigne	0	0	47	756	50	199	85	590
Shorea robusta	119	239	502	27,544	0	32,403	267	9,831
Syzygium cumini	80	239	80	654	0	423	82	1,446
Terminalia alata	0	0	92	975	199	920	102	849
Trewia nudiflora	40	0	7	351	50	274	95	939
Other species	358	995	440	3,986	1,343	10295	711	6,228
Total	**1,154**	**1,832**	**1,546**	**36,683**	**1,642**	**44,539**	**1,808**	**23,029**

Note: Sp = Saplings and Sd = Seedlings

The status of regeneration was best (approx. 45,000 seedlings/ha) in STMH forests followed by Sal forests (approx. 37,000 seedlings/ha). In contrast, it was poor in KS forests (slightly more than 1,800 seedlings/ha). The results also showed that the higher the crown cover of the forest stand, the more the number of seedlings per ha; however the number of saplings were found higher in the forest stands with lower canopy cover. The number of seedlings was highest in large saw-timber stands (more than 37,000 seedlings/ha) and the number of saplings was highest in seedling-and-sapling stage stands (more than 3,000 saplings/ha). The number of seedlings and saplings were found to be the highest in the Buffer Zone areas of the Terai Forests (35,900 seedlings/ha and 1,900 samplings/ha) (Table 22).

Table 22. Seedling and sapling stock

Forest Type	No. of plots	Seedlings/ha	Saplings/ha	Total (No./ha)
SK/KS	5	1,830	1,154	2,984
Sal	80	36,683	1,547	38,230
STMH	8	44,539	1,641	46,180
TMH	82	23,031	1,807	24,838
Total/Average	**175**	**29,649**	**1,662**	**31,311**
Crown Cover				
< 40%	26	10,261	1,928	12,189
40–69%	65	28,360	1,570	29,930
>70%	84	36,648	1,651	38,299
Total/Average	**175**	**29,649**	**1,662**	**31,311**
Development Status				
Seedling and sapling stand (<12.5 cm DBH)	10	19,894	3,084	22,978
Pole-timber stand (12.5–25.0 cm DBH)	43	19,117	1,462	20,579
Small saw-timber stand (25.0 – 50.0 cm DBH)	65	34,499	1534	36,033

Large saw-timber stand (>50.0 cm DBH)	57	37,168	1,595	38,763
Total/Average	**175**	**29,649**	**1,662**	**31,311**
Management Regime				
Government Managed	63	34,240	1,645	35,885
Protected Areas	22	34,933	1,067	36,000
Buffer Zone	16	35,860	1,915	37,775
Community Forest	53	25,469	1,866	27,335
Collaborative Forest	19	17,507	1,675	19,182
Total/Average	**173***	**148,009**	**8,168**	**156,177**

* Two plots in the Private Forest were excluded

In general, regeneration in Terai forests was very good (about 30,000/ha). The status of regeneration was abundant in the Far-western and relatively sparse in Western Development Region compared to other Development Regions (Table 23).

Table 23. Status of regeneration in different development regions of the Terai

Development region	No. of plots	Seedlings/ha	Saplings/ha
Far-Western	54	40621 (32,826)	1,463 (497)
Mid-Western	34	25,740 (15,219)	1,568 (1194)
Western	22	20,057 (10,743)	1,483 (796)
Central	44	27,346 (26,166)	2,102 (995)
Eastern	21	22,642 (13,926)	1,592 (1393)
Total/Average	**175**	**29,649 (21,287)**	**1,662 (995)**

Note: Median values are given in the parentheses.

Basal Area

The total basal area of live trees in the Terai forests was slightly more than 18 m^2/ha with about two-thirds that of the dominant trees (Table 24).

Table 24. Basal area per ha according to crown classes

SN	Tree status	Crown class	Basal area (≥5 cm DBH), m^2/ha
1	Live trees	Dominant	12.79
2		Co-dominant	2.81
3		Intermediate	1.31
4		Suppressed	0.44
5		Understory	0.21
6		Broken	0.81
	Sub Total		**18.38**
7	Standing dead trees	Dead usable*	0.28
8		Dead unusable	0.03
	Sub-total		**0.31**
9	Dead wood		N/A

*Tree stems that can be used at least for firewood

In terms of diameter classes, per hectare basal area was about 1 m^2/ha in sampling (5-10 cm), about 3 m^2/ha in pole (10-20 cm), slightly more than 6 m^2/ha in small saw-timber (20-50 cm), and approx. 8

m²/ha in the mature trees (≥50 cm). *Shorea robusta* was found to have the highest basal area with approx. 48% of the total followed by *Terminalia alata* with approx. 11% of the total basal area (Table 25).

Table 25. Species and DBH class wise Basal area m²/ha in Terai forests

		DBH Class(cm) and Basal Area m²/ha				
SN	**Scientific Name**	**5-10**	**10-20**	**20-50**	**≥ 50**	**Total**
1	*Shorea robusta*	0.39	0.87	2.78	4.70	8.74
2	*Terminalia alata*	0.17	0.18	0.52	1.07	1.94
3	*Anogeissus latifolius*	0.05	0.07	0.27	0.28	0.67
4	*Adina cordifolia*	0.00	0.00	0.09	0.40	0.49
5	*Syzygium cumini*	0.01	0.05	0.21	0.28	0.55
6	*Mallotus philippensis*	0.17	0.34	0.42	0.02	0.95
7	*Lagerstroemia parviflora*	0.06	0.15	0.36	0.05	0.62
8	*Terminalia bellirica*	0.00	0.01	0.17	0.12	0.30
9	*Lannea coromandelica*	0.00	0.01	0.17	0.15	0.33
10	*Buchanania latifolia*	0.05	0.13	0.22	0.00	0.40
	Other species	0.40	0.81	1.28	0.90	3.39
	Total	**1.30**	**2.62**	**6.49**	**7.97**	**18.38**

5.2.2. Volume

The total stem volume of the live trees in the Terai forests was 68.91 million m³ (167.42 m³/ha). The total volume of standing dead trees was 1.77 million m³ (2.51 m³/ha) and that of dead wood was 2.63 million m³ (6.39 m³/ha) (Table 26).

Table 26. Stem volume per ha according to crown classes

SN	Tree status	Crown class	Stem volume (≥5 cm DBH), m³/ha
1	Live trees	Dominant	130.01
2		Co-dominant	20.88
3		Intermediate	7.93
4		Suppressed	2.15
5		Understory	1.10
6		Broken	5.34
	Sub Total		**167.42**
7	Standing dead trees	Dead usable*	2.23
8		Dead unusable	0.28
	Sub-total		**2.51**
9	Dead wood		**6.39**

**Tree stems that can be used at least for firewood*

In terms of diameter classes, per hectare stem volume was about 6 m^3/ha in sampling (5-10 cm), about 17 m^3/ha in pole (10-20 cm), slightly more than 57 m^3/ha in small saw-timber (20-50 cm), and approx. 87 m^3/ha in the mature trees (≥50 cm). *Shorea robusta* was found to have the highest volume with approx. 55% of the total followed by *Terminalia alata* with approx. 12% of the total stem volume (Table 27).

Table 27. Species and DBH class-wise stem volume m^3/ha in Terai Forest

		DBH Class(cm) and stem volume m^3/ha				
SN	**Scientific Name**	**5-10**	**10-20**	**20-50**	**≥ 50**	**Total**
1	*Shorea robusta*	1.80	6.56	28.68	54.67	91.71
2	*Terminalia alata*	0.69	1.14	5.19	12.40	19.42
3	*Anogeissus latifolius*	0.29	0.42	2.28	2.74	5.73
4	*Adina cordifolia*	0.01	0.01	0.63	4.09	4.74
5	*Syzygium cumini*	0.03	0.25	1.39	2.42	4.09
6	*Mallotus philippensis*	0.81	1.90	2.50	0.09	5.30
7	*Lagerstroemia parviflora*	0.32	1.02	2.76	0.33	4.43
8	*Terminalia bellirica*	0.02	0.08	1.66	1.22	2.98
9	*Lannea coromandelica*	0.00	0.04	1.41	1.36	2.81
10	*Buchanania latifolia*	0.22	0.74	1.59	0.00	2.55
	Other species	1.57	4.71	9.40	7.97	23.65
	Total	**5.76**	**16.87**	**57.49**	**87.29**	**167.42**

In terms of quality class, the total stem volume in Quality Class 1 (High-quality sound tree) was about 122 m^3/ha, the major proportion that of *Shorea robusta* followed by *Terminalia alata* (Table 28).

Table 28. Species and Quality class wise stem volume m^3/ha in Terai Forest

		Stem Volume/ha (m^3)			
SN	**Scientific Name**	**Quality-1**	**Quality-2**	**Quality-3**	**Total**
1	*Shorea robusta*	78.71	10.50	2.51	91.72
2	*Terminalia alata*	16.17	1.12	2.13	19.42
3	*Anogeissus latifolius*	4.10	0.94	0.69	5.73
4	*Mallotus philippensis*	0.05	0.78	4.48	5.31
5	*Adina cordifolia*	3.36	0.55	0.82	4.73
6	*Lagerstroemia parviflora*	2.86	0.80	0.77	4.43
7	*Syzygium cumini*	1.90	1.39	0.81	4.10
8	*Terminalia bellirica*	2.49	0.44	0.03	2.96
9	*Lannea coromandelica*	1.98	0.51	0.31	2.80
10	*Buchanania latifolia*	0.90	0.97	0.68	2.55
	Other species	9.85	6.04	7.78	23.67
	Total	**122.37**	**24.04**	**21.01**	**167.42**

The largest proportion of stem volume without bark (10 and 20 cm top diameters) was comprised by high-quality sound trees, followed by sound trees (Table 29). The species-wise volume occupied by trees belonging to different stem quality class.

Table 29. Stem volume by quality classes

Quality class	Stems (No./ha)	Basal area (m^2/ha)	Stem vol. (m^3 /ha)	10 cm top vol. (m^3/ha)	20 cm top vol. (m^3/ha)
High-quality sound tree	153.68	11.79	122.37	93.92	83.09
Sound tree	154.00	3.12	24.04	15.80	11.24
Cull tree	275.72	3.47	21.01	12.25	7.35
Total	**583.40**	**18.38**	**167.42**	**121.98**	**101.68**

Growing stock per ha was higher in the core regions of PAs than outside them and the growing stock in Buffer Zones was the least. Although the basal area and volume per ha was higher in PA core regions, the number of trees per ha was higher outside the PAs. Thus, the frequency of large trees was higher inside PA core regions than outside PAs (Table 30).

Table 30. Growing stock inside and outside PAs

Management regime	No. of plots	No. of trees (no./ha)	Basal area (m^2/ha)	Stem vol. (m^3/ha)	10 cm top vol. (m^3/ha)	20 cm top vol. (m^3/ha)
PA core	22	479.21	20.08	178	129.97	103.42
Buffer zone	16	632.07	14.83	135.72	95.54	82.16
Outside PA	137	594.45	18.52	169.42	123.78	103.67
Average		**583.40**	**18.38**	**167.42**	**121.98**	**101.68**

The size classes of trees revealed that the proportion of small trees was higher than that of large ones (Figure 20). This fact indicated that Terai forests were unevenly aged natural forests at the time of assessment.

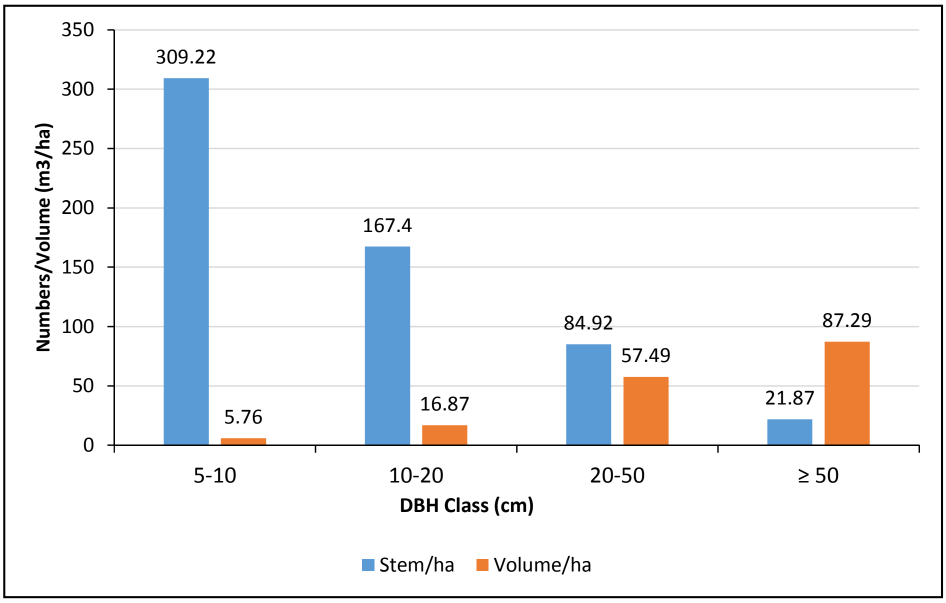


Figure 20. Number of stems and volume per ha by DBH class

Out of the total stem volume (10 cm top diameter, under bark) of 122.8 m^3/ha, *Shorea robusta* was found to have highest stem volume per hectare (67.17 m^3/ha) followed by *Terminalia alata* (14.36 m^3/ha). The similar trend was found for stem volume (20 cm top diameter, under bark) (Table 31).

Table 31. Stem volume (without bark) per ha by minimum top diameter

SN	Scientific name	Vol. 10 cm top dia.(m3/ha)	Vol. 20 cm top dia.(m3/ha)
1	*Shorea robusta*	67.17	59.34
2	*Terminalia alata*	14.36	12.93
3	*Anogeissus latifolius*	4.63	3.77
4	*Adina cordifolia*	3.74	3.58
5	*Syzygium cumini*	3.13	2.71
6	*Mallotus philippensis*	2.92	1.06
7	*Lagerstroemia parviflora*	2.85	1.67
8	*Terminalia bellirica*	2.43	2.04
9	*Lannea coromandelica*	2.35	2.03
10	*Buchanania latifolia*	1.56	0.67
	Other species	16.84	11.88
	Total	**121.98**	**101.68**

5.2.3. Biomass

The live trees above-ground air-dried biomass was 196.18 t/ha and below-ground was 5.98 t/ha. The air-dried above-ground biomass of the Terai forests was 202.64 t/ha; the below-ground biomass was 6.09 t/ha (Table 32).

Table 32. Above- and below-ground biomass

I. Live Trees	**Biomass Components**	**Air Dry biomass (t/ha)**
Above Ground	Stem	139.05
	Branch	48.85
	Foliage	8.28
Below Ground	Stump and Coarse Roots	5.98
II. Dead Trees		
Above Ground	Stem	2.15
	Branch	0
	Foliage	0
Below Ground	Stump and Coarse Roots	0.11
III. Dead Wood		
Above Ground	Stem	4.31
Total above Ground biomass		202.64
Total below Ground biomass		6.09
Total biomass		208.73
Total oven dry biomass/ha		**189.75**

In the tree components, the biomass in stem was approx. 139 t/ha, in branch was about 49 t/ha and in the foliage was about 8 t/ha. In terms of species wise tree component biomass, highest biomass was found in *Shorea robusta* with about 111 t/ha followed by *Terminalia alata* with approx. 27 t/ha (Table 33).

Table 33. Species wise tree component biomass t/ha in Terai Forest (Air dry)

SN	Scientific Name	Tree component Biomass t/ha in Terai Forest (Air Dry)			
		Stem	**Branch**	**Foliage**	**Total**
1	*Shorea robusta*	80.71	25.22	5.36	111.29
2	*Terminalia alata*	18.45	7.38	0.86	26.69
3	*Anogeissus latifolius*	5.04	2.01	0.25	7.30
4	*Adina cordifolia*	3.17	1.27	0.14	4.58
5	*Syzygium cumini*	3.15	1.26	0.15	4.56
6	*Mallotus philippensis*	3.57	1.43	0.22	5.22
7	*Lagerstroemia parviflora*	3.77	1.51	0.22	5.50
8	*Terminalia bellirica*	2.00	0.80	0.10	2.90
9	*Lannea coromandelica*	1.89	0.76	0.09	2.74
10	*Buchanania latifolia*	1.72	0.69	0.11	2.52
	Other species	15.58	6.52	0.78	22.88
	Total	**139.05**	**48.85**	**8.28**	**196.18**

5.2.4. Comparison of Terai Forest Areas by Development Status

The area occupied by the small-sawtimber was in decreasing order from 1964 to 1991 to 2011 as observed in the national forest resource inventories conducted in those periods. On the other hand, that occupied by the large-sawtimber was decreased rapidly from 1964 to 1991, but fairly stable from 1991 to 2011. Likewise, the area occupied by seedling and sapling as well as the pole timber, was increased slightly over the time period (Table 34). However, there was an inconsistency in the total area coverage of the Terai Physiographic Region used during the different forest resource assessments.

Table 34. Comparison of Terai forest areas in terms of development stages

Development stage	Forest area (%)		
	FRS 1964	**NFI 1991**	**FRA 2011**
Seedling and sapling (<12.7 cm DBH)	2.4	4.5	5.7
Pole timber (12.7–27.9 cm DBH)	11.9	12.0	24.6
Small sawtimber (28.0–53.2 cm DBH)	67.2	48.5	37.1
Large sawtimber (>53.3 cm DBH)	18.5	35.0	32.6
Total	**100.0**	**100.0**	**100.0**

High-quality sound trees comprised a large proportion of stem volume. Most of the volume of high-quality sound trees was constituted by trees with 40 cm - 70 cm DBH (Figure 21).

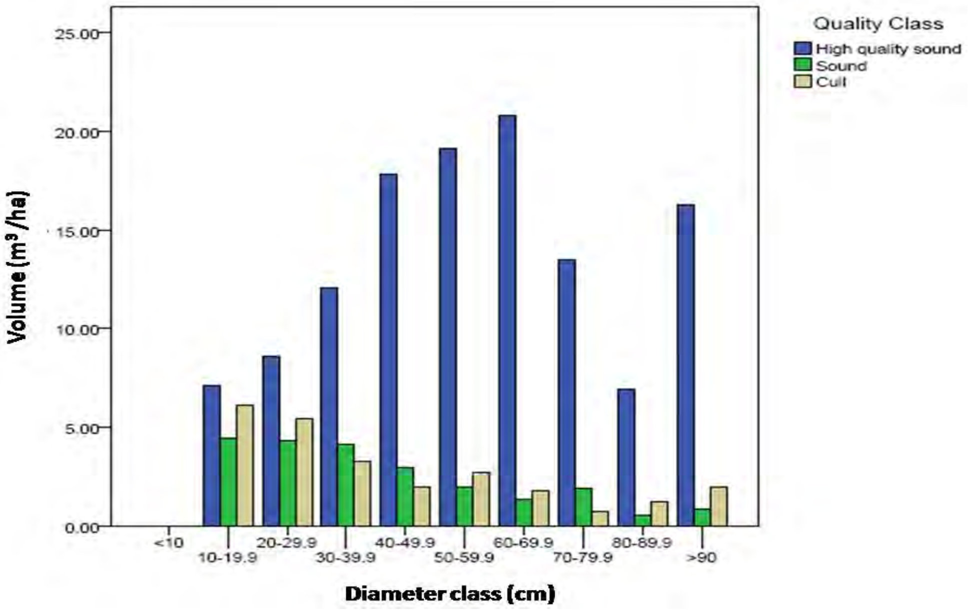


Figure 21. Distribution of volume by stem-quality class and tree size

When comparing the amount of timber volume occupied by different stem quality classes with FRS (1964), volume occupied by the high quality sound trees was increased from 48.0% to 73.1% whereas the volume occupied by the sound tree was decreased from 40.0% to 14.4%. The volume occupied by the cull tree was almost the same (Table 35).

Table 35. Comparison of FRA Nepal timber quality

Timber quality class	FRS 1964	FRA 2011	
	(Vol. %)	Vol. (m^3/ha)	(Vol. %)
High-quality sound tree	48.0	122.37	73.1
Sound tree	40.0	24.04	14.4
Cull tree	12.0	21.01	12.5
Total	**100.0**	**167.42**	**100.0**

5.2.5. Quality Assurance of Forest Inventory

Of the 19 sub-plots, seven had the same number of trees per ha. The maximum difference in the number of trees per ha was 462. In totality, the average number of trees per ha was 1061.0 from the regular field measurements and 1059.5 trees from the quality assurance measurements respectively. Similarly, the basal area was the same in two sub-plots in the case of both the measurements. The maximum difference in the basal area was 4.1 m^2/ha. On an average, the basal area per hectare was 23.0 m^2/ha on the basis of the regular field measurements whereas it was 23.1 m^2/ha based on the quality assurance measurements. Those differences between measurements were not found statistically significant when independent sample t-test (P-value = 0.96) was applied. A detailed quality assurance report is presented in Annex 6.

5.3. Terai Forest Soils

5.3.1. Soil Organic Carbon in Terai Forest

Almost 75% of the CCSPs in the Terai showed no stones on visual inspection of the soil pit walls. In the remaining 25% of CCSPs, there were varying stoniness conditions. Stones were mostly confined to sandy soil textures, but some stony sites were found in clay loam soils. Sal and Terai Mixed Hardwood, being the most abundant forest types, occasionally had stones in the top 30 cm layer up to more than 60% of soil volume, but the majority of the sites were practically stone-less. The total carbon in the soil component was 13.85 Tg, equivalent to 50.80 Tg CO_2 (Table 36).

Table 36. Soil Organic Carbon (SOC)

Soil	
Carbon (t/ha)	33.66
Total Carbon in the Terai (ton)	13,853,782.80
Total Carbon in soil component (Tg)	**13.85**
Total CO_2 equivalent in soil component (Tg)	50.80

Soil Organic Carbon by Development Region

The amount of carbon stock in the litter and debris together ranged from was 0.20 t/ha in the Eastern Terai to 0.35 t/ha in the Central Terai (Table 37).

Table 37. Distribution of stocks of SOC, litter and woody debris

Development region	SOC (t/ha)	Litter and debris carbon (t/ha)	Area ('000 ha)	Total carbon (Tg)	Total CO_2 equivalent (Tg)
Eastern	32.7 (47.12)	0.20 (0.002)	**56.2**	1.85	6.80
Central	39.3 (17.05)	0.35 (0.001)	**95.2**	3.77	13.82
Western	18.7 (22.09)	0.26*	**47.2**	0.89	3.25
Mid-western	32.2 (14.6)	0.26*	**85.6**	2.78	10.20
Far-western	33.0 (5.92)	0.22 (0.003)	**127.3**	4.23	15.52
Mean	**33.3**	**0.26**			
Total	**-**	**-**	**411.6**	**13.81**	**50.68**

Note: The standard errors of the corresponding values are given in the parentheses.* The standard errors not provided as there were limited samples in this category. n = 42 and the total average estimate was used

Soil Organic Carbon by Forest Types

Sal and TMH Forests showed high variability in SOC content. Bulk density was lowest (1.27 g/cm^3) in the Khair-Sissoo Forest having highly organic soils, and highest (1.36 g/cm^3) in the TMH Forest having compressed soils. The proportion of stones, on an average, within all the forest types was found to be 3.53% (Table 38).The largest stocks of SOC was found in the TMH Forest (35.74 t/ha) followed by the Sal Forest (33.81 t/ha) and the least (12.37 t/ha) in the STMH Forest.

Table 38. Distribution of organic carbon in soil, litter and debris by forest type

Forest types	Bulk density (g/cm^3)	SOC % (fine fraction)	Stones (%)	SOC (t/ha)	Litter and debris (t/ha)	Area ('000 ha.)	SOC, litter and debris (Tg C)	CO_2 (Tg)
KS	1.27 (0.03)	0.62 (0.02)	0.00	24.58 (10.72)	0.17 (0.001)	11.77	0.29	1.07
Sal	1.34 (0.001)	0.90 (0.003)	3.31 (8.49)	33.81 (4.67)	0.29 (0.0003)	188.13	6.42	23.55

Forest types	Bulk density (g/cm^3)	SOC % (fine fraction)	Stones (%)	SOC (t/ha)	Litter and debris (t/ha)	Area ('000 ha.)	SOC, litter and debris (Tg C)	CO_2 (Tg)
STMH	1.32	0.32	22.50	12.37	0.28	18.81	0.24	0.87
TMH	1.36 (0.002)	0.94 (0.003)	3.63 (10.92)	35.74 (4.04)	0.29 (0.0004)	192.87	6.95	25.50
Average/Total	**1.34**	**0.88**	**3.53**	**33.66**	**0.28**	**411.58**	**13.9**	**51.01**

Note: *The values given in parentheses are the standard errors of the corresponding values. No value of SE has been provided for STMH forests as there was only one cluster in that forest type.

5.4. Carbon Stock in the Terai Forests

The above-ground carbon was estimated by multiplying estimated biomass by a conversion factor of 0.47, as recommended by the IPCC (IPCC, 2006) while CO_2 equivalent was estimated by multiplying carbon by a conversion factor of 44/12, as recommended by the Alabama Forestry Commission (n.d.). The total carbon stock in the Terai forests was 50.68 Tg (123.14 t/ha) (Table 39).

Table 39. Carbon stock in the Terai forests

Carbon Pool in the Terai Forest	
Carbon (t/ha)	89.18
Total Carbon in million ton	36.704,704.40
CO_2 equivalent (t/ha)	327.01
Total Carbon in tree component (Tg)	36.71
Total CO_2 equivalent in tree component (Tg)	134.59
Litter and Debris	
Carbon (t/ha)	0.28
Total Carbon in ton	115,242.40
CO_2 equivalent (t/ha)	1.03
Total Carbon in litter and debris component (Tg)	0.12
Total CO_2 equivalent in litter and debris component (Tg)	0.42
Soil	
Carbon (t/ha)	33.66
Total Carbon in ton	13,853,782.80
Total Carbon in soil component (Tg)	13.85
Total CO_2 equivalent in soil component (Tg)	50.80

The total carbon dioxide (CO_2) pool in the Terai forests was approx. 186 Tg (Table 40).

Table 40. Carbon stock in the Terai forests

Total CO_2 equivalent pool in Terai Forest	**Tg**
Total CO_2 equivalent in tree component	134.59
Total CO_2 equivalent in litter and debris component	0.42
Total CO_2 equivalent in soil component	50.80
Total	**185.81**

5.5. Terai Forest Biodiversity

5.5.1. Tree Species Diversity

Altogether, 164 tree species belonging to 115 genera and 51 families were recorded in the Terai forests. This is 24% of the total 696 tree species (Press *et al.*, 2000) found in Nepal. ***Fabaceae***, with 14 genera and 24 species, was the largest family. Thirty-four families were represented by single genus and species. *Ficus*, with five species, was the largest tree genera (Annex 7). The average tree species (α-diversity) recorded per plot was 10.00. The standard deviation of the number of species observed per plot (i.e. β-diversity) was 5.296 diversity units. The high β-diversity indicated that there was very high tree species turnover from one cluster to another in the region. The fact that the β-diversity was not as high as the α-diversity in the Terai region indicated the presence of disturbances, which could have enhanced species richness and increased α-diversity (O'Dea *et al.*, 2006). The high eigen-values (DCA first axis = 91% and DCA second axis = 51%) also indicated that the high tree species heterogeneity was mostly explained by the environmental variability of the Terai.

In the ordination plot, most species were concentrated towards the centre, a fact which indicates high β-diversity. Dispersion of species was better along the second than the first axis, indicating that species heterogeneity is largely explained by the second axis. Tree species such as *Terminalia alata*, *Dillenia pentagyna* and *Shorea robusta* have high crown cover whereas *Lannea coromandelica* and *Schleichera oleosa* have low crown cover. Shrubs are positively correlated with tree species such as *Adina cordifolia* and *Lagerstroemia parviflora* and negatively correlated with tree species like *Anogeissus latifolius* and *Buchanania latifolia*. Herbaceous species were found in open canopy areas and are poorly associated with *Syzygium cumini*. Seedlings and saplings are positively correlated with each other but showed no correlation with herbaceous species. Crown cover is negatively correlated with herbaceous species and shrubs and shows almost no correlation with seedlings (Figure 22). Closed canopies tend to block sunlight and prevent ground vegetation from growing well, whereas open canopies facilitate the growth of ground vegetation (Saxena and Singh, 1982).

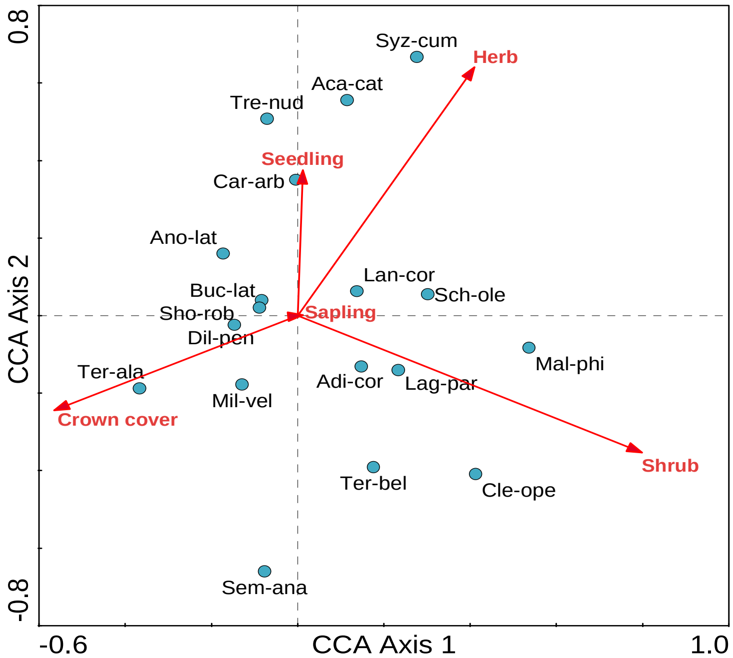


Figure 22. Relationships between trees, shrubs and herbs

Note: Forest variables are represented by red arrows, and species by closed blue circles. The species are listed by the first three letters of the genus and the specific epithet, they include*:* Aca-cat = *Acacia catechu*, Adi-cor = *Adina cordifolia*, Ano-lat = *Anogeissus latifolius*, Buc-lat = *Buchanania latifolia*, Car-arb = *Careya arborea*, Cle-ope = *Cleistocalyx operculatus*, Dil-pen = *Dillenia pentagyna*, Lag-par = *Lagerstroemia parviflora*, Lan-cor = *Lannea coromandelica*, Mal-phi = *Mallotus philippensis*, Mil-vel = *Miliusa velutina*, Sch-ole = *Schleichera oleosa*, Sem-ana = *Semecarpus anacardium*, Sho-rob = *Shorea robusta*, Syz-cum = *Syzygium cumini*, Ter-ala = *Tectona grandis*, Ter-bel = *Terminalia bellirica and* Tre-nud = *Trewia nudiflora*

Tree species diversity ranged from 1-25 per plot and from 1-14 per sub-plot. Sub-plots within the Parsa Wildlife Reserve and the Sapath Forest in Kapilvastu district had the maximum tree species richness (14). Details on tree species abundance in the Terai region are presented in Annex 8.

Tree Species Occurrence

In 15 sub-plots, there was only one tree species; on 11, it was Shorea *robusta* and on the other four, it was variously *Trewia nudiflora*, *Dalbergia sissoo*, *Garuga pinnata*, and *Diospyros tomentosa*. Figure 23 highlights the frequency of the dominant and major associated tree species. The tree species distribution curve was uni-modal and perfectly bell-shaped. *S. robusta* was the main dominant tree species and was found at a very high frequency. Major associated tree species were *Terminalia alata*, *Mallotus philippensis*, *Lagerstroemia parviflora* and *Anogeissus latifolius*. Eighteen species occurred only once in 175 sub-plots, in the Terai region.

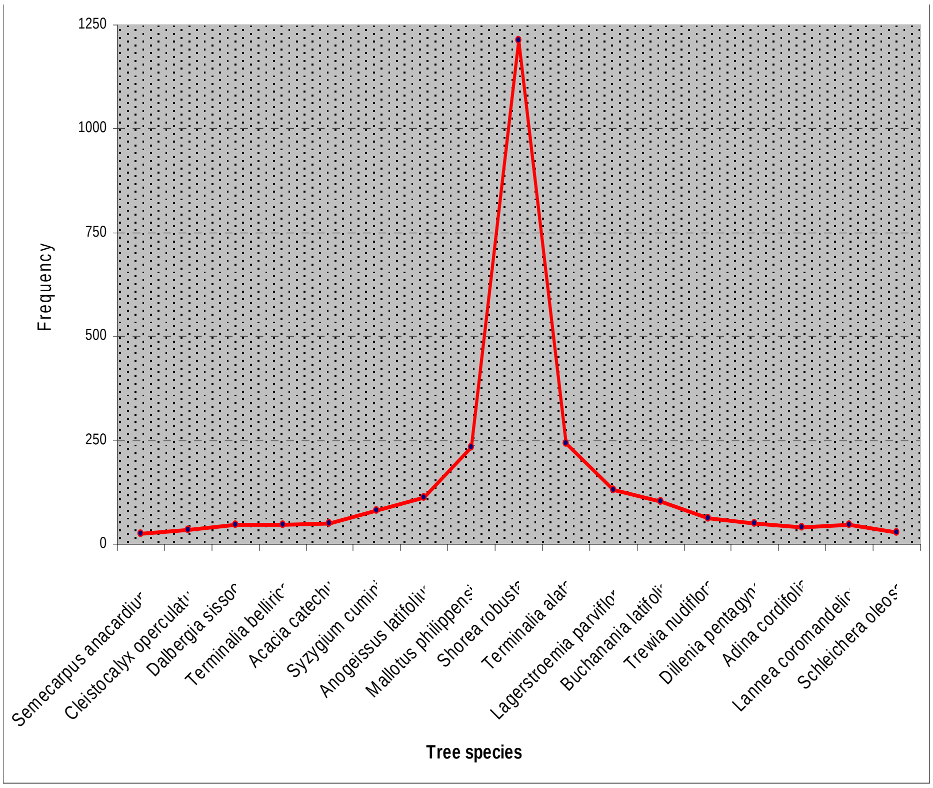


Figure 23. Major tree species frequency

The value of the Shannon-Weaver diversity index (=5.0) indicated that tree species richness was high and that trees are evenly distributed in the Terai region. This value for natural forest communities usually falls between 1.0 and 6.0 (Stilling, 1996).

Shrub Species Diversity

Altogether, 70 shrub species belonging to 62 genera and 34 families were recorded on 49 plots and 133 sub-plots. ***Fabaceae***, with five genera and five species, was the largest. Eighteen families had only a single genus and single species (Annex 7). *Ardisia solanacea* and *Clerodendrum viscosum* were the most abundant shrub species, comprising 33% and 24% of the total respectively. A maximum number of *Ardisia solanacea* was recorded 540 on a single plot in Charkose Jhadi, Baklauri VDC, in Sunsari district. Other major shrub species found were *Murraya koenigii*, *Holarrhena pubescens* and *Woodfordia fruticosa*. Out of 70 shrub species, three species (*Agave cantala*, *Chromolena odoratum* and *Ocimum gratissium*) were invasive (Siwakoti, 2012). *Caesalpinia cucullata*, *Clerodendrum japonicum*, *Flemingia macrophylla* and *Maesa chisia* each occurred only once.

Multivariate analysis shows that the maximum species abundance is obtained along the first ordination axis which also represents the tree abundance. It means the species like *Dobinea vulgaris*, *Grewia optiva* and *Melastoma melabathricum* are mainly found in the areas with more tree species. More herbaceous species are distributed along the second axis, which is positively correlated with *Flemingia macrophylla*, a shrub species. Shrub species like *Sambucus hookeri*, *Murraya koenigii*, *Clerodendrum viscosum* and *Woodfordia fruticosa* are concentrated in the areas with lower tree abundance. Similarly, the species like *Clausena pentaphylla*, *Zizyphus oenoplia*, *Clerodendrum serratum* and *Antidesma acidum* are distributed within the region of lower herb abundance. The species like *Acacia pennata*, *Trema politoria*, *Murraya paniculata*, and *Millettia extensa* are distributed in the areas with lower tree as well as herb abundance (Figure 24).

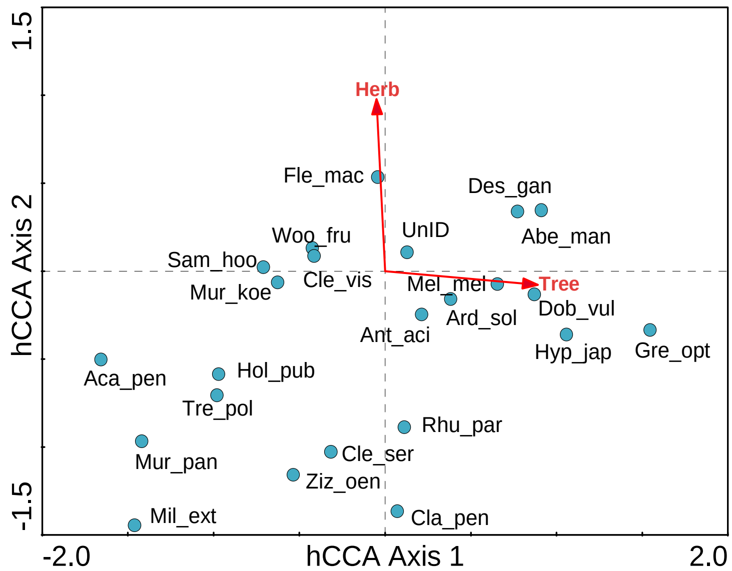


Figure 24. Relationships between shrub species and trees

Note: Forest variables are represented by red arrows, and species by closed blue circles. The species are listed by the first three letters of the genus and the specific epithet, they include: Abe-man = *Abelmoschus manihot*, Aca-pen = *Acacia pennata*, Ant-aci = *Antidesma acidum*, Ard-sol = *Ardisia solanacea*, Cla-pen = *Clausena pentaphylla*, Cle-ser = *Clerodendrum serratum*, Cle-vis = *Clerodendrum viscosum*, Dob-vul = *Dobinea vulgaris*, Des-gan = *Desmodium gangeticum*, Fle-mac = *Flemingia macrophylla*, Gre-opt = *Grewia optiva*, Hol-pub = *Holarrhena pubescens*, Hyp-jap = *Hypericum japonicum*, Mel-mel = *Melastoma melabathricum*, Mil-ext = *Millettia extensa*, Mur-koe = *Murraya koenigii*, Mur-pan = *Murraya paniculata*, Rhu-par = *Rhus parviflora*, Sam-hoo = *Sambucus hookeri*, Tre-pol = *Trema politoria*, unID = unidentified species, Woo-fru = *Woodfordia* fruticosa and Ziz-oen = *Zizyphus oenoplia*

5.5.2. Herbaceous Species Diversity

Altogether, 109 species of herbaceous plants belonging to 85 genera and 49 families were recorded in the Terai forests. ***Asteraceae***, with 12 genera and 15 species, was the largest family and ***Fabaceae***, with five genera and six species, was the second largest (Annex 7). Twenty-families were represented by only a single genus and single species. Multivariate analysis of herbaceous species indicates very high β-diversity (11.32). Maximum heterogeneity is explained by the third (76%) and fourth (70%) axes of CANOCO DCA analysis, but high species-environmental correlations are reflected by the first and the second axes. Tree species are abundant on the first axis whereas shrubs are scattered along the second axis. Herbaceous species are distributed away from tree species. Some species like *Cyperus rotundus*, *Diplazium esculentum*, *Curculigo orchioides* and *Achyranthes aspera* are concentrated in the areas with many trees, while other species like *Elephantopus scaber* and *Chromolena odoratum*, are concentrated in the regions with many shrub species. On the other hand, species like *Argemone mexicana* and *Sida rhombifolia* are concentrated in the areas with few shrubs, and species like *Bidens pilosa* and *Oxalis corniculata* are concentrated in the areas with few trees species (Figure 25).

The most common herb species recorded in the Terai Forests were *Ageratum conyzoides, Cyperus rotundus, Chromolena odoratum, Curculigo orchioides* and *Hydrocotyle sibthorpioides.* Similarly, most herb abundant plots in the Terai were Bhimdatta MP, Kanchanpur; Ramshikhar Jhala, Kailali; Phattepur, Banke; and Belgaachi, Mahottari, respectively.

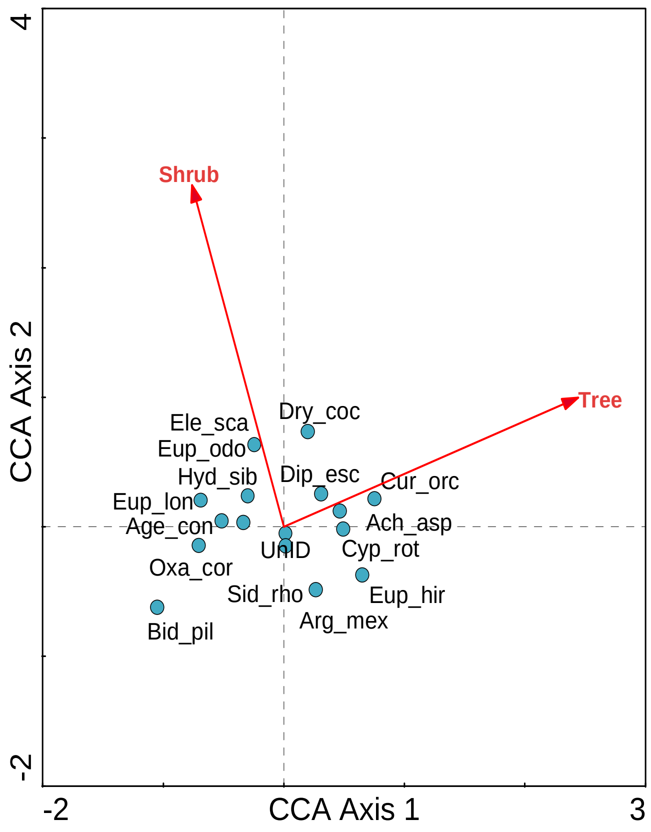


Figure 25. Relationship between herb species, trees and shrubs

Note: Forest variables are represented by red arrows, and species by closed blue circles. The species are listed by the first three letters of the genus and the specific epithet, they include: Ach-asp = *Achyranthes aspera*, Age-con = *Ageratum conyzoides*, Arg-mex = *Argemone Mexicana*, Bid-pil = *Bidens pilosa*, Cur-orc = *Curculigo orchioides*, Cyp-rot = *Cyperus rotundus*, Dip-esc = *Diplazium esculentum*, Dry-coc = *Dryopteris cochleata*, Ele-sca = *Elephantopus scaber*, Eup-hir = *Euphorbia hirta*, Eup-lon = *Euphorbia longifolia*, Eup-odo = *Eupatorium odoratum*, Hyp-sib = *Hydrocotyle sibthorpioides*, InID = Unidentified species, Oxa-cor = *Oxalis corniculata* and Sid-rho = *Sida rhombifolia*

5.5.3. Climbers and Epiphytes and their Host Species

Thirty species of climbers and five species of epiphytic plants belonging to 16 families and 25 genera were found in the Terai region. Among the climbers, ***Vitaceae,*** with four genera and four species, was the largest. ***Dioscoraceae***, with seven species, was the largest monogeneric taxa. The most common climbers were *Bauhinia vahlii, Spatholobus parviflorus, Trachelospermum lucidum, Tetrastigma serrulatum* and *Dioscorea bulbifera.* ***Orchidaceae***, with three genera and three species, was the largest epiphytic family. The most common host species were *S. robusta*, *T. alata*, *M. philippensis* and *Hymenodictyon excelsum*.

5.5.4. Large Mammalian Species

The Terai forests of Nepal harbour 11 orders, 23 families, 48 genera and 65 species of mammals (Suwal *et al.*, 1995; Bhuju *et al.*, 2007; Baral and Shah, 2008; Jnawali *et al.*, 2011). Fifteen species are legally protected under the NPWC Act of 1973. Three, the Gangetic dolphin (*Platanista gangetica*), Indian chevrotain (*Moschiola meminna*) and Black buck (*Antilope cervicapra*), are critically endangered; 16 are endangered; and nine are vulnerable according to the National Red Data Book of Nepal, 2008. Altogether, 18 species fall under IUCN Red List categories. Among them, eight are endangered and ten, vulnerable. Seventeen fall under CITES Appendix I, seven under Appendix II and 13 under Appendix III (Annex 9). Flagship mammalian species, specifically the Asiatic elephant and Bengal tiger, were reported outside the PAs in Pursauna and Dumarwana VDCs in Bara district; Dumariya VDC in Rautahat district; Sundarpur and Bayarban VDCs in Morang district; Pahalmanpur, Ram Shikhar, and Khailad VDCs in Kailali district; and Chisapani, Narayanpur, and Kachanapur VDCs in Banke district.

5.5.5. NTFPs

A total of 370 different species of flora, fauna and avifauna were found to be used to derive non-timber forest products (NTFPs) in the Terai Region. Altogether, 128 species of trees belonging to 93 genera and 45 families; 54 species of shrubs belonging to 48 genera and 28 families; and 84 species of herbs belonging to 51 genera and 34 families were used among the flora communities. Nine species of fern and fern-allies; 30 species of climbers were used, in the Terai Region (Annexes 7 and 10). Among the floral communities, the ***Poaceae*** family, with 17 genera and 22 species, was the largest.

The NTFPs most commonly practiced as medicines were *Phyllanthus emblica*, *Terminalia chebula*, *Aegle marmelos* and *Piper longum*. Plants like *Ficus benghalensis*, *Ficus religiosa* and *Aegle marmelos* had significant religious usage. *Syzygium cumini* was the most used tree species for fruit and *Bauhinia vahlii* for fiber. *Mallotus philippensis* was used to support for climbing vegetables and *S. robusta* for leaf plates and cups as well as for resin and seed oil and agricultural implements. The most-used multipurpose NTFPs of the region were *S. robusta*, *A. catechu*, *Schleichera oleosa*, *Syzygium cumini*, *P. emblica*, *B. vahlii*, *Asparagus racemosus*, *Murraya koenigii*, *Aegle marmelos*, *Bombax ceiba* and *Lagerstroemia parviflora*. The plant and animal parts used as NTFPs for different purposes are listed in Annex 10.

5.5.6. Conservation Status of Important Plant Species

Thirteen species were found to be important according to international as well as national conservation status. Four species, *Rauvolfia serpentina*, *Dalbergia latifolia*, *Pterocarpus marsupium* and *S. robusta*, are legally protected by the GoN. One of them, *D. latifolia*, falls under 'Vulnerable' category in the IUCN Red List. High medicinal-valued and CITES Appendices and the medicinal plants prioritized for i) research and development and ii) agro-technology development by the 'Department of Plant Resources' are given in Table 41.

Table 41. List of Protected, Threatened and Prioritised Medicinal Plant Species

SN	Local name	Botanical name	P	MPRD	MPAD	CITES	IUCN
1	Sarpagandha*	*Rauvolfia serpentina* (L.) Benth. Ex Kurz	√	√	√	II	-
2	Satisal**	*Dalbergia latifolia* Roxb.	√	-	-	-	VU
3	Bijaya Sal**	*Pterocarpus marsupium* Rox.	√	-	-	-	-
4	Sal**	*Shorea robusta* Gaertn.	√	-	-	-	-
5	Bojho	*Acorus calamus* Linn.	-	√	-	-	-
6	Satawari	*Asparagus racemosus* Wild.	-	√	√	-	-
7	Nim	*Azadirachta indica* A. Juss.	-	√	-	-	-
8	Ban Tarul	*Dioscorea deltoidea* Wallich ex Kunth	-	√	-	II	
9	Pipla	*Piper longum* Linn.	-	√	√	-	-
10	Amala	*Phyllanthus emblica* Linn.	-	√		-	-
11	Gurjo Lahara	*Tinospora sinensis* (Lour.) Merr.	-	√	√	-	-
12	Sungava	*Acampe papillosa* (Lindl.) Lindl.	-	-	-	II	-
13	Sunakhari	*Desmotrichum fimbriatum* Bl.	-	-	-	II	-

Source: DPR (2012)

Note:
P = Protected by Government of Nepal
MPRD = Medicinal Plants prioritised for Research and Development
MPAD = Medicinal Plants prioritised for Agro-technology Development
II = CITES Appendix
** = species banned for export outside country without processing*
*** = species banned for felling, transportation and export*
VU = Vulnerable, IUCN Red List

5.6. Forest Disturbance

Trained ecologists used standardised guidelines to assess the nature and degree of 15 types of natural and anthropogenic disturbances in 175 forested sub-plots with known management regimes (Figure 26). They categorised disturbances as low (<10% trees/seedlings affected), medium (10–25% of trees/seedlings affected or a few trees felled/dead) and high (>25 % of trees/seedlings affected by the disturbance or several trees felled/dead). The assessment found that the Terai forests were highly disturbed by livestock grazing, tree cutting, sapling and pole cutting, and forest fires (Annex 11).

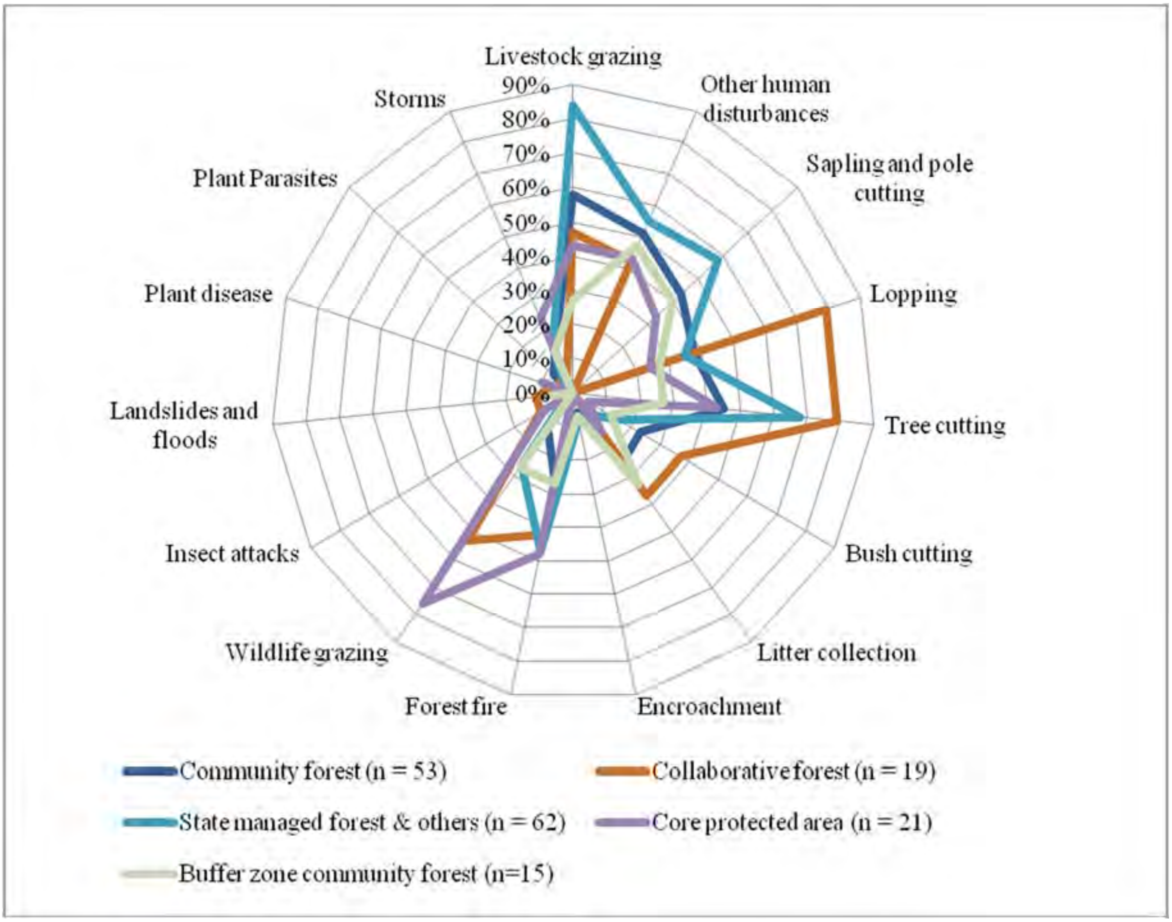


Figure 26. Intensity of forest disturbances by management regime

References

Alabama Forestry Commission. n.d. Measure Your Carbon. Retrieved April 2013 from http://forestry.alabama.gov/HowMuchCarbonHaveYourTreesStored.aspx?bv=5ands=0

Altrell, D., Branthomme, A., and Tavani, R. n.d. Assessing Growing Stock and Stock Changes through Multi-purpose National Forest Monitoring and Assessment. Retreived on December 2, 2013, from www.fao.org/forestry/26100-03805443a729838ab9172b9f1b989b1ca.doc

Baatz, M., and Schape, A. 2000. Multiresolution Segmentation: An Optimization Approach for High Multi- Scale Image Segmentation. Angewandt Geographische Informationsverarbeitung XII. Beitrage zum AGIT Symposium Salzburg 200Karlsruhe.

Baral, H.S. and Shah, K.B. 2008. Wild Mammals of Nepal. Kathmandu, Nepal: Himalayan Nature.

Bhuju U.R., Shakya, P.R., Basnet, T. and Shrestha, S. 2007. Nepal Biodiversity Resource Book, Protected Areas, Ramsar Sites and World Heritage Sites (1st ed.). Kathmandu, Nepal: ICIMOD.

Carson, B., Shah, P.B. and Maharjan, P.L. 1986. Land Systems Report: The Soil Landscapes of Nepal. Land Resources Mapping Project. Kenting Earth Sciences Limited.

CBS. 2001. Central Bureau of Statistics. National Population and Housing Census 2001. Kathmandu.

CBS. 2012. National Population and Housing Census 2011, National Report. Kathmandu, Nepal.

Chaturvedi, A.N. 1982. Forest Mensuration. International Book Distributors. Dehradun, India.

Cochran, W.G. 1977. Sampling Techniques (3rd ed.). New York, New York. John Wiley and Sons, Inc.

Das, K. 2013. Man-Elephant Conflicts in North Bengal. Retrieved from http://www.teriuniversity.ac.in/mct/pdf/assignment/Kalyan-Das.pdf.

DFRS. 1999. Forest Resources of Nepal (1987–1998). Government of Nepal, Ministry of Forests and Soil Conservation, Department of Forest Research and Survey

DoF. 2005. Forest Cover Change Analysis of the Terai Districts 1990/ 91–2000/01. Department of Forests. Kathmandu, Nepal.

DPR. 2007. Medicinal Plants of Nepal (Revised ed.), Bulletin. Department of Plant Resources, No 28, Thapathali. Kathmandu, Nepal.

DPR. 2012. Plants of Nepal: Fact Sheet. GoN, Ministry of Forests and Soil Conservation, Department of Plant Resources. Thapathali, Kathmandu.

FAO. 2006. Guidelines for soil description (4th ed.). Food and Agriculture Organisation of the United Nations, Publishing Management Service, Information Division, Rome, Italy.

FORESC. 1993. Forest Resources of the Terai Districts. Forest Survey Division, Forest Research and Survey Centre, Ministry of Forests and Soil Conservation, GoN.

FRA Nepal, 2014. Standard Guidelines for Forest Cover Mapping. Department of Forest Research and Survey/ Forest Resource Assessment Nepal (Unpublished).

FRA Nepal, 2010. Retrieved from http://www.franepal.org/wpcontent/uploads/downloads/project_documents/Project_Document_approved_by_PSC_23_June_2010_for_external_distribution.pdf. Retrieved Sept.3,2013.

FRA Nepal, 2011. Forest Resource Assessment, Nepal. Inventory Design. http://www.franepal.org/wp content/uploads/downloads/project_documents/Inventory_Design_REVISED_FINAL_DRAFT_14022011.pdf.

FRS. 1967. Forest Statistics for the Terai and Adjoining Regions 1967 (Publication No. 4). Department of Forests, Kathmandu, Nepal.

Heinonen, J., Saramaki, J. and Sekeli, P.M. 1996. A Polynomial Taper Curve Function for Zambian Exotic Tree Plantations. *Journal of Tropical Forest Science*, 8 (3): 339–354.

Hill, M.O. and Gauch H.G.J. 1980. Detrended Correspondence Analysis: An Improved Ordination Technique. *Vegetation*, 42: 47-58.

IPCC. 2006. Good Practice Guidance for National Greenhouse Inventories. Agriculture, Forestry and Other Land Uses (Vol. 4). Geneve, Switzerland. http://www.ipcc nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf. Retrieved Apr. 25, 2013

ISRIC. 2009. SOTER database for LADA partners countries (http://www.isric.org/UK/About+Soils/Soil+data/Geographic+data/National/default.htm).

IUCN. 2013. The IUCN Red List of Threatened Species™ Strategic Plan 2013–2020. Version 1.0. IUCN Red List Committee.

Jackson, J.K. 1994. Manual of Afforestation in Nepal. Nepal-United Kingdom Forestry Research Project. Forest Survey and Research Office, Department of Forests, Kathmandu, Nepal.

JAFTA. 2001. Activity Report of Wide Area Tropical Forest Resources Survey (Kingdom of Nepal). Japan Forest Technology Association, Information System Development Project for the Management of Tropical Forest.

Jnawali, S.R., Baral, H.S., Lee, S., Acharya, K.P., Upadhyay, G.P., Pandey, M., Shrestha, R., Joshi, D., Laminchhane, B.R., Griffiths, J., Khatiwada, A. P., Subedi, N. and Amin, R. (Compilers). 2011. *The Status of Nepal Mammals*. The National Red List Series. Kathmandu, Nepal: Department of National Parks and Wildlife Conservation.

Jones C., Gregory J., Thorpe R., Cox P., Murphy J., Sexton D. and Valdes, H. 2004. Systematic Optimization and Climate Simulation of FAMOUS, a Fast Version of HADCM3 *(*Hadley Centre Technical Note No. 60). Retrieved from 33pp: http:==www.metoffice.gov.uk=research=hadleycentre=pubs=HCTN=HCTN_60.pdf).

Kleinn, C. 1994. Forest Resources Inventories in Nepal Status, Qou, Needs, Recommendations. FRISP, HMGN/FINNIDA

Kharal, D. K. and Fujiwara, T. 2012. Growth and yield estimation of *Chamaecyparis* spp. through tree ring Analysis. *Banko Janakari* 22 (2): 36-42

Korhonen, L. 2006. Havumetsän latvuspeiton mittaaminenja ennustaminen puustotunnuksista. M. Sc.thesis. University of Joensuu, Faculty of Forestry.71 p. Available at: http://cc.joensuu.fi/~lakorhon/latvuspeitto.pdf. (in Finnish).

LRMP. 1986. Land System Report, Land Resource Mapping Project: Kenting Earth Science, Canada.

Matthews, S., Shivakoti, G.P. and Chhetri, N. 2000. Population Forces and Environmental Change: Observations from Western Chitwan, Nepal. *Society and Natural Resources*, 13: 763-775.

Mehtatalo, L. 2012. Forest Biometrics Functions of Lauri Mehtatalo - lmfor package. Retrieved from http://joyx.joensuu.fi/~lamehtat/documents/lmfor.pdf

MoFSC. 1988. Master Plan for the Forestry Sector in Nepal. Kathmandu, Nepal.

Munsell. 2009. The Munsell Soil Colour Charts (2009 Revision).

NPWC. 1972. National Parks and Wildlife Conservation Act, 2029 B.S. Government of Nepal.

O'Dea N., Whittaker, R.J. and Ugland. K.I. 2006. Using Spatial Heterogeneity to Extrapolate Species Richness: A New Method Tested on Ecuadorian Cloud Forest Birds. *Journal of Applied Ecology*, 43: 189-198.

Ostrom, E. 1990. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press, New York.

Press, J.R., Shrestha, K.K. and Sutton D.A. 2000. Annotated Checklist of the Flowering Plants of Nepal. The Natural History Museum, London, U.K.

Pribyl, D.W. 2010. A Critical Review of the Conventional SOC to SOM conversion factor. *Geoderma*, 156: 75-83.

Sapkota, I.P., Tigabu, M. and Oden, P.C. 2009. Spatial Distribution, Advanced Regeneration and Stand Structure of Nepalese Sal (*Shorea robusta*) Forests Subject to Disturbances of Different Intensities. *Forest Ecology and Management*, 257: 1966-1975.

Saxena, A.K. and Singh, J.S. 1982. A Phytosociological Analysis of Woody Species in Forest Communities of a part of KuMaoun Himalaya. *Vegetatio* 50: 3-22.

Sharma, E.R. and Pukkala, T. 1990. Volume Equations and Biomass Prediction of Forest Trees of Nepal (Publication No. 47). Kathmandu, Nepal: Forest Survey and Statistics Division, Kathmandu.

Siwakoti, M. 2012. Threats and Opportunity of Invasive Alien Plant Species in Wetlands Conservation of Nepal. In *Proceedings:* International Wetland Symposium, 66-72.

Stilling P. 1996. Ecology. Theories and Applications. New Jersey, USA: Prentice Hall International Editions.

Survey Department. 2001. National Topographical Base Maps. Kathmandu, Nepal.

Suwal, R.N. and Verheugt, W.J.M. 1995. Enumeration of the Mammals of Nepal (Biodiversity Profile Project. Technical Publication No. 6). Kathmandu, Nepal: DNPWC.

terBraak, C.J.F. and Smilauer P. 1998. Reference Manual and User's Guide to Canoco for Windows: Software for Canonical Community Ordination (Version 4). Ithaca, N.Y.: Micro Computer Power.

terBraak, C.J.F. and Smilauer P. 2002. Canoco for Windows (Version 4.5). The Netherlands: Biometrics-Plant Research International, Wageningen.

Toutin, T. 2004. Geometric Processing of Remote Sensing Images: Models, Algorithms and Methods. International Journal of Remote Sensing, 25 (10): 1893-1924.

Walkley, A. and Black, I.A. 1934. An Examination of the Degtjareff Method for Determining Organic Carbon in Soils: Effect of Variations in Digestion Conditions and of Inorganic Soil Constituents. *Soil Science,* 63:251-263.

Westman, C.J., Hytonen, J. and Wall, A. 2006. Loss-on-Ignition in the Determination of Pools of Organic Carbon in Soils of Forests and Afforested Arable Fields. Communications in Soil Science and Plant Analysis, 37 (7-8): 1059-1075.

Annexes

Annex 1: Data Needs Assessment

FRA Nepal carried out an assessment of the data need of selected stakeholders' in 2010. This process involved: a) a stakeholders' workshop; b) questionnaire survey; c) literature review; and d) personal contact with relevant organization. The table below presents specific data needs that were expressed by the selected stakeholders including Department of National Parks and Wildlife Conservation (DNPWC), Department of Forest (DoF), REDD purpose, Departments of Plant Resources (DPR) Department of Soil Conservation and Watershed Management (DSCWM), National Trust for Nature Conservation (NTNC), Nepal Forester Association (NFA), and Federation of Community Forest User Group of Nepal (FECOFUN).

S.N	Variable	FRA Scope	Stakeholder
1	Forest Cover Map (national/regional/district level)	Very High	DOF
2	Growing stock (Biomass/volume/carbon) estimate National level	Very High	DOF
3	Major NTFPs and their distribution	Limited	DOF
4	Land cover/landuse	Limited	DNPWC
5	Unique ecosystem, habitat types, spp. Richness	Limited	DNPWC
6	Diversity animals at regional scale	Limited	DNPWC
7	Diversity plants/trees regional/national scale	Limited	DNPWC
8	Encroachment Area	No	DNPWC
9	Wetland/its type	No	DPWC
10	Change in forest cover over time • Biomass Gain-Loss over time • Forest degradation and or rehabilitation	High	REDD
11	Biomass (above-ground and below-ground biomass) • Dead organic matter (dead wood and litter) • Soil organic matter change in forest cover (at national & local level*)*	Very High	REDD
12	Vegetation maps at least up to ecological regions	High	DPR
13	Habitat mapping of major NTFPs; availability of key NTFPs	High	DPR
14	Methodological framework for major NTFPs inventory	High	DPR
15	Chemical contents of main NTFPs according to their habitat types	No	DPR
16	Detailed land use and land cover related data of Siwalik. • Maps of four river basins (Koshi, Narayani, Karnali and Mahakali rivers) and their condition.	No	DSCWM
17	Soil characteristics (porosity, permeability, cohesion, texture, density, nutrients).	Limited	DSCWM
18	Soil carbon contents and organic matter	Very High	DSCWM
19	Drainage density	No	DSCWM
20	Physiographic wise forest data; • Carbon sequestration inside and outside the PAs and • Forest covers change over time in each physiographic region	Very High	NFA
21	Delineation of major river basins and their conditions;	No	NFA
22	At least physiographic wise forest and forestry map and data	Very High	FECOFUN
23	Contribution of CFs to mitigate climate change	No	FECOFUN
24	Comparative data between CFs and government managed forests	Yes	FECOFUN
25	NTFPs related data;	Limited	FECOFUN
25	Contribution of CF in the GDP;	No	FECOFUN
27	Information on private forest	Limited	FECOFUN
28	Role of CF in poverty alleviation	No	FECOFUN

Annex 2: Diameter-height Models for Different Tree species

Botanical name: *Shorea robusta*

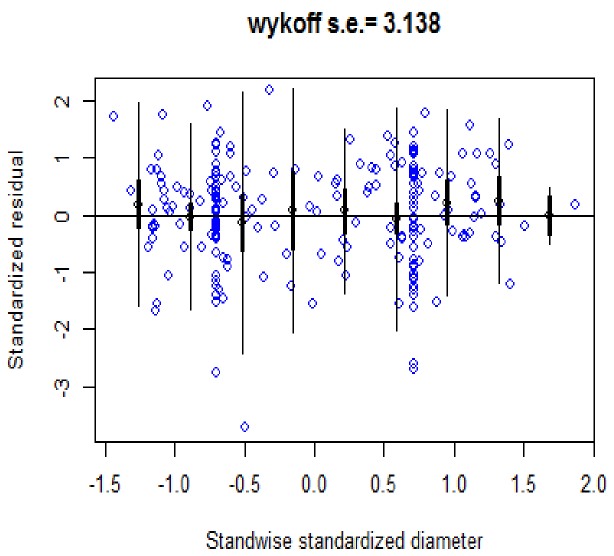
Local name: Sal, Shakhuwa

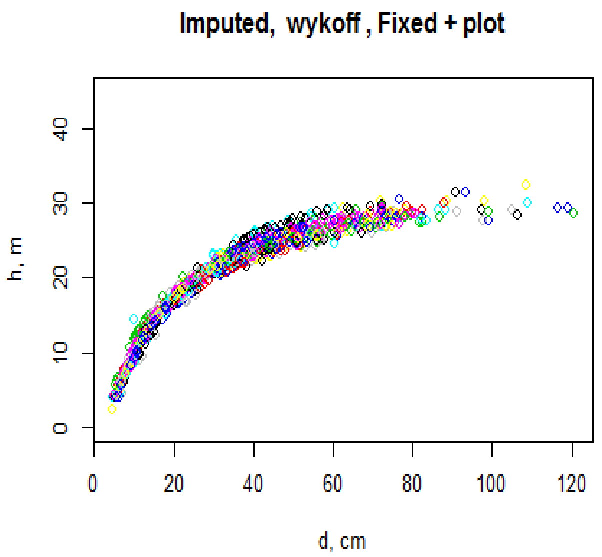
FRA database code: 6615

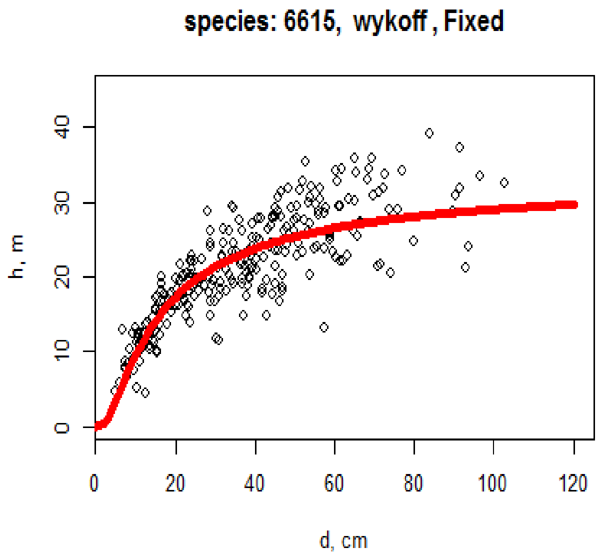
Model = Wykoff

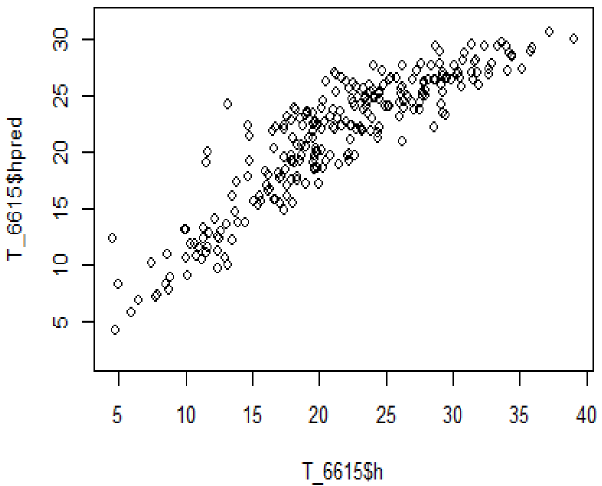
Equation: h(d) = bh + exp(a + b/(d + 1))

Parameter	Validity
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a = 3.503477 b = -13.775051	s.e.= 3.138 Adj. R^2 = 0.805 (for mixed model only) F-statistic: 1072 on 1 and 258 DF, p-value: < 2.2e-16 Residuals: min= -3.72 Q1= -0.56 med=0.05 Q3=0.67 max= 2.2









Botanical name: *Anogeissus latifolius*

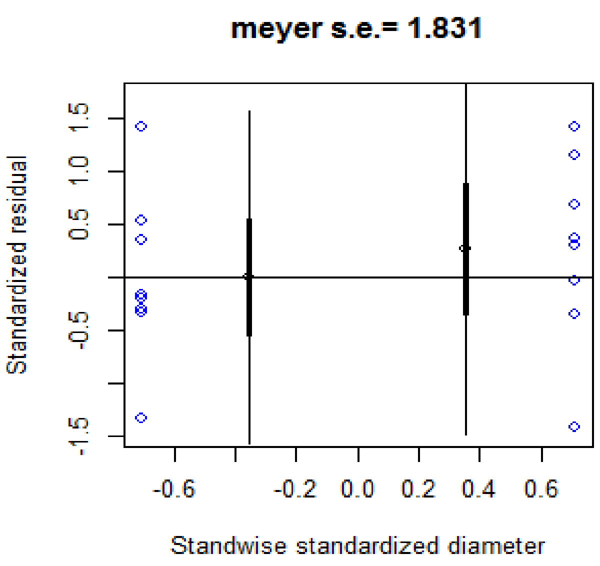
Local name: Gumghatti, Banjhi, Dhabadane, Kath khajuwa

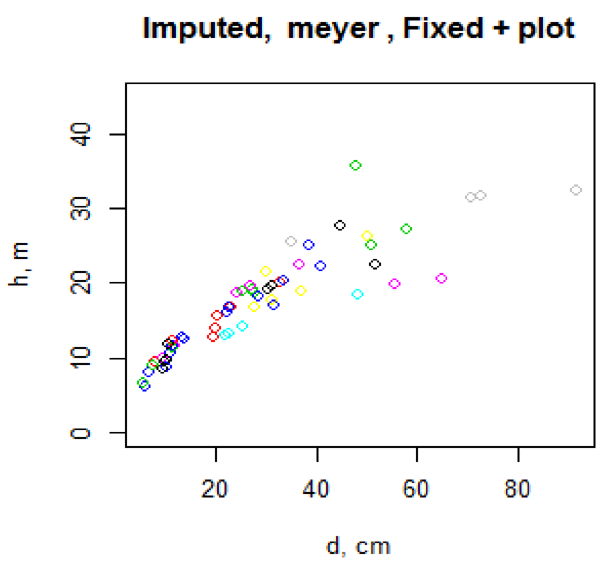
FRA database code: 6113

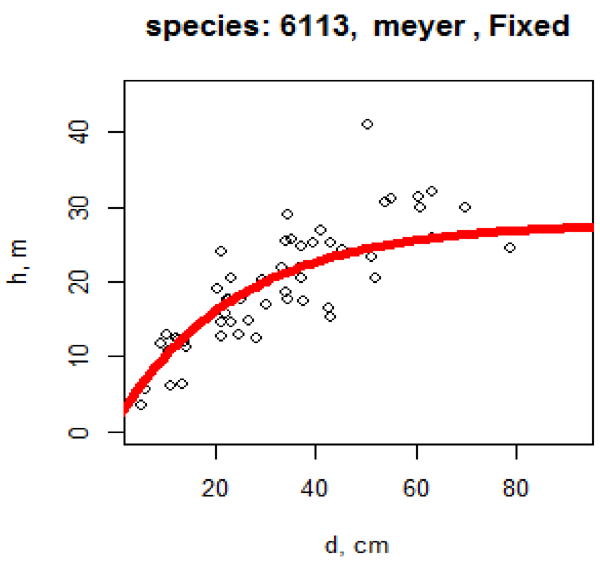
Model = Meyer

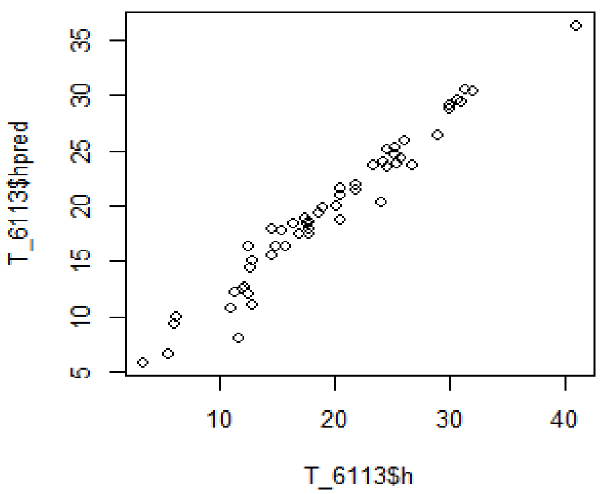
Equation: h(d) = bh + a (1-exp(-b d))

Parameter	Validity
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a = 26.54728406 b = 0.04079307	s.e.=1.831 Adj. R^2=0.9583 (for mixed model only) F-statistic: 1195 on 1 and 51 DF, p-value: < 2.2e-16 Residuals: min= -1.47 Q1= -0.38 med= -0.08 Q3=0.35 max= 1.71









Botanical name: *Buchanania latifolia*

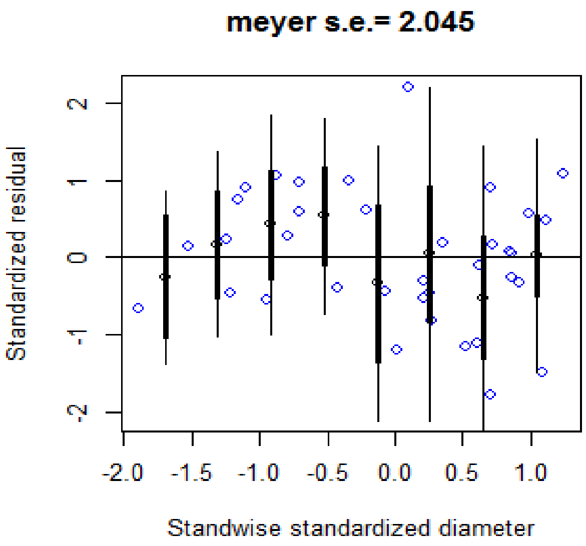
Local name: Piyari, Kaja, Char, Piyal

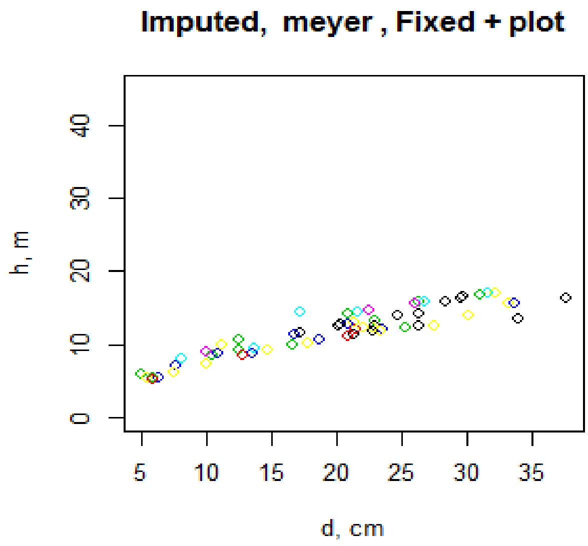
FRA database code: 6147

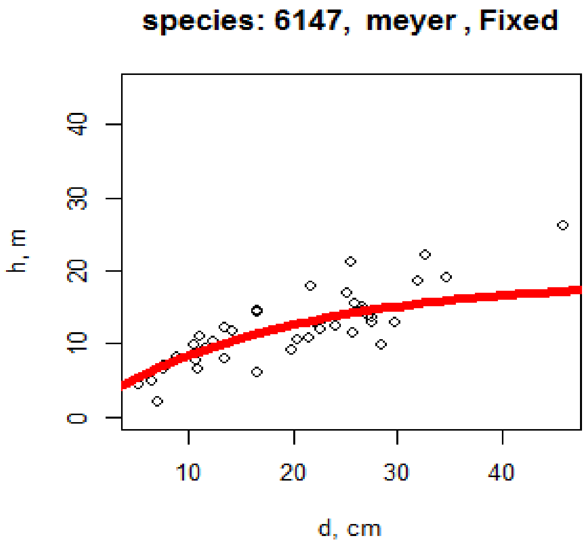
Model = Meyer

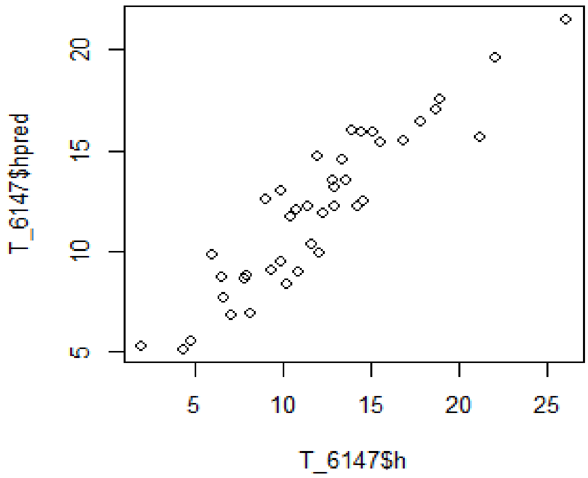
Equation: h(d) = bh + a (1-exp(-b d))

Parameter	Validity
h(d) = predicted height for dbh 'd' bh = breast height (=1.3) d = diameter at breast height a = 17.4584715 b = 0.0522067	s.e.=2.045 Adj. R^2=0.9583 (for mixed model only) F-statistic: 1195 on 1 and 51 DF, p-value: < 2.2e-16 Residuals: min= -2.06 Q1=-0.52 med=0.05 Q3=0.59 max= 2.18









Botanical name: *Cleistocalyx operculata*

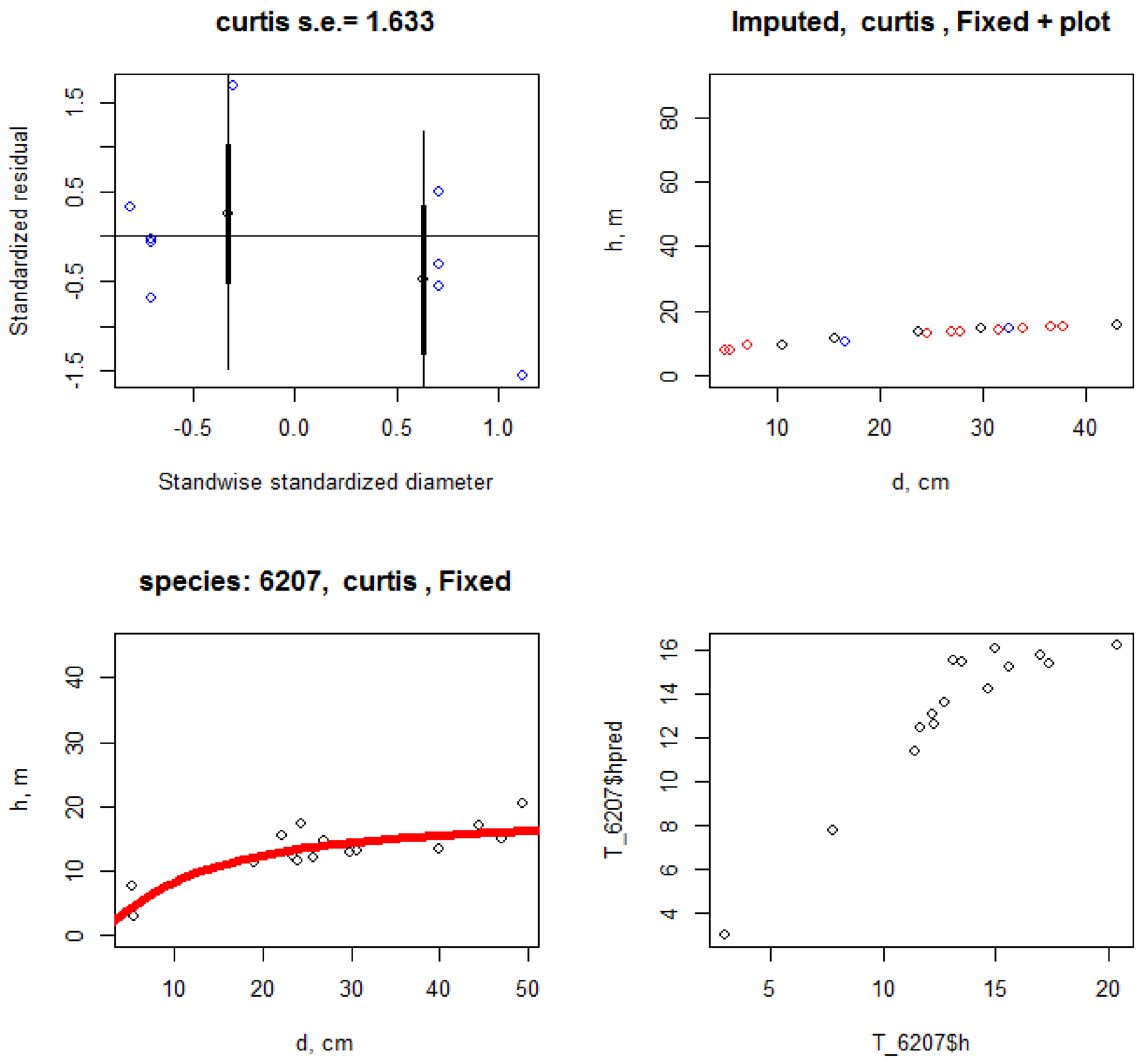
Local name: Kyamuna, Rani, Kusum, Phulepa

FRA database code: 6207

Model = Curtis

Equation: h(d) = h(d) = bh + a (d/(1 + d))^b

Parameter	Validity
h(d) = predicted height for dbh 'd' bh = breast height (=1.3) d = diameter at breast height a= 18.29839 b= 10.15904	s.e.=1.633 Adj. R^2=0.8318 (for mixed model only) F-statistic: 70.26 on 1 and 13 DF, p-value: 1.337e-06 Residuals: min= -1.55 Q1=-0.59 med= -0.07 Q3= 0.34 max= 1.68



Botanical name: *Dalbergia sissoo*

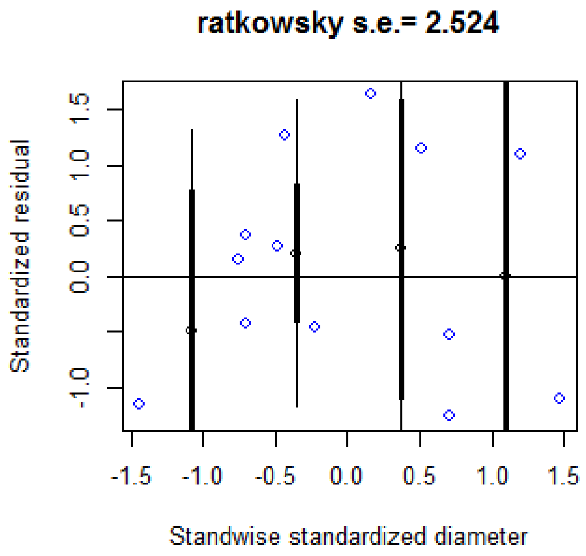
Local name: Sissoo, Sissau

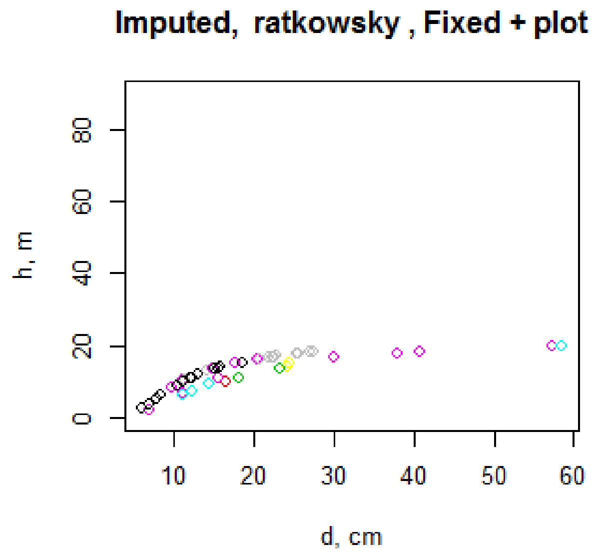
FRA database code: 6239

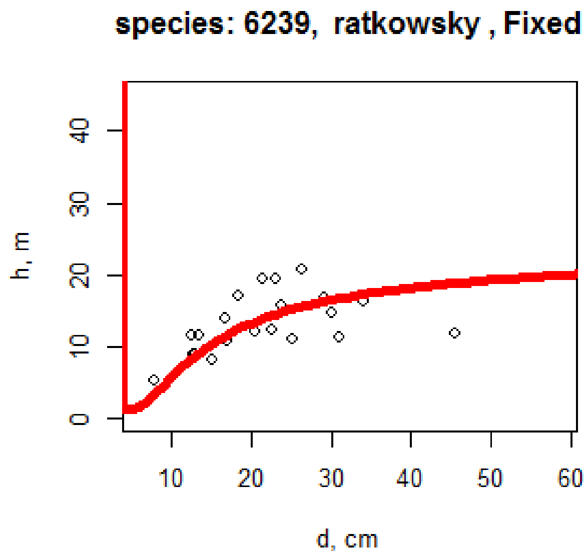
Model = Ratkowsky

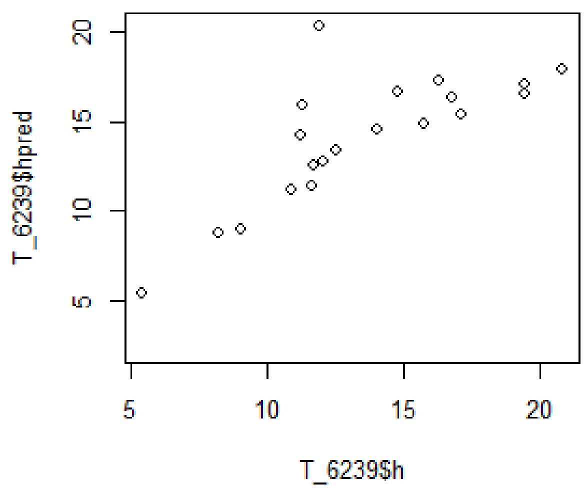
Equation: h(d) = bh + a exp(-b/(d + c))

Parameter	Validity
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a =22.465687 b=10.233322 c=-3.699245	s.e.=2.524 Adj. R^2=0.603 (for mixed model only) F-statistic: 31.37 on 1 and 19 DF, p-value: 2.115e-05 Residuals: min= -1.27 Q1= -0.54 med= -0.23 Q3=0.27 max= 1.64









Botanical name: *Dillenia pentagyna*

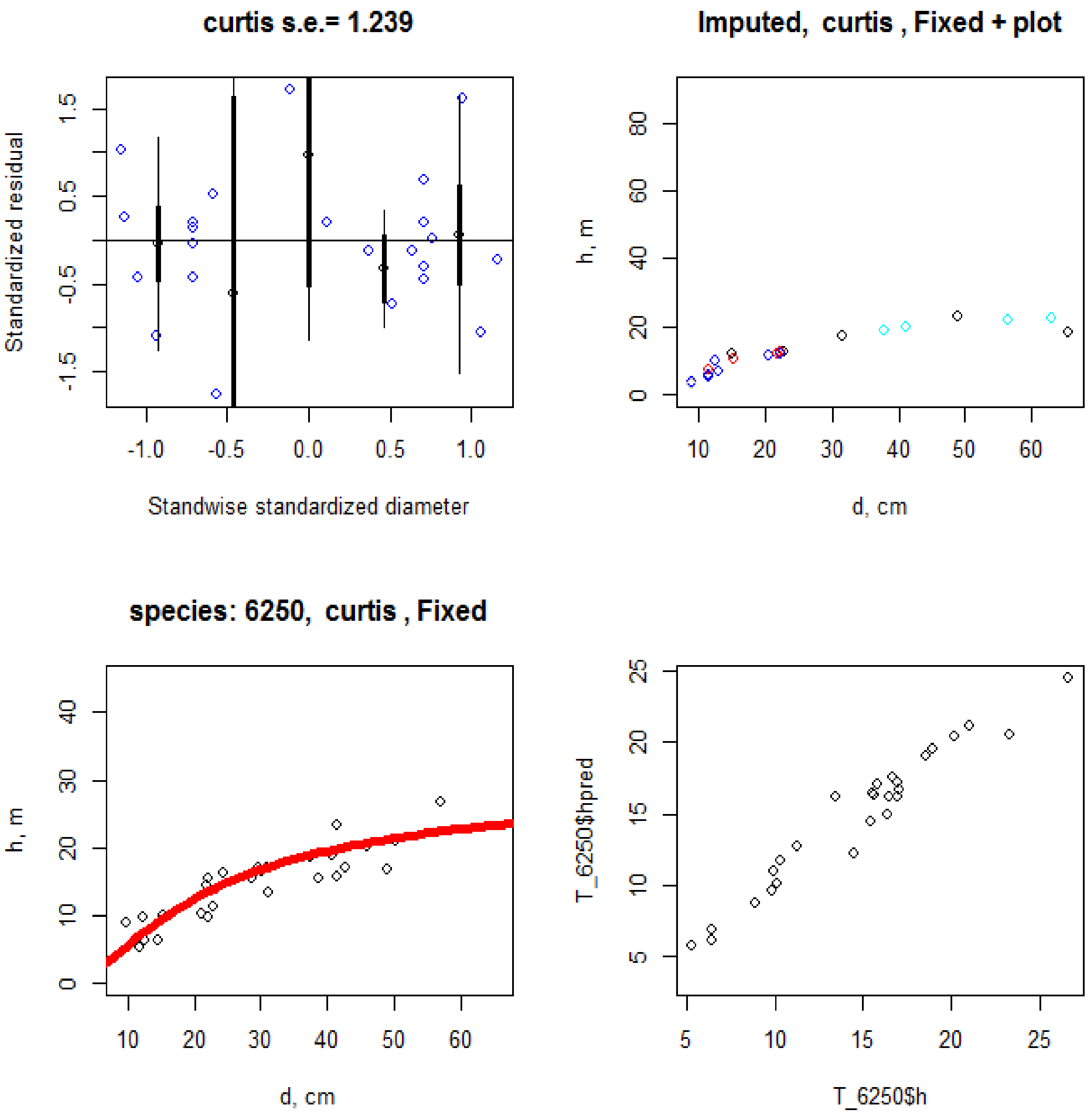
Local name: Tantari, Agai, Chalta

FRA database code: 6250

Model = Curtis

Equation: h(d) = bh + a (d/(1 + d))^b

Parameter	Validity
h(d) = predicted height for dbh 'd' bh = breast height (=1.3) d = diameter at breast height a =30.04399 b=20.15751	s.e.=1.239 Adj. R^2=0.9441 (for mixed model only) F-statistic: 440.2 on 1 and 25 DF, p-value: < 2.2e-16 Residuals: min= -1.76 Q1=-0.45 med= -0.13 Q3=0.23 max= 1.72



Botanical name: *Lagerstroemia parviflora*

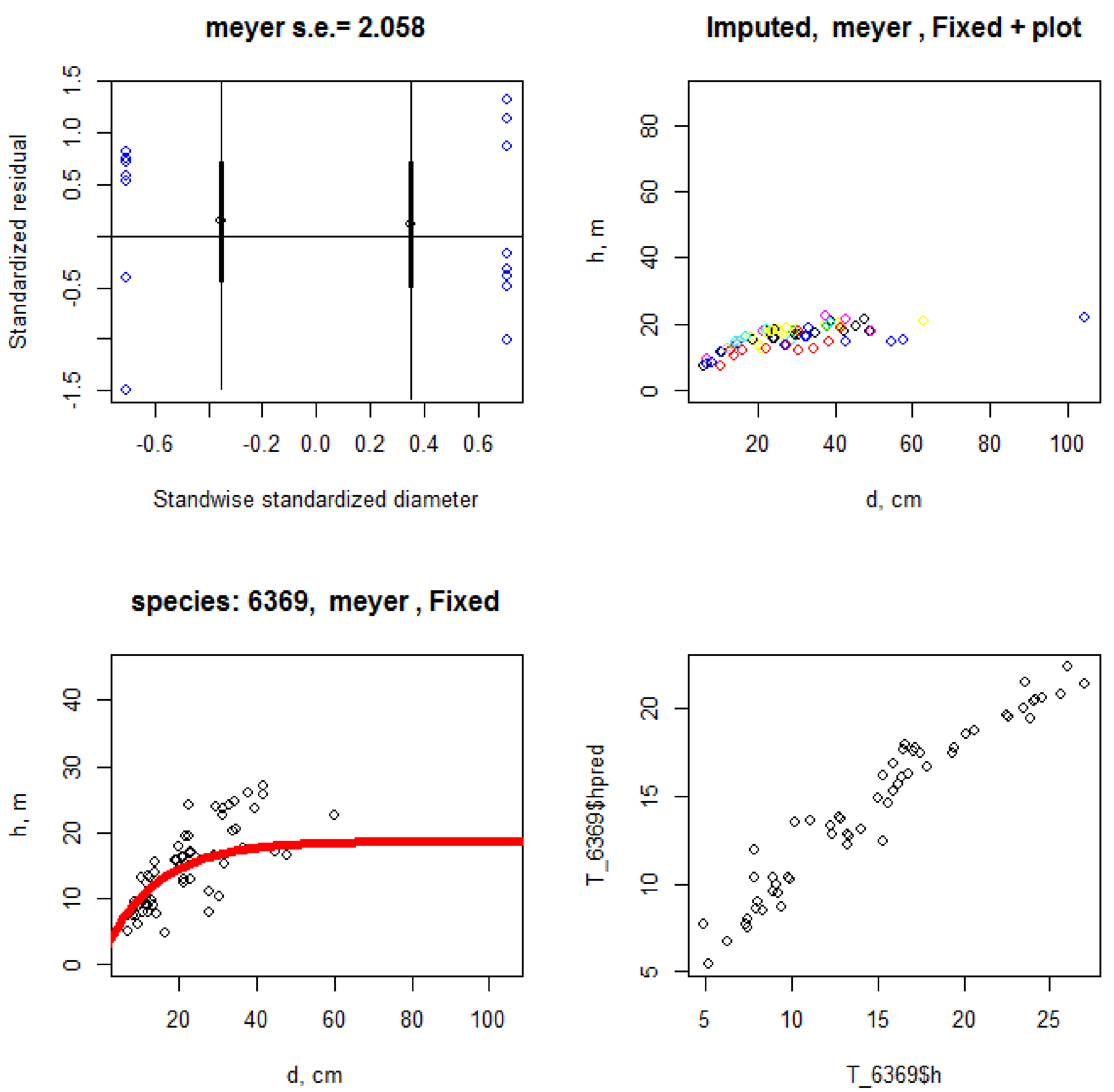
Local name: Bot dhangero, Sidda, Hade

FRA database code: 6369

Model = Meyer

Equation: h(d) = bh + a (1-exp(-b d))

Parameter	**Validity**
h(d) = predicted height for dbh 'd' bh = breast height (=1.3) d = diameter at breast height a =17.38177875 b=0.07197713	s.e.=2.058 Adj. R^2=0.9332 (for mixed model only) F-statistic: 811.1 on 1 and 57 DF, p-value: < 2.2e-16 Residuals: min= -1.49 Q1=-0.37 med= -0.0014 Q3=0.58 max= 1.39



Botanical name: *Lannea coromandelica*

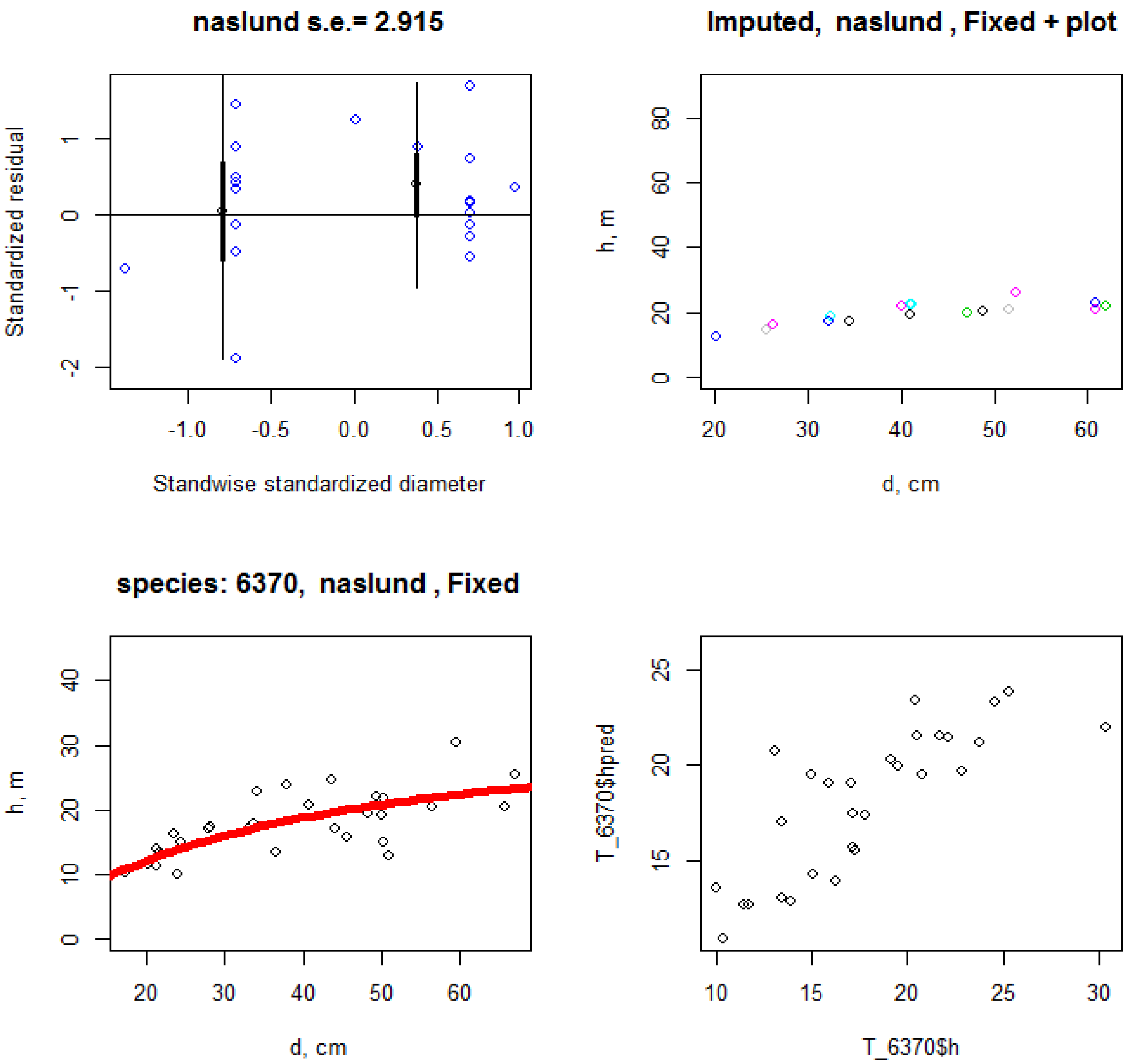
Local name: Dabdabe, Chainchuinge, Hallure, Jhighat

FRA database code: 6370

Model = Naslund

Equation: *h(d) = bh + d^2/(a + b d)^2*

Parameter	**Validity**
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a =2.5859760 b=0.1743985	s.e.=2.915 Adj. R^2=0.6382 (for mixed model only) F-statistic: 50.39 on 1 and 27 DF, p-value: 1.241e-07 Residuals: min= -2.13 Q1= -0.59 med=0.03 Q3=0.49 max= 1.70



Botanical name: *Mallotus philippensis*

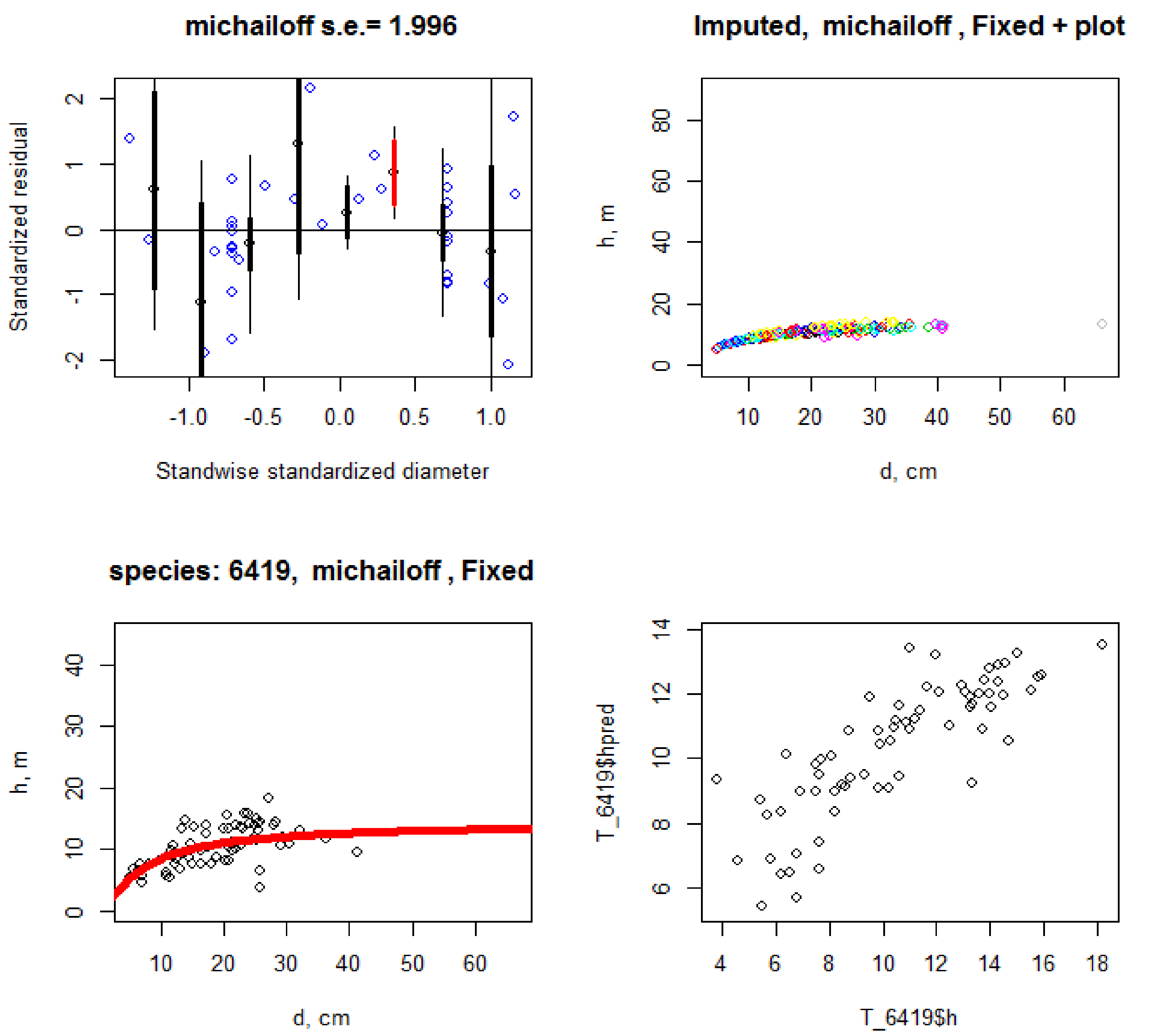
Local name: Sindhure, Rohini

FRA database code: 6419

Model = Michailoff

Equation: h(d) = bh + a e^(-b d^(-1))

Parameter	**Validity**
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a =13.279011 b=6.194178	s.e.=1.996 Adj. R^2=0.6751 (for mixed model only) F-statistic: 140.2 on 1 and 66 DF, p-value: < 2.2e-16 Residuals: min= -2.08 Q1=-0.45 med= -0.02 Q3=0.65 max= 2.15



Botanical name: *Mangifera indica*

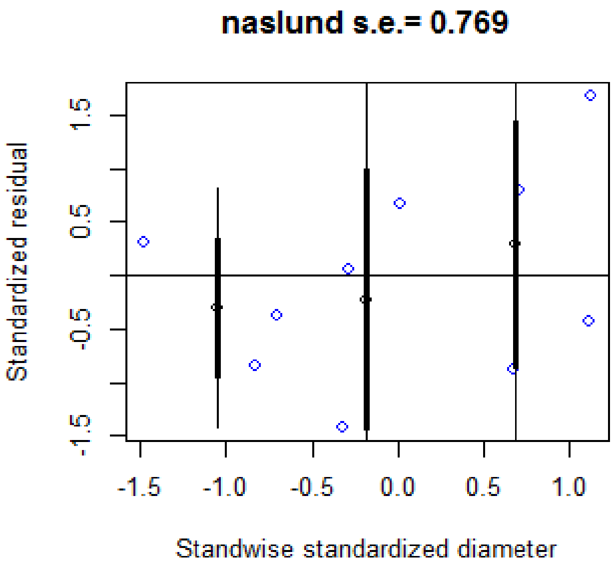
Local name: Aanp

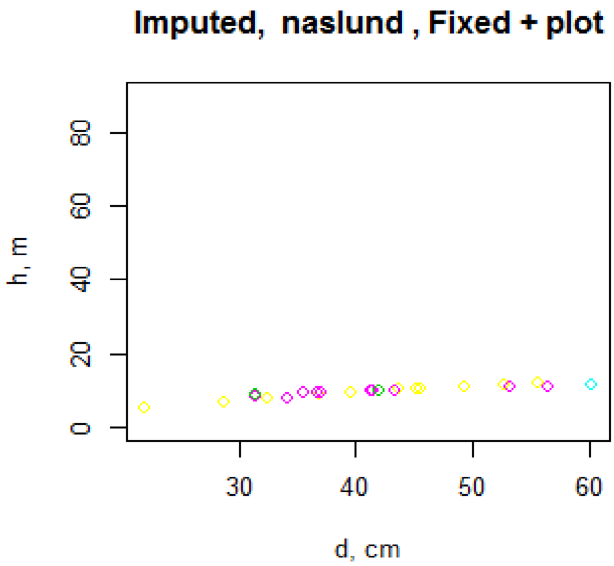
FRA database code: 6425

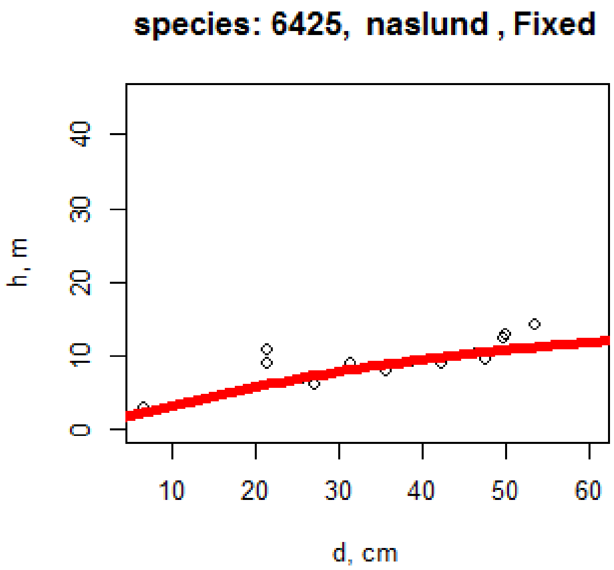
Model = Naslund

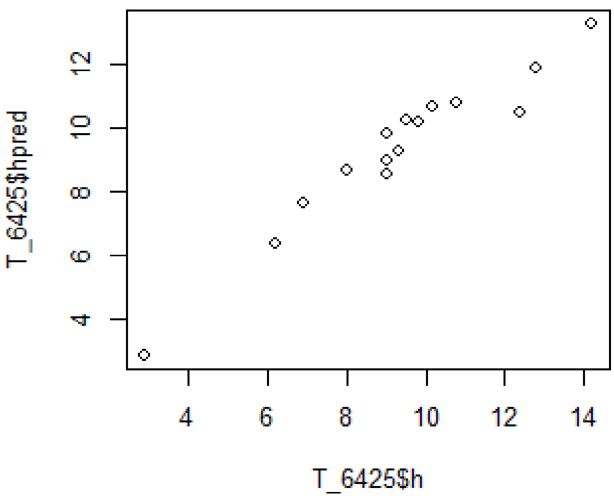
Equation: h(d) = bh + d^2/(a + b d)^2

Parameter	**Validity**
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a = 4.9306301 b= 0.2251841	s.e.=0.769 Adj. R^2=0.9251 (for mixed model only) F-statistic: 174 on 1 and 13 DF, p-value: 6.655e-09 Residuals: -min=1.42 Q1= -0.55 med=0.061 Q3=0.49 max=1.68









Botanical name: *Schleichera oleosa*

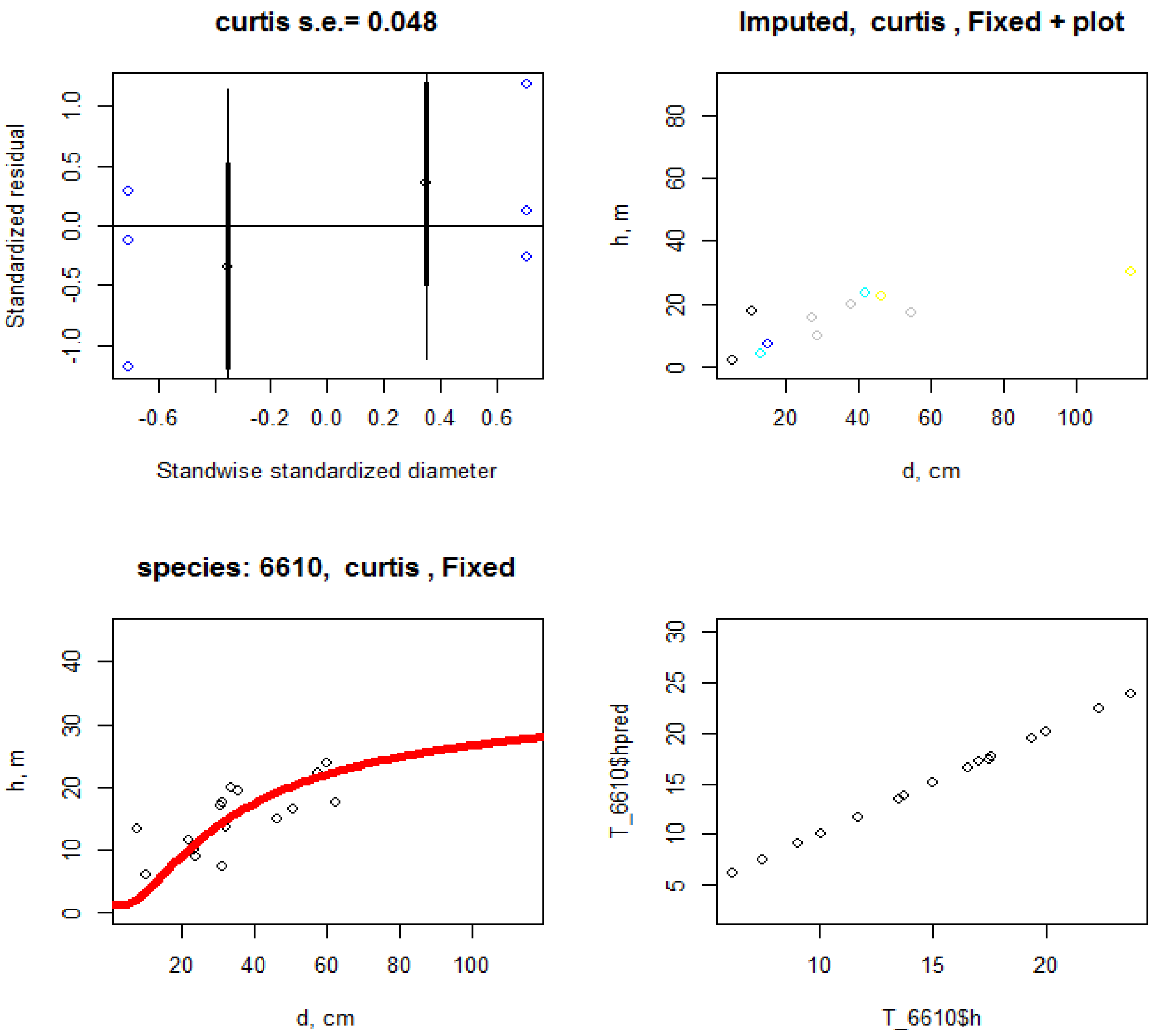
Local name: Kusum, Gosum

FRA database code: 6610

Model = Curtis

Equation: h(d) = bh + a (d/(1 + d))^b

Parameter	**Validity**
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a =34.56165 b=30.81776	s.e.=0.048 Adj. R^2=0.9999 (for mixed model only) F-statistic: 1.631e+05 on 1 and 14 DF, p-value: < 2.2e-16 Residuals: min= -1.18 Q1=-0.041 med= -0.006 Q3=0.02 max= 1.19



Botanical name: *Syzygium cumini*

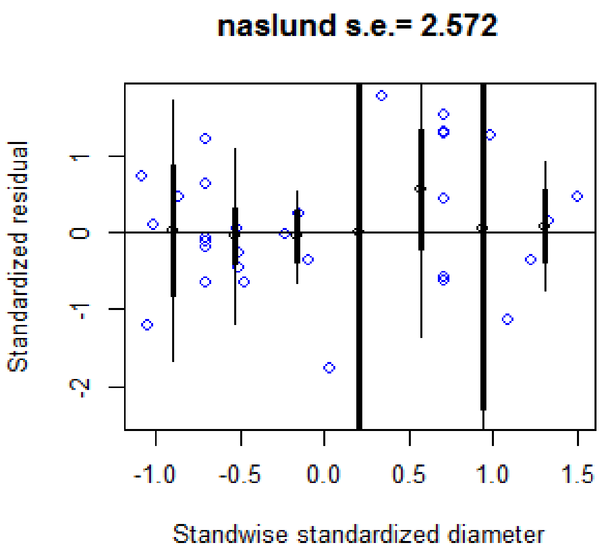
Local name: Jamun, Jamuno

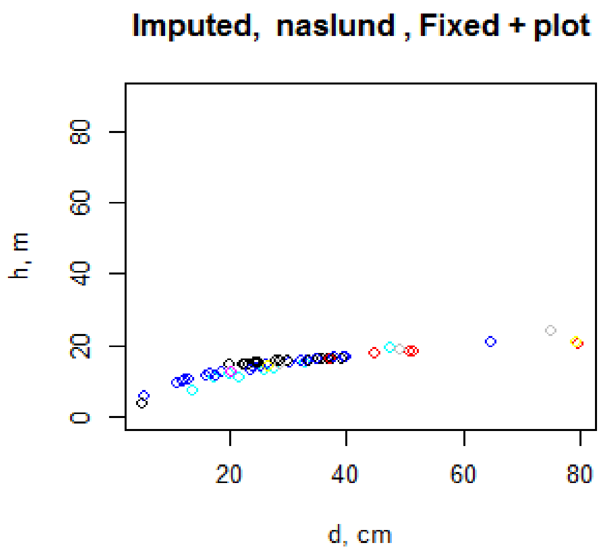
FRA database code: 6651

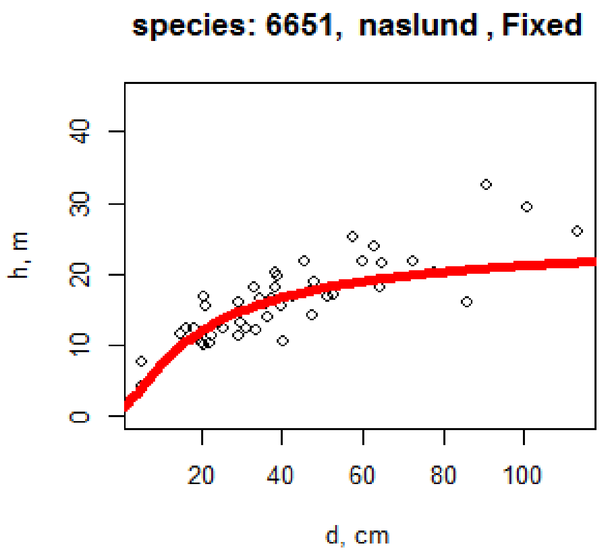
Model = Naslund

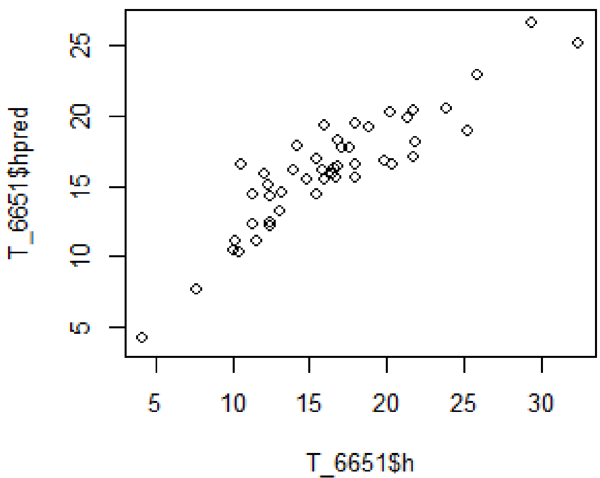
Equation: h(d) = bh + d^2/(a + b d)^2

Parameter	Validity
h(d) = predicted height for dbh 'd' bh = breast height (=1.3) d = diameter at breast height a =2.0245401 b=0.2038471	s.e.=2.572 Adj. R^2=0.8013 (for mixed model only) F-statistic: 186.5 on 1 and 45 DF, p-value: < 2.2e-16 Residuals: min= -2.39 Q1=-0.52 med= 0.012 Q3=0.46 max=1.77









Botanical name: *Terminalia alata*

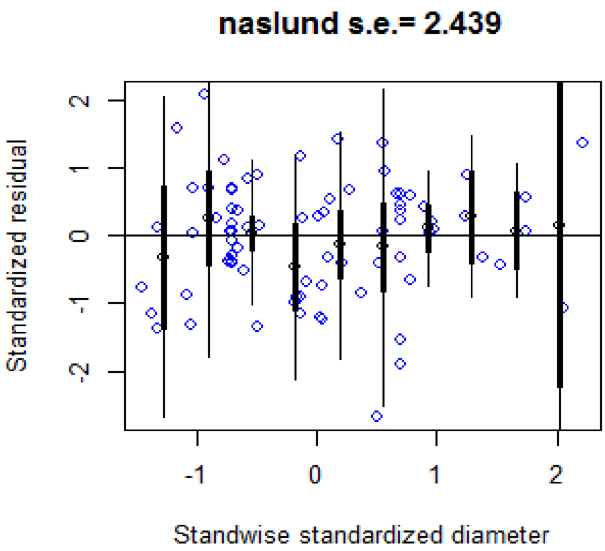
Local name: Asna, Saaj, Yasal

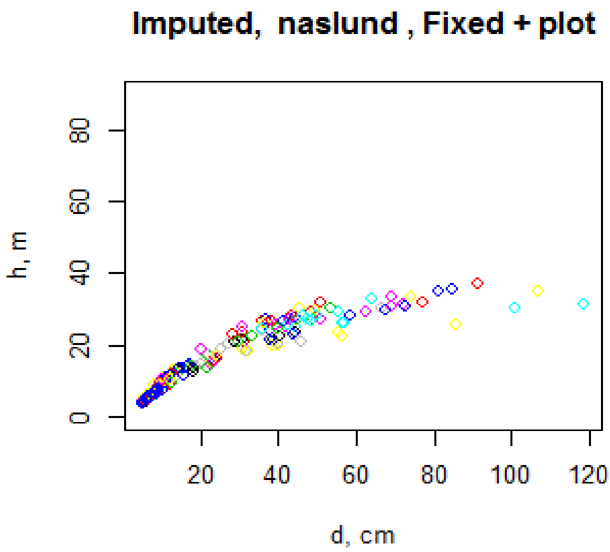
FRA database code: 6660

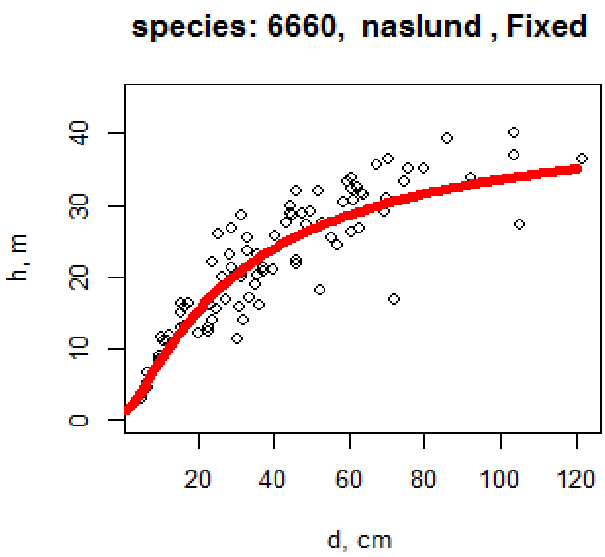
Model = Naslund

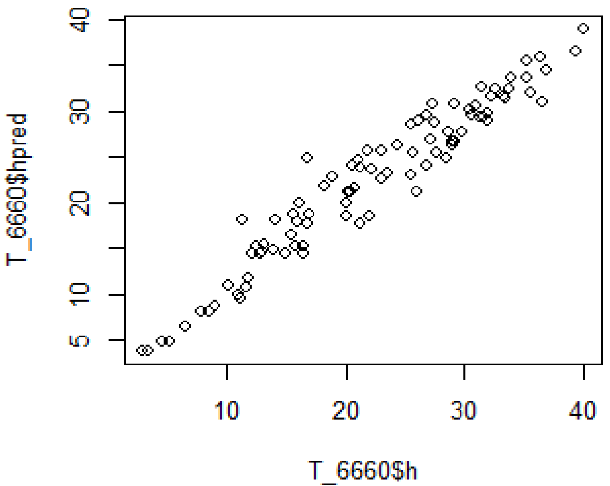
Equation: h(d) = bh + d^2/(a + b d)^2

Parameter	Validity
h(d) = predicted height for dbh 'd' bh = breast height (=1.3) d = diameter at breast height a =2.2859701 b=0.1529833	s.e.=2.439 Adj. R^2=0.9313 (for mixed model only) F-statistic: 1207 on 1 and 88 DF, p-value: < 2.2e-16 Residuals: min= -2.67 Q1=-0.67 med=0.06 Q3=0.56 max=2.09









Botanical name: *Terminalia bellirica*

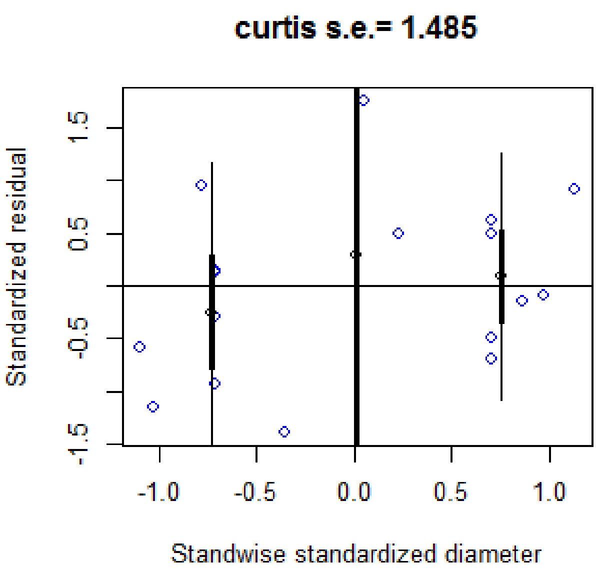
Local name: Barro, Barai, Bahera

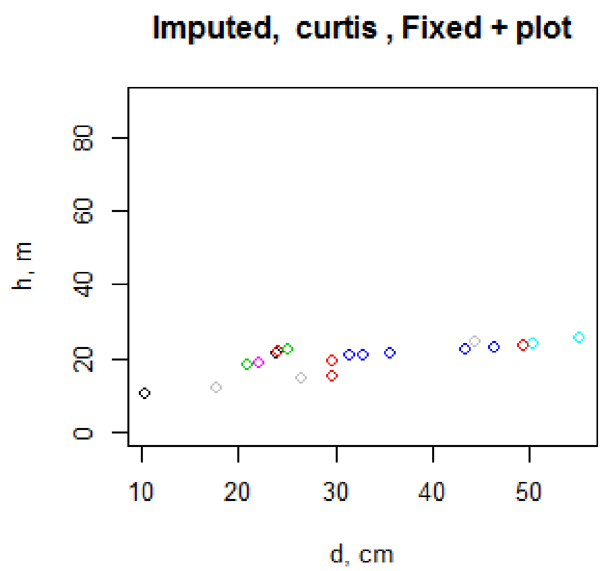
FRA database code: 6662

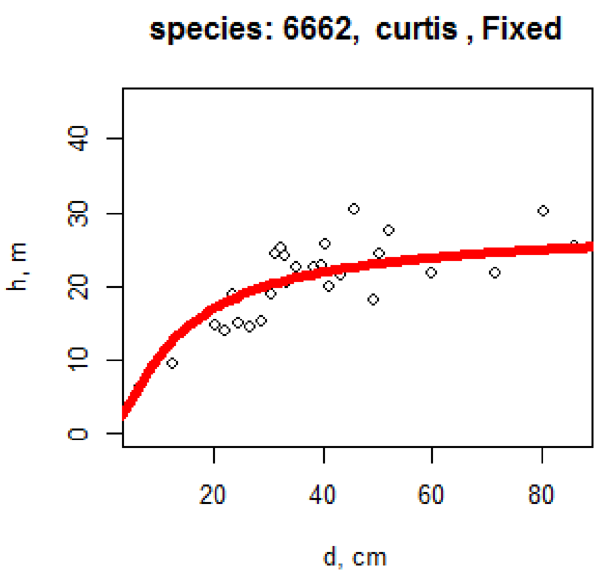
Model = Curtis

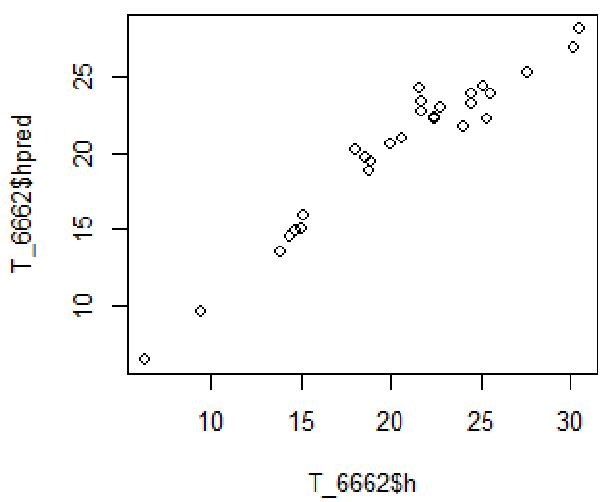
Equation: h(d) = bh + a (d/(1 + d))^b

Parameter	Validity
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a =27.27914 b=11.29984	s.e.=1.485 Adj. R^2=0.9371 (for mixed model only) F-statistic: 403.5 on 1 and 26 DF, p-value: < 2.2e-16 Residuals: min= -1.38 Q1=-0.34 med=0.08 Q3=0.53 max=1.76









Botanical name: *Trewia nudiflora*

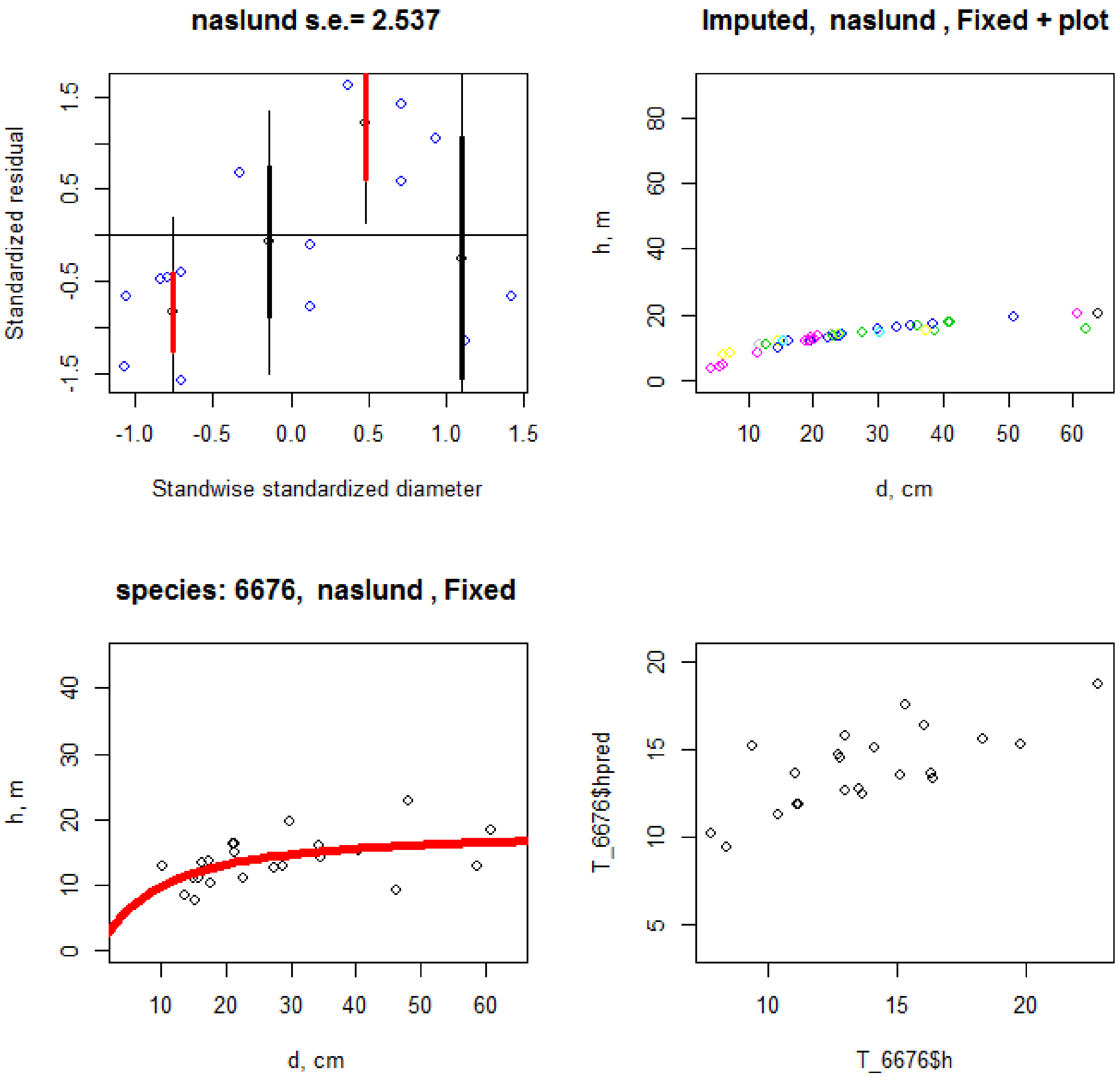
Local name: Bhelor, Gutel, Pitha, Ramrittha

FRA database code: 6676

Model = Naslund

Equation: h(d) = bh + d^2/(a + b d)^2

Parameter	Validity
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a =1.0270802 b=0.2388778	s.e.=2.537 Adj. R^2=0.5075 (for mixed model only) F-statistic: 22.64 on 1 and 20 DF, p-value: 0.00012 Residuals: min= -1.57 Q1=-0.66 med= -0.35 Q3=0.65 max=1.63



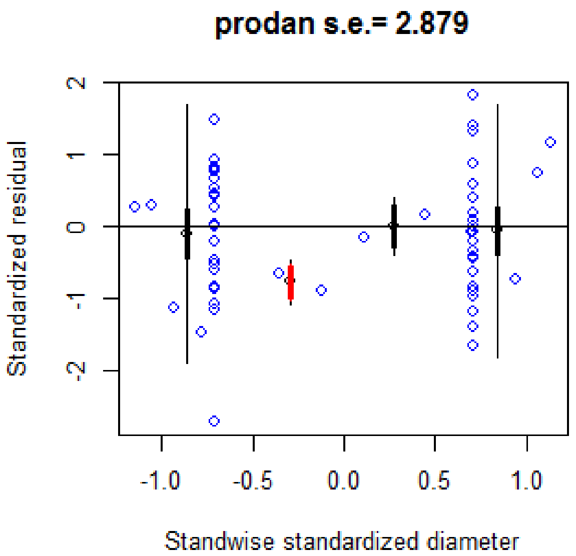
Group 1

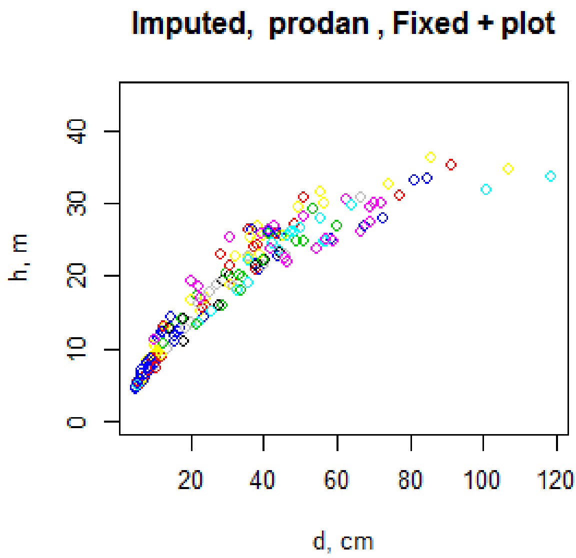
FRA Database code	Botanical name	Local name
6664	*Terminalia chebula*	Harro
6089	*Adina cordifolia*	Haldu
6139	*Bombax ceiba*	Simal

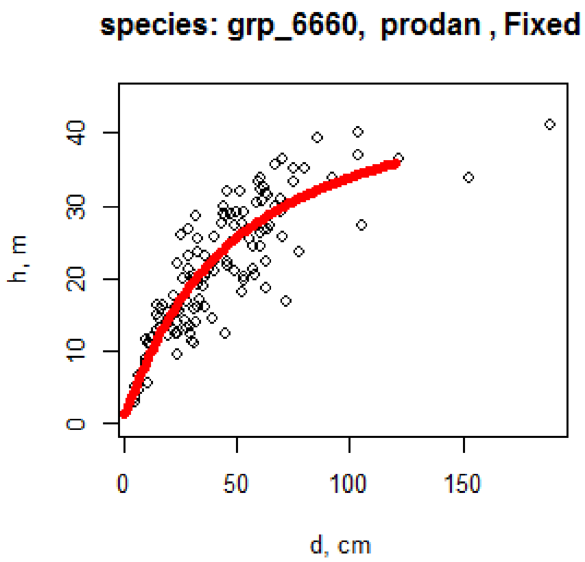
Model = Prodan (grp_6660)

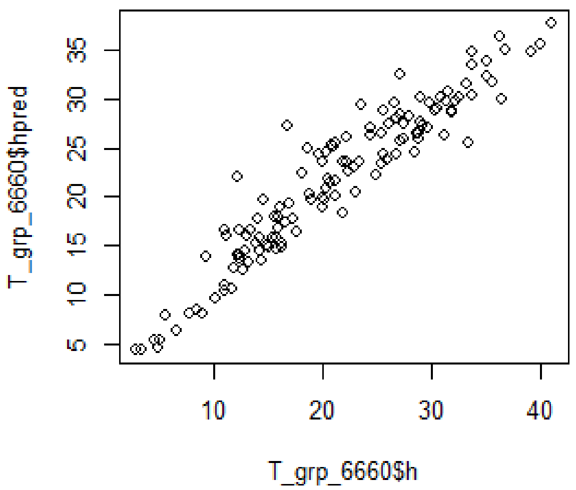
Equation: h(d) = bh + d^2/(a + bd + c d^2)

Parameter	Validity
h(d) = predicted height for dbh 'd' bh = breast height (=1.3) d = diameter at breast height a =2.54385959 b=0.97132460 c=0.02066396	s.e.=2.879 Adj. R^2=0.8982 (for mixed model only) F-statistic: 1121 on 1 and 126 DF, p-value: < 2.2e-16 Residuals: min= -2.71 Q1=-0.68 med= -0.031 Q3=0.41 max=1.83









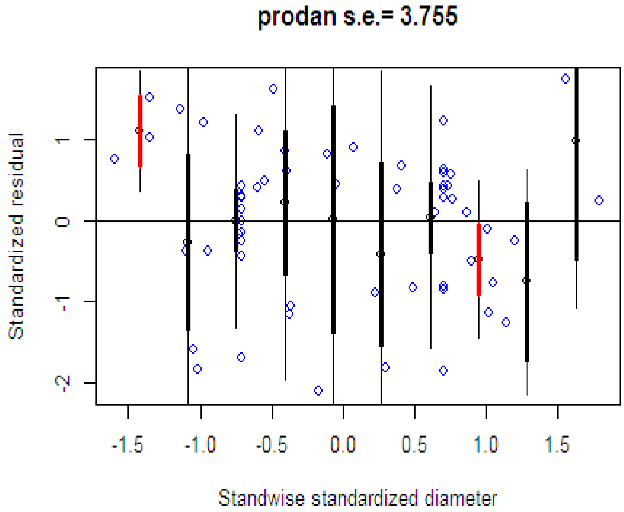
Group 2

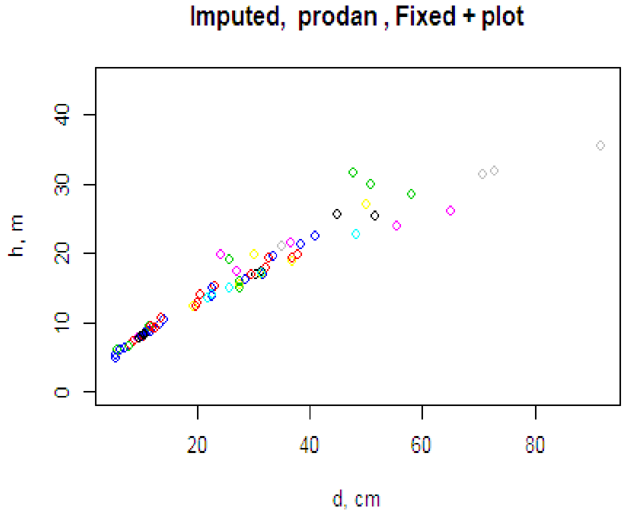
Model: Prodan (grp_6113)

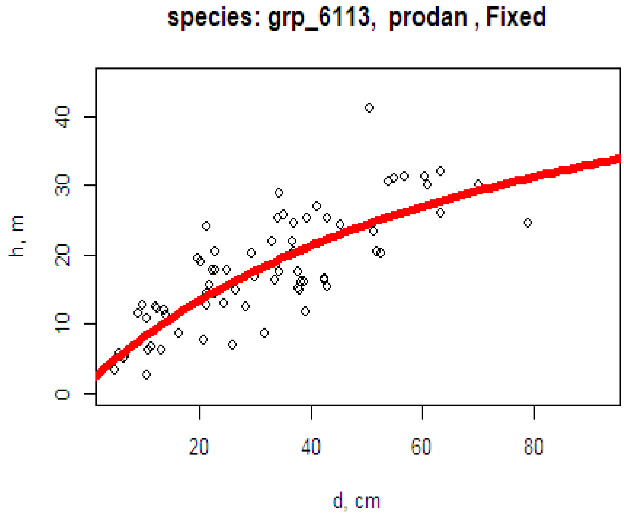
Equation: h(d) = bh + d^2/(a + bd + c d^2)

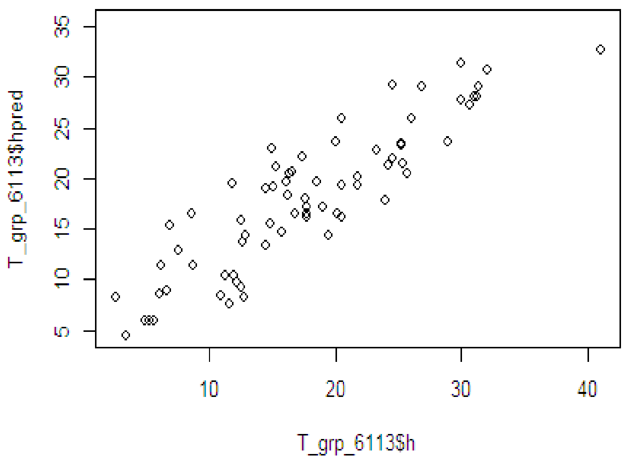
FRA Database Code	Botanical Name	Local Name
6259	*Diosyprus tomentosa.*	Bidipat
6470	*Ochna obtusata*	
6163	*Carissa carandas*	Karonda
6115	*Aporusa octandra*	Hade

Parameter	Validity
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a = -0.15073359 b = 1.33425940 c=0.01674942	s.e.=3.755 Adj. R^2= 0.7854 (for mixed model only) F-statistic: 257.2 on 1 and 69 DF, p-value: < 2.2e-16 Residuals: min= -2.11 Q1=-0.79 med=0.09 Q3=0.59 max= 1.74









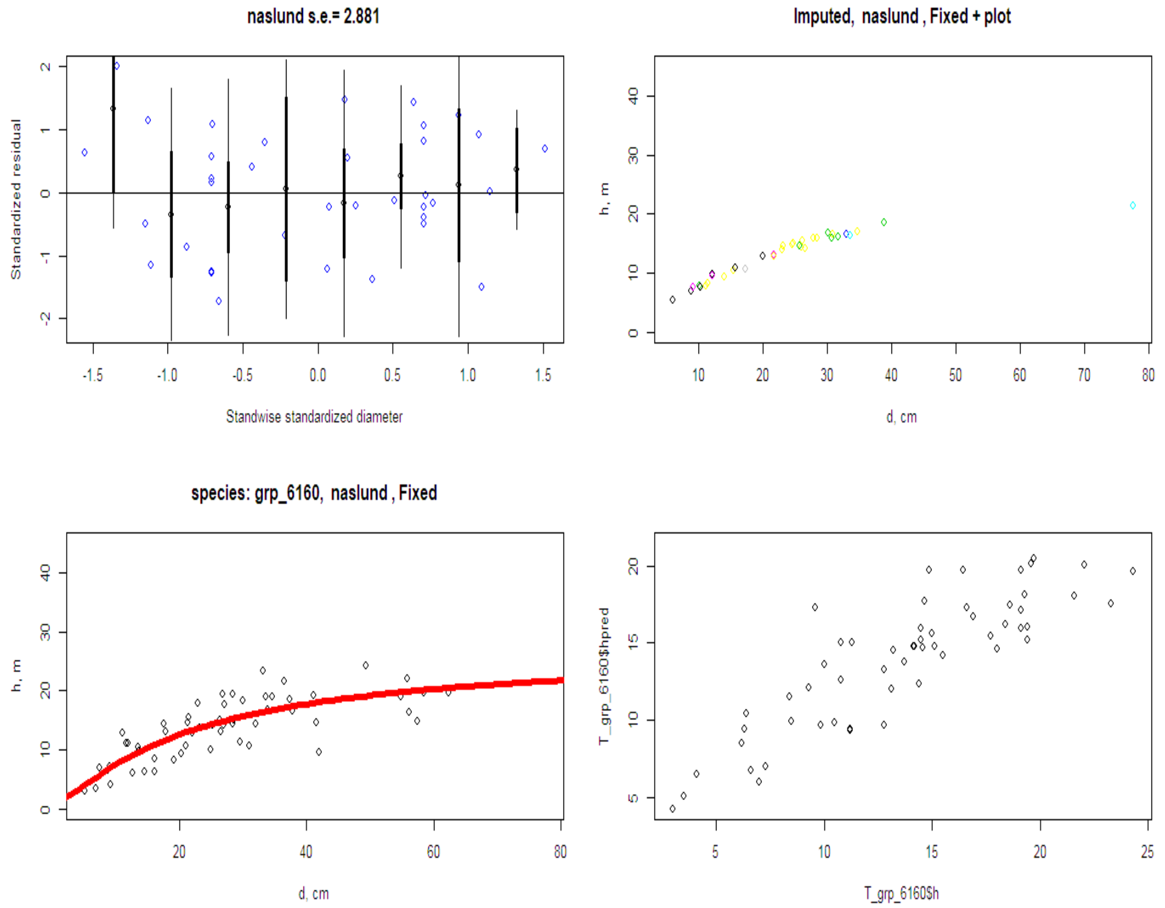
Group 3

Model: Naslund (grp_6160)

Equation: h(d) = bh + d^2/(a + b d)^2

FRA Database Code	Botanical Name	Local Name
6160	*Careya arborea*	Kumbhi, Kuma, Bodar
6153	*Butea monosperma*	Palans
6266	*Ehretia acuminata*	Loro
6639	*Stereospermum personatum*	Pandari
6632	*Spondias pinnata*	Amaro
6611	*Semecarpus anacardium*	Bhalayo
6412	*Madhuca longifolia*	Mahauwa
6335	*Gardneria angustifotia*	Dabdabe
6337	*Gmelina arborea*	Khamari
6290	*Eucalyptus camaldulensis*	Masala
6114	*Anthocephalus chinensis*	Kadam

Parameter	Validity
h(d) = predicted height for dbh ‘d’	s.e.=2.881
bh = breast height (=1.3)	Adj. R^2= 0.7421 (for mixed model only)
d = diameter at breast height	F-statistic: 159.3 on 1 and 54 DF, p-value: < 2.2e-16
a = 2.0331571 b=0.1954669	Residuals: min= -2.22 Q1= -0.81
	med= -0.093 Q3=0.58 max= 1.99

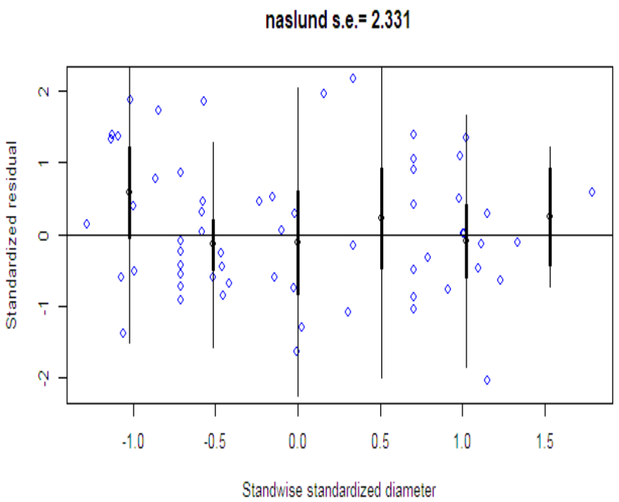


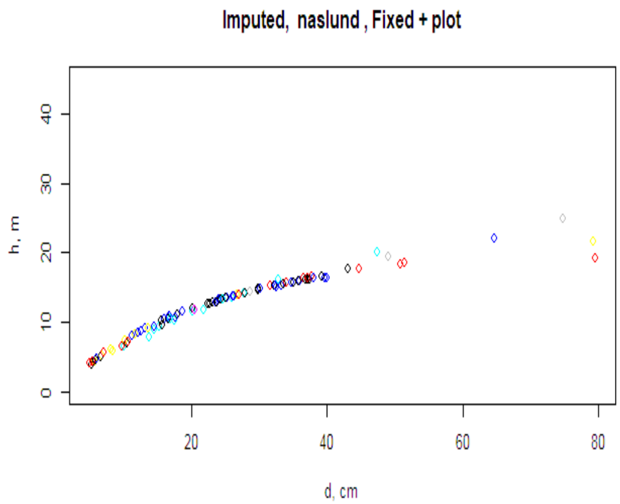
Group 4
Model: Naslund (grp_6207)

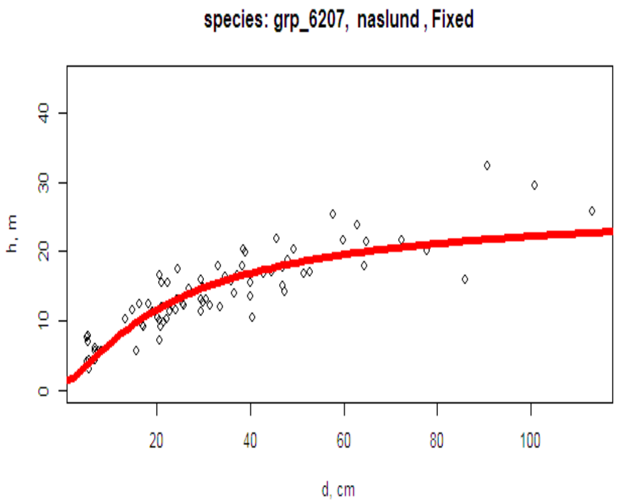
Equation: h(d) = bh + d^2/(a + b d)^2

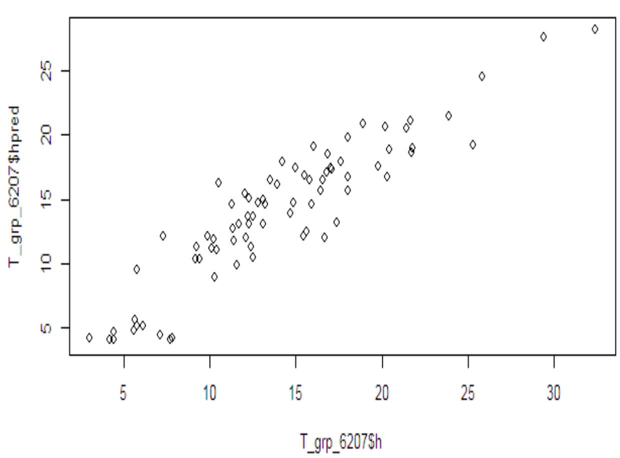
Database Code	**Botanical Name**	**Local Name**
6695	*Xeromphis spinosa*	Main kada
6097	*Alangium chinensis*	Bamanpati
6126	*Bauhinia malabarica*	Khatuwa
6469	*Nyctanthes arbortristis*	Parijat
6507	*Phyllanthus emblica*	Amala

Parameter	**Validity**
h(d) = predicted height for dbh 'd' bh = breast height (=1.3) d = diameter at breast height a =2.2948641 b=0.1956261	s.e.=2.331 Adj. R^2= 0.8406 (for mixed model only) F-statistic: 401.8 on 1 and 75 DF, p-value: < 2.2e-16 Residuals: min -2.19 Q1=-0.61 med= -0.096 Q3=0.57 max= 2.18







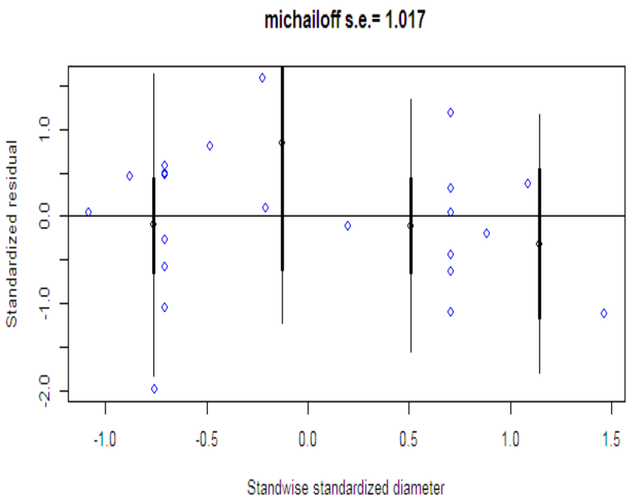


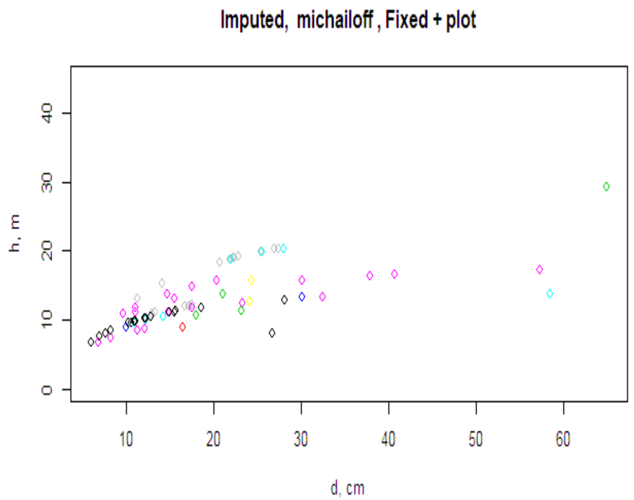
Group 5
Model: Michailoff (grp_6239)

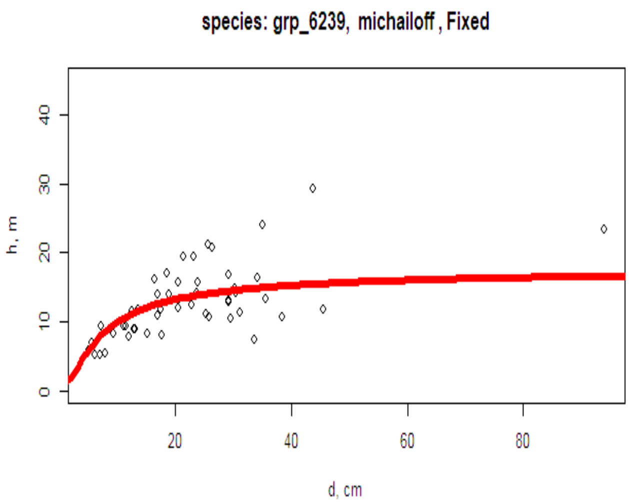
Equation: bh + a e^(-b d^(-1))

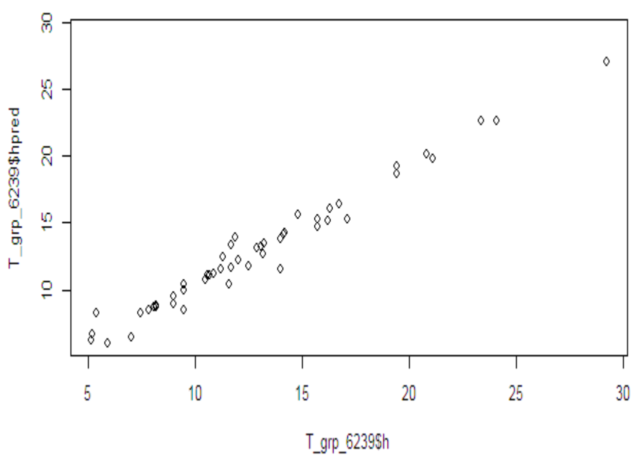
Database Code	Botanical Name	Local Name
6235	*Dalbergia latifolia*	Satisal
6104	*Albizia procera*	Seto Siris
6549	*Pterocarpus marsupium*	Bijayasal
6465	*Neolitsea umbrosa*	Khapate
6602	*Sapium insigne*	Khirro
6659	*Tectona grandis*	Teak

Parameter	Validity
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a = 16.406742 b=6.268887	s.e.=1.017 Adj. R^2 = 0.9705(for mixed model only) F-statistic: 1578 on 1 and 47 DF, p-value: < 2.2e-16 Residuals: min -1.98 Q1= -0.35 med= -0.062 Q3= 0.39 max= 1.58









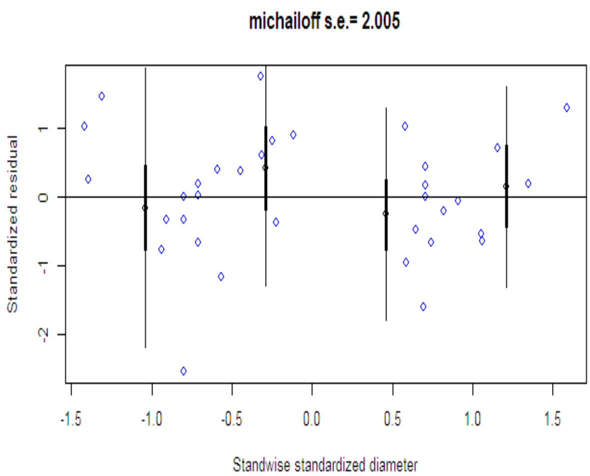
Group 6

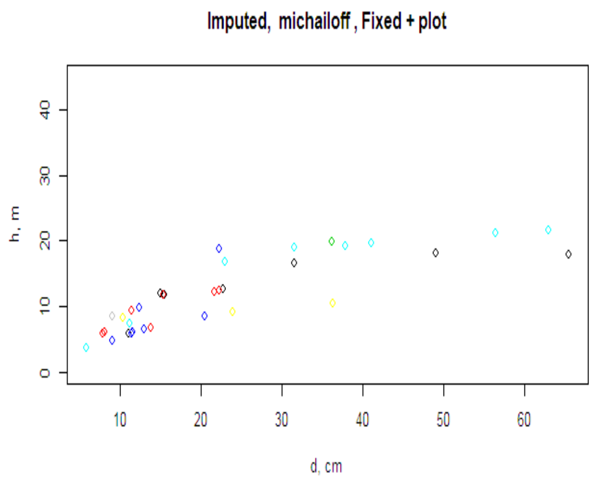
Model: Michailoff (grp_6250)

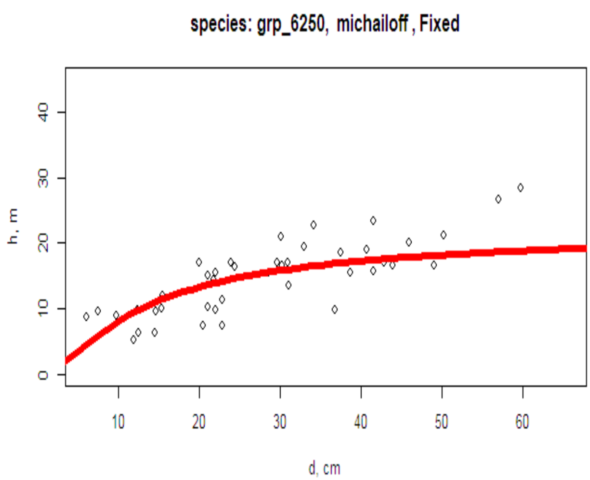
Equation: bh + a e^(-b d^(-1))

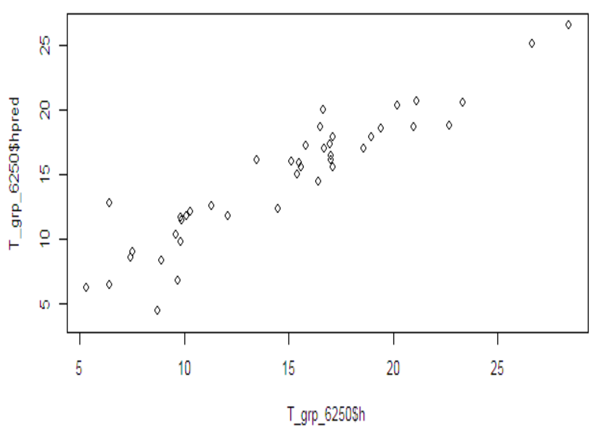
Database Code	Botanical Name	Local Name
6127	*Bauhinia malabarica*	Tanki
6701	*Zizyphus mauritiana*	Bayar
6172	*Cassia fistula*	Raj Brikchhya
5556	*Morus australis*	Kimbu
5160	*Debregeasia salicifolia*	Dar
6028	*Wendlandia coriacea*	Kagiyo
6375/6503	*Ligustrum confusum*	Kanike phool
6065	*Acacia nilotica*	Babul, Kikar, Babur, Jharkat

Parameter	Validity
h(d) = predicted height for dbh 'd'	s.e.=2.005
bh = breast height (=1.3)	Adj. R^2= 0.8674 (for mixed model only)
d = diameter at breast height	F-statistic: 269.3 on 1 and 40 DF, p-value: < 2.2e-16
a = 21.28088 b= 11.39737	Residuals: min = -2.55 Q1=-0.53 med= -0.005 Q3=0.57 max= 1.76









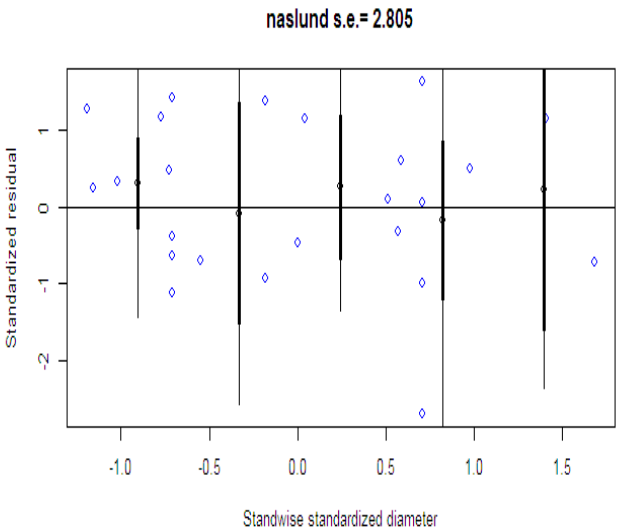
Group 7

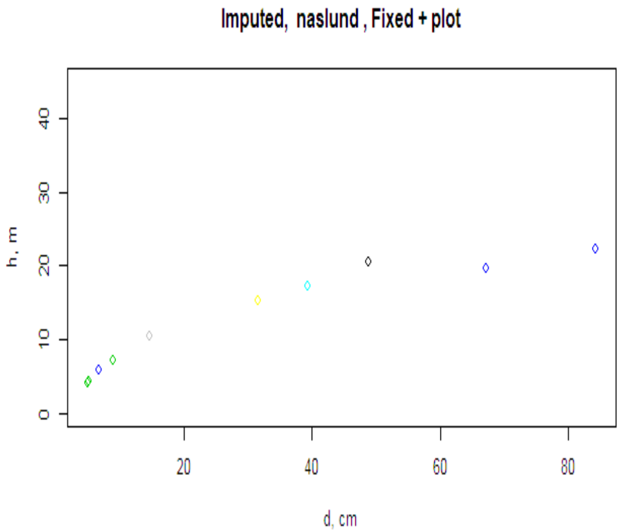
Model: Naslund (grp_6349)

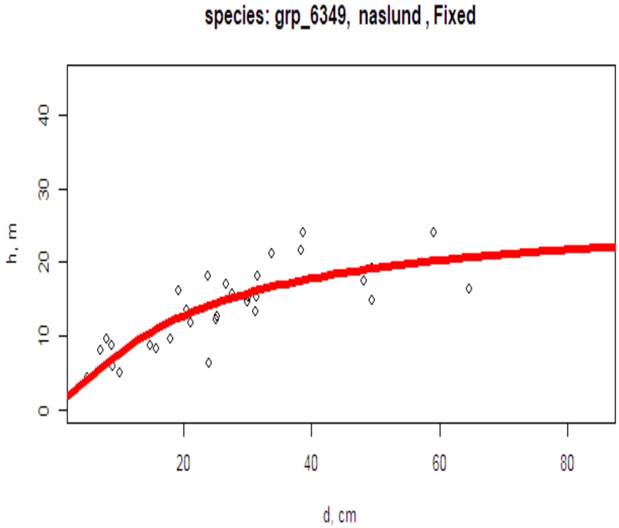
Equation: h(d) = bh + d^2/(a + b d)^2

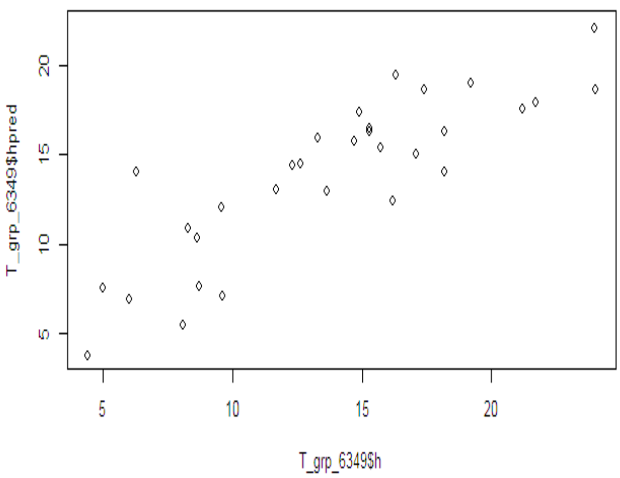
Database Code	**Botanical Name**	**Local Name**
6256	*Diospyros malabarica*	Tendu
6446	*Miliusa velutina*	Karyauta
6349	*Hymenodictyon excelsum*	

Parameter	**Validity**
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a = 1.9820443 b=0.1962487	s.e.=2.805 Adj. R^2= 0.7234 (for mixed model only) F-statistic: 79.47 on 1 and 29 DF, p-value: 8.368e-10 Residuals: min = -2.70 Q1=-0.70 med= -0.31 Q3=0.65 max= 1.63









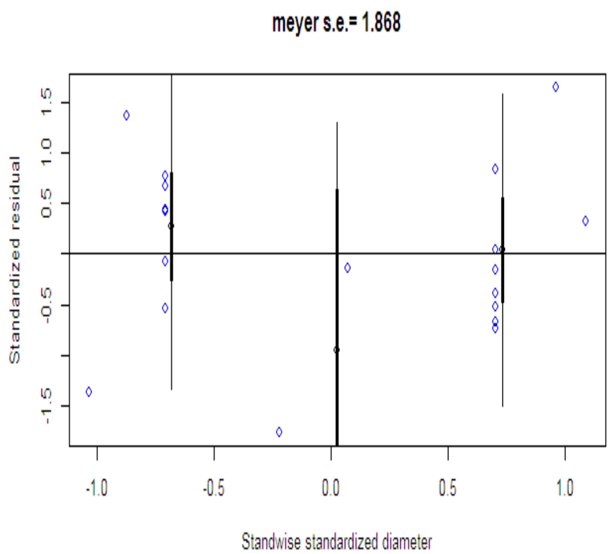
Group 8

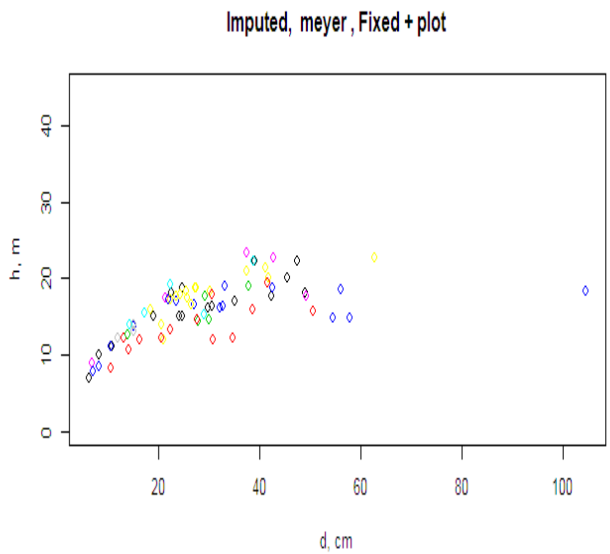
Model: Meyer (grp_6369)

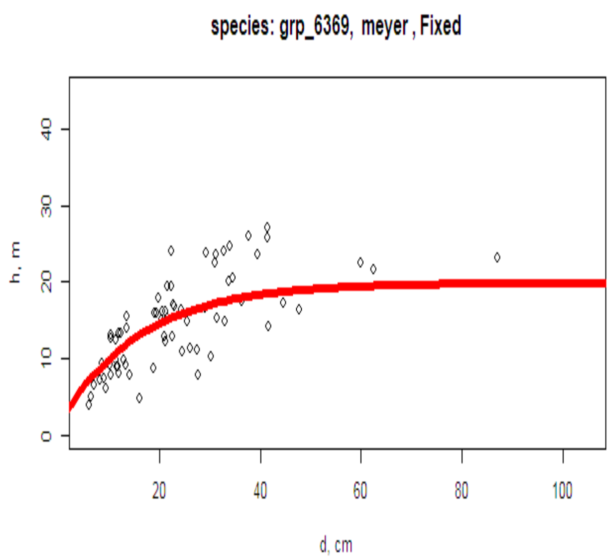
Equation: h(d) = bh + a (1-exp(-b d))

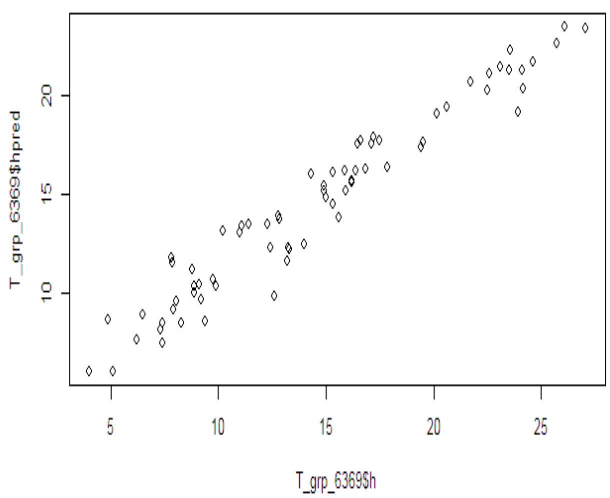
Database Code	Botanical Name	Local Name
6299	*Exbucklandia populnea*	Piple
6221	*Cornus oblonga*	Latikath
6526	*Populus jacquemontiana*	Lahare Peepal
6265	*Dysoxylum gobara*	Dhanmina
5447	*Leucaena leucocephala*	Ipil Ipil

Parameter	Validity
h(d) = predicted height for dbh 'd'	s.e.=1.868
bh = breast height (=1.3)	Adj. R^2= 0.9406 (for mixed model only)
d = diameter at breast height	F-statistic: 1094 on 1 and 68 DF, p-value: < 2.2e-16
a = 18.64649755 b=0.06211236	Residuals: min = -1.77 Q1=-0.50
	med= -0.05 Q3=0.44 max= 1.65









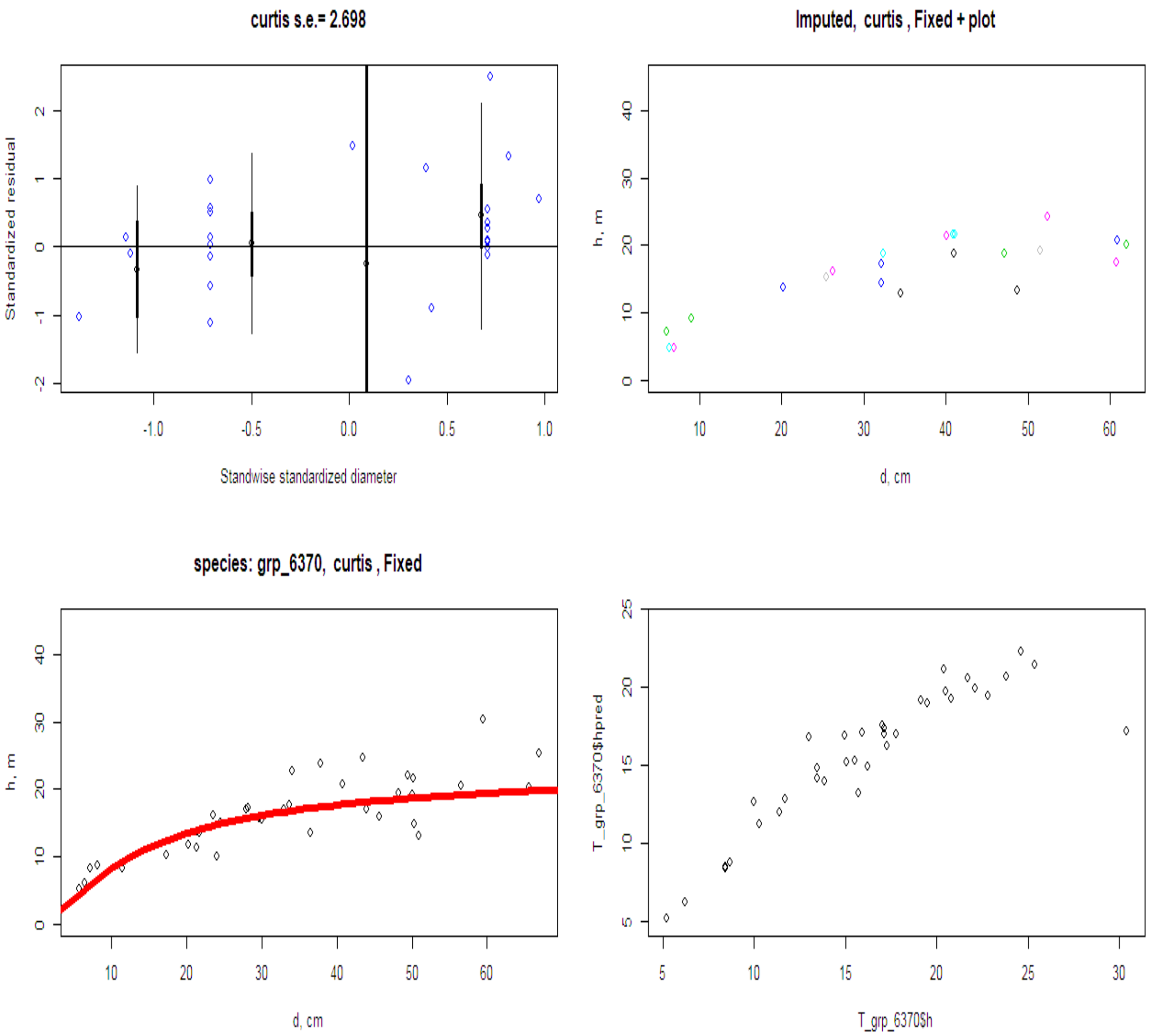
Group 9

Model: Curtis (grp_6370)

Database Code	Botanical Name	Local Name
6168	*Casearia elliptica*	Thulo Deri, Sano Bethe
6367	*Kydia calycina*	Bori
6264	*Dysoxylum binectariferum*	Sano Dhamina

Parameter	Validity
h(d) = predicted height for dbh 'd'	s.e.=2.698
bh = breast height (=1.3)	Adj. R^2= 0.7879 (for mixed model only)
d = diameter at breast height	F-statistic: 132.5 on 1 and 34 DF, p-value: 2.86e-13
a = 22.21654 b=12.25755	Residuals: min = -1.96 Q1=-0.22
	med=0.053 Q3=0.51 max= 2.49

Equation: h(d) = bh + a (d/(1 + d))^b



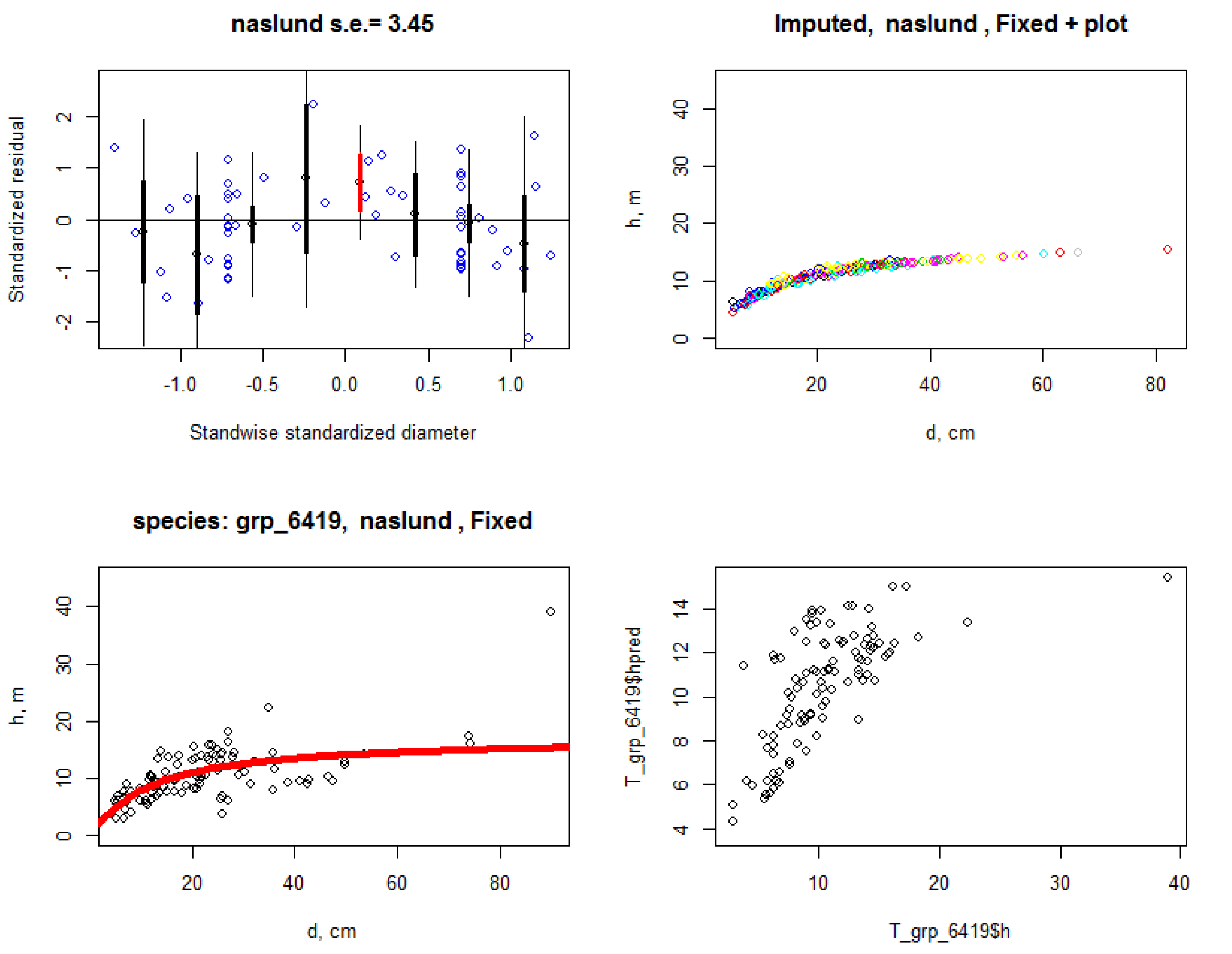
Group 10

Model: Naslund (grp_6419)

Database Code	Botanical Name	Local Name
6548	*Psidium guajava*	Belauti, Amba
4848	*Ardisia solanacea*	Lwanthi
6301	*Feronia limonia*	Kentho
6170	*Casearia graveolens*	Badkaule
6039	*Woodfordia fruticosa*	Dhairo
6411	*Madhuca latifolia*	Lati mauwa

Equation: h(d) = bh + d^2/(a + b d)^2

Parameter	Validity
h(d) = predicted height for dbh 'd'	s.e.=3.45
bh = breast height (=1.3)	Adj. R^2= 0.4377 (for mixed model only)
d = diameter at breast height	F-statistic: 81.18 on 1 and 102 DF, p-value: 1.259e-14
a = 1.4122892 b= 0.2507964	Residuals: min = -2.31 Q1=-0.76
	med= -0.067 Q3=0.50 max=2.71



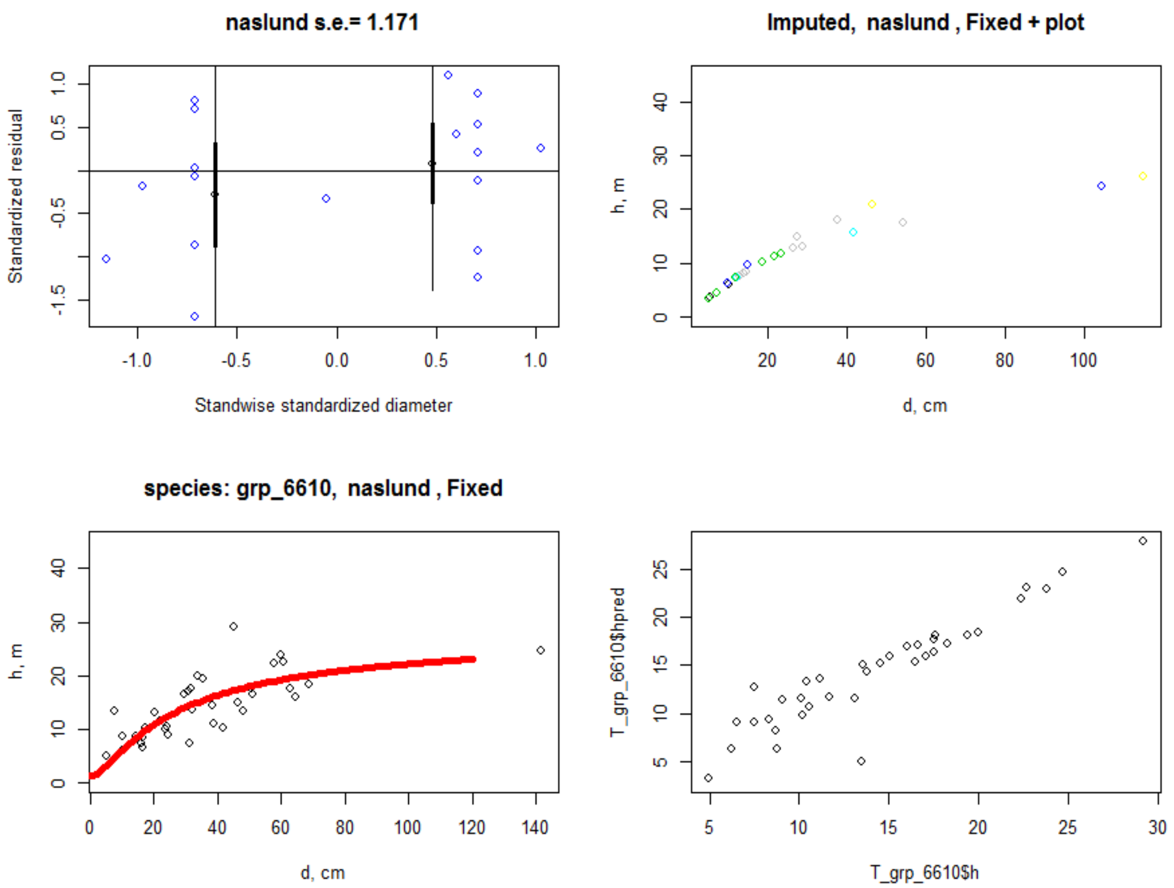
Group 11

Model: Naslund (grp_6610)

Equation: h(d) = bh + d^2/(a + b d)^2

Database Code	**Botanical Name**	**Local Name**
6090	*Aegle marmelos*	Bel
6123	*Azadirachta indica*	Neem
6202	*Citrus maxima*	Bhogate
6287	*Erythrina stricta*	Phaledo
6428	*Melia azedarach*	Bakaino
6613	*Sesbania grandiflora*	Agasti
6669	*Toona ciliata*	Tooni
6109	*Alstonia scholaris*	Chhatiwan
6448	*Mitragyna parviflora*	Tikul
6398	*Litsea glutinosa*	Hadchur
6401	*Litsea monopetala*	Kutmiro

Parameter	**Validity**
h(d) = predicted height for dbh 'd' bh = breast height (=1.3) d = diameter at breast height a = 2.6023047 b=0.1925751	s.e.=1.171 Adj. R^2 = 0.8626 (for mixed model only) F-statistic: 220.8 on 1 and 34 DF, p-value: < 2.2e-16 Residuals: min -2.23 Q1=-0.41 med=-0.021 Q3=0.49 max=2.24



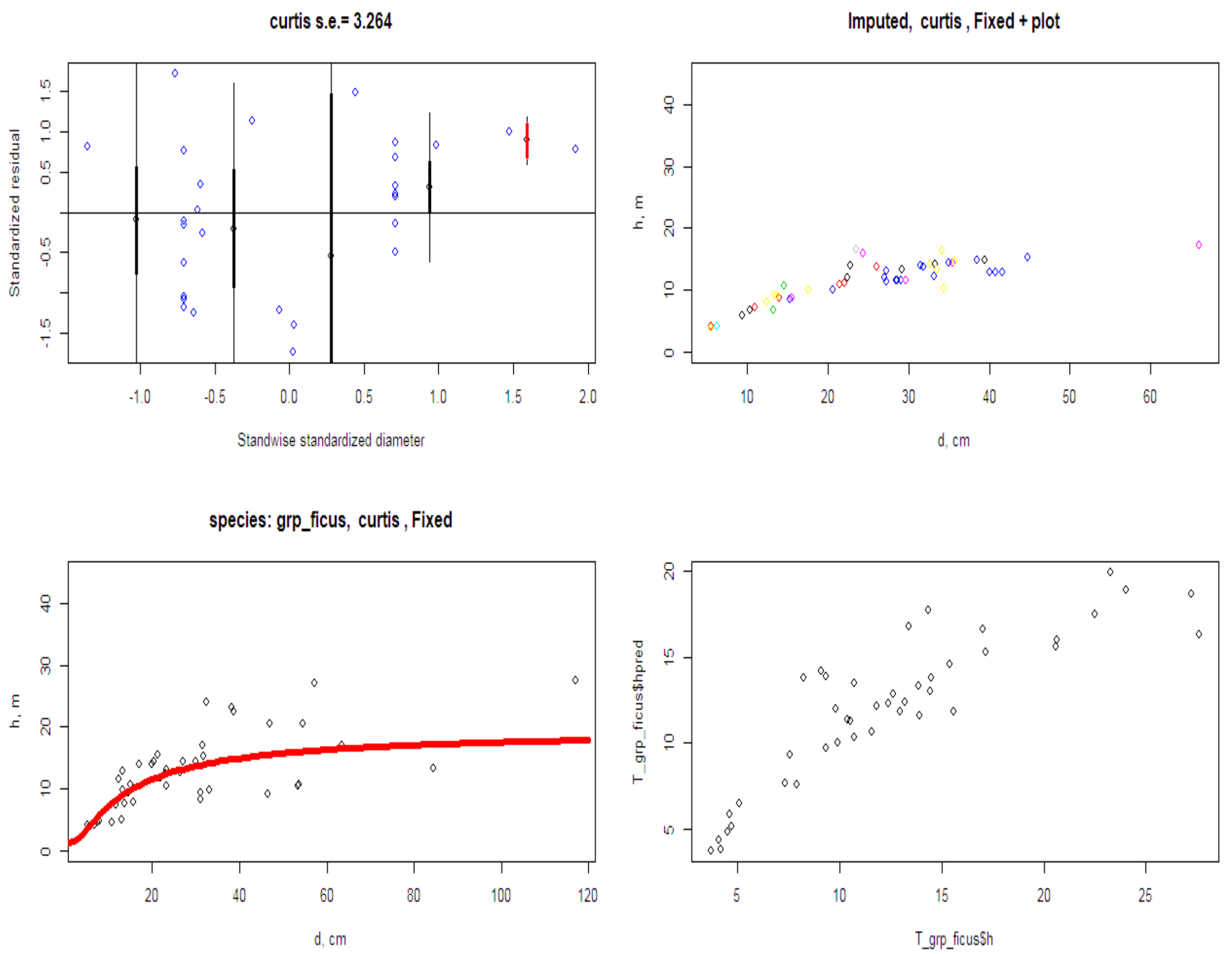
Group 12

Model: Curtis

Equation: h(d) = bh + a (d/(1 + d))^b

Database Code	Botanical Name	Local Name
6307	*Ficus benghalensis*	Bar
6322	*Ficus racemosa*	Gullar
6323	*Ficus religiosa*	Pipal
6641	*Streblus asper*	Bedulo
6120	*Artocarpus heterophyllus*	Katahar
6122	*Artocarpus lakoocha*	Badahar
6315	*Ficus hispida*	Khasreto
6316	*Ficus lacor*	Kavro
6063	*Acacia catechu*	Khair
6325	*Ficus semicordata*	Khanyu, Khanayo
6269	*Ehretia laevis*	Loro, Pan, Datrung
6246	*Desmodium oojenense*	Sadan, Pandan

Parameter	Validity
h(d) = predicted height for dbh 'd'	s.e.=3.264
bh = breast height (=1.3)	Adj. R^2= 0.7482 (for mixed model only)
d = diameter at breast height	F-statistic: 125.8 on 1 and 41 DF, p-value: 4.561e-14
a =18.32153 b=11.87107	Residuals: min -1.73 Q1= -0.48
	med=0.025 Q3=0.72 max=1.72



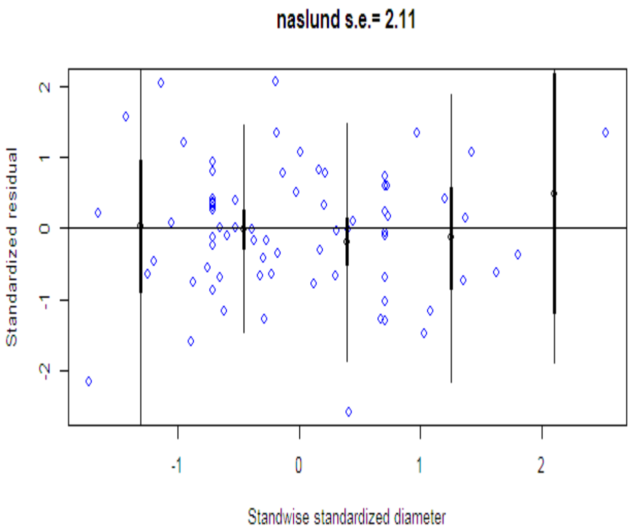
Group 13

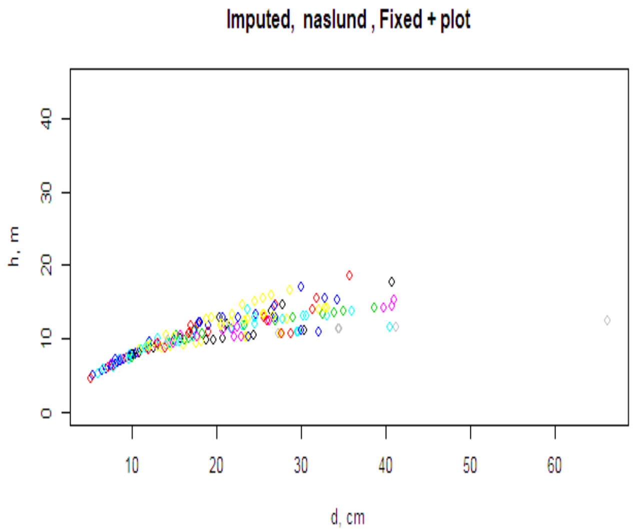
Model: Naslund

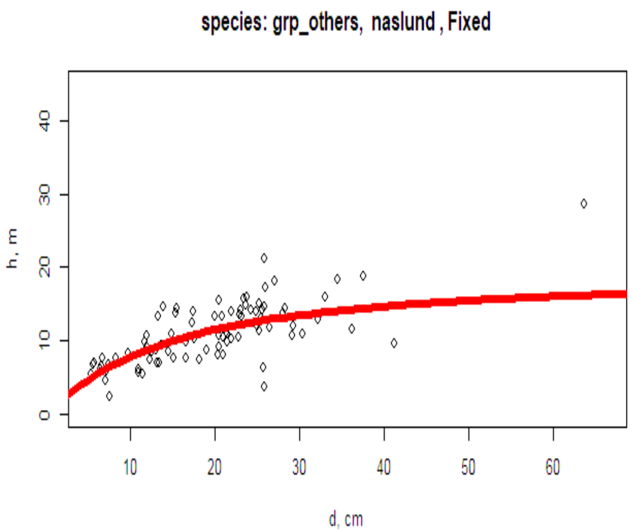
Equation: h(d) = bh + d^2/(a + b d)^2

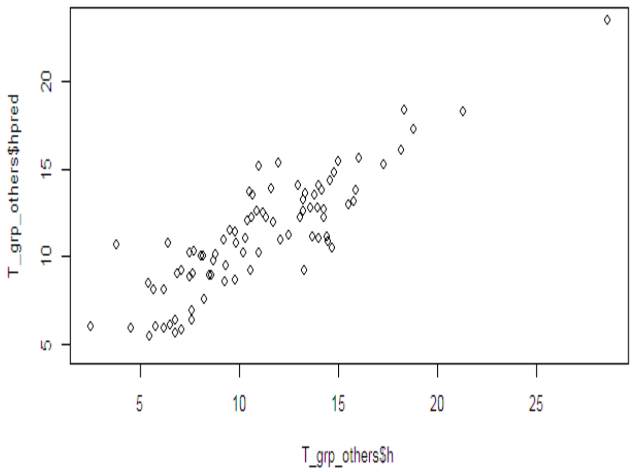
Database Code	Botanical Name	Local Name
6144	*Bridelia retusa*	Gayo
6702	*Zizyphus rugosa*	Kanta Bayer
6098	*Albizia chinensis*	Seto siris
6083	*Acrocarpus fraxinifolius*	Mandania
6341	*Grewia subinaequalis*	Shyal phusre

Parameter	Validity
h(d) = predicted height for dbh ‘d’ bh = breast height (=1.3) d = diameter at breast height a =1.5687975 b=0.2339752	s.e.=2.11 Adj R^2=0.7584 (for mixed model only) F-statistic: 261.5 on 1 and 82 DF, p-value: < 2.2e-16 Residuals: min -2.59 Q1=0.67 med=-0.004 Q3=0.52 max=2.068









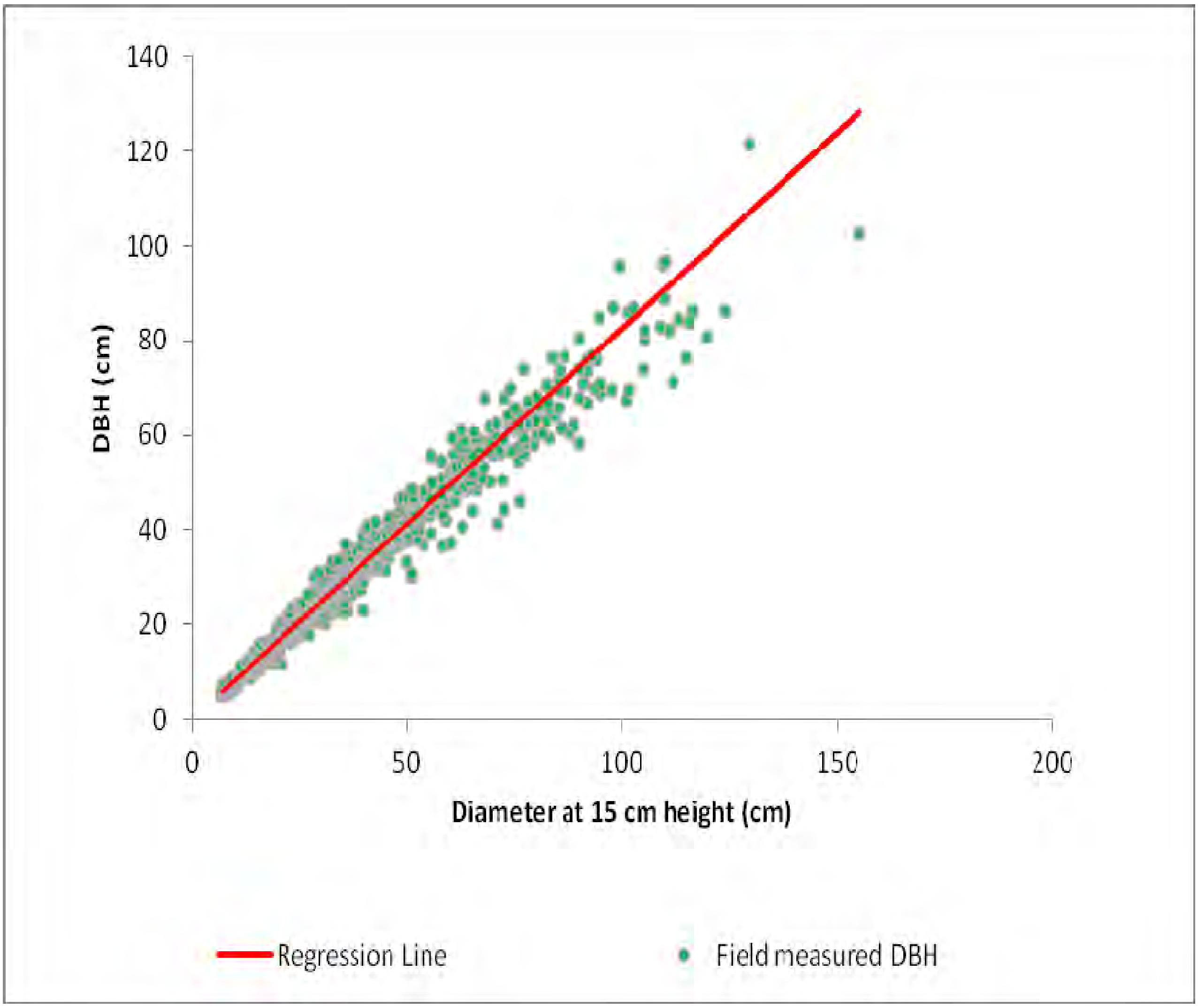
Annex 3: Equation for Predicting Tree DBH from Diameter at 15 cm Height (stump)

Equation: Ln Dbh=a+b Ln(d_15)

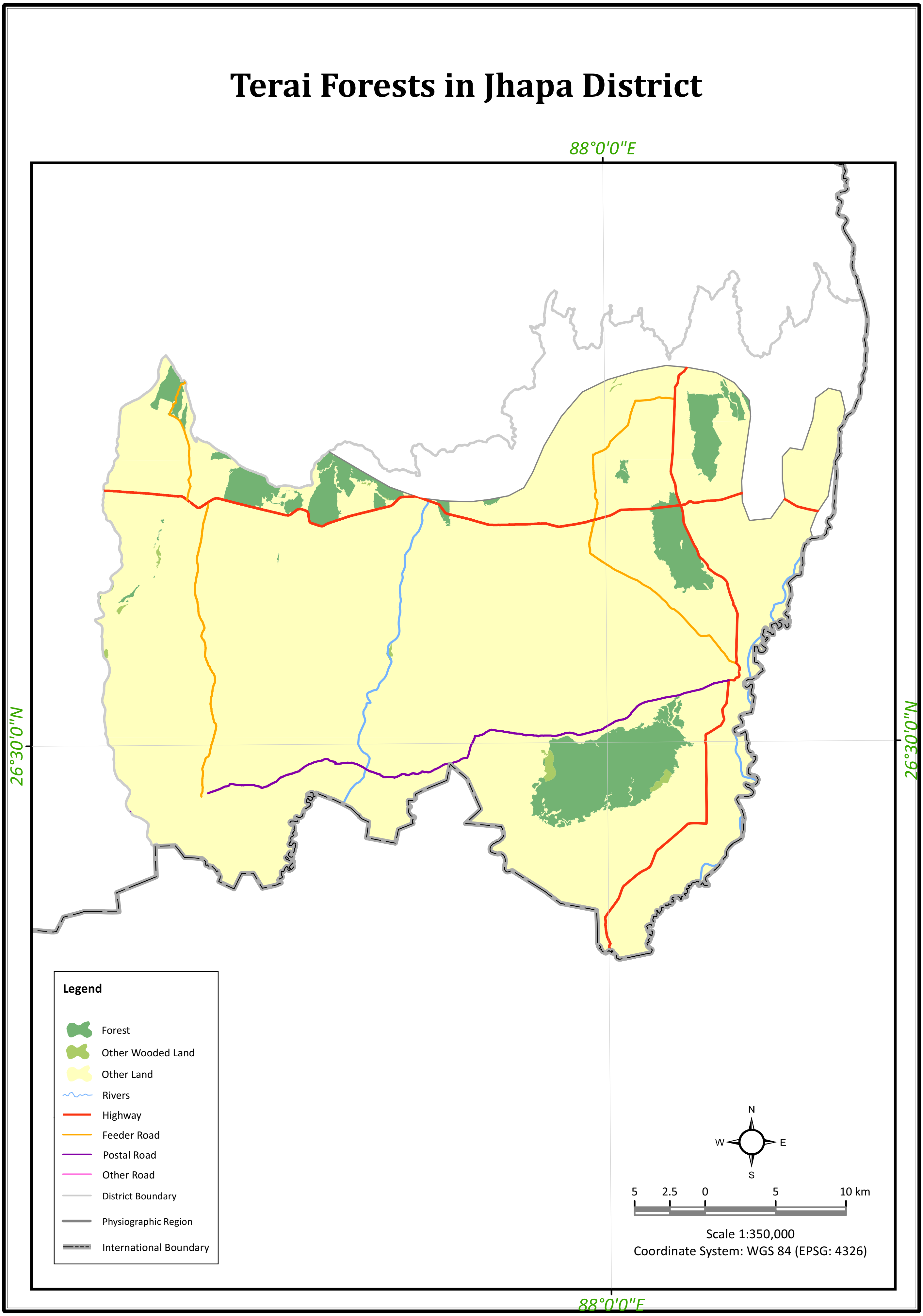
Where,

- Ln = Natural logarithm
- Dbh = Diameter at breast height
- d_15 = Diameter of stumps measured at 15 cm from ground level.
- a and b = Constant

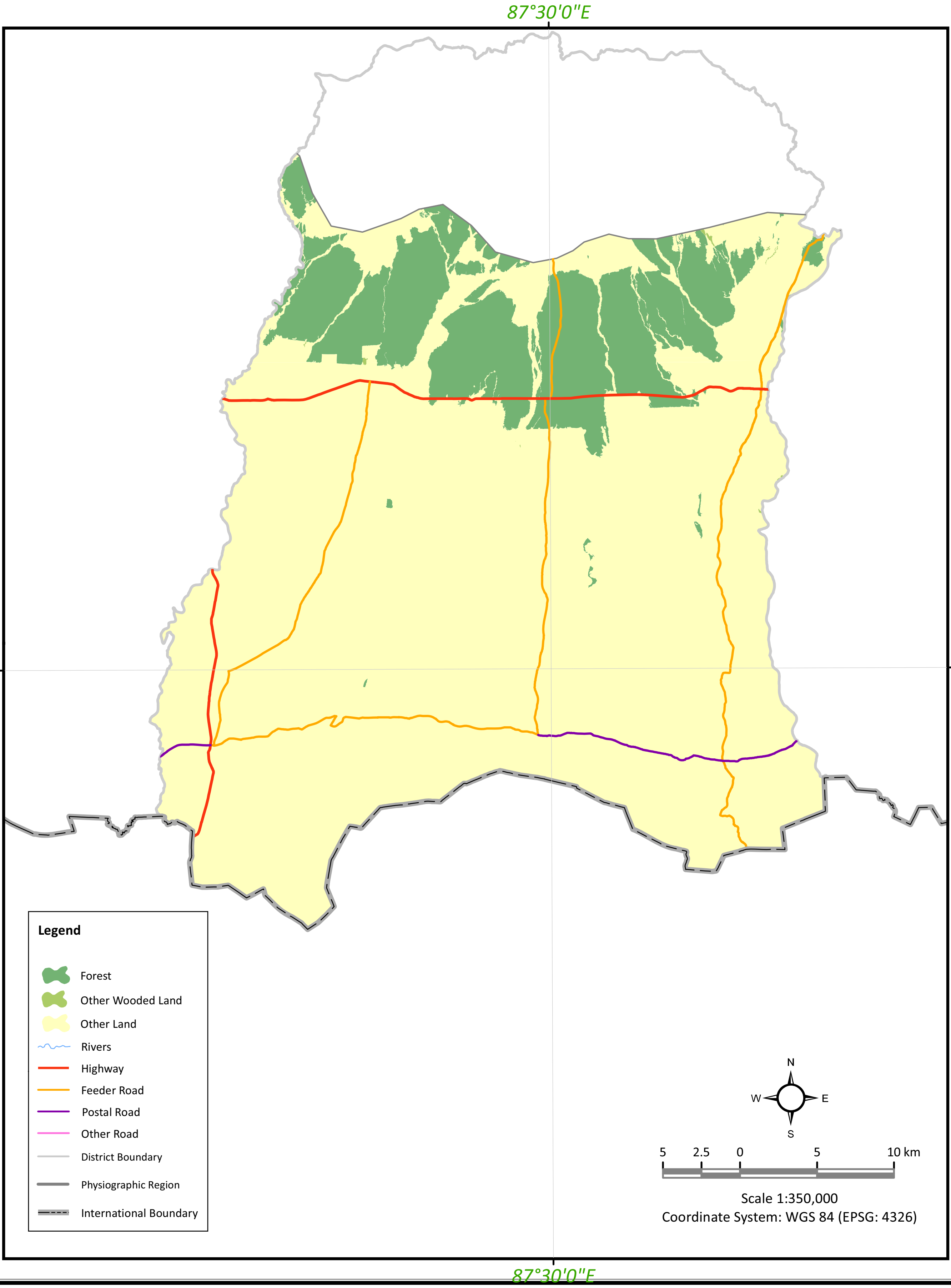
Estimate	SE	Residual SE	Adjusted R-Square	F-statistic	DF	p_value
a = -0.200345	0.018477	0.09609	0.9756	3.597e+04 on 1	898	< 2.2e-16
b = 1.002703	0.005287					



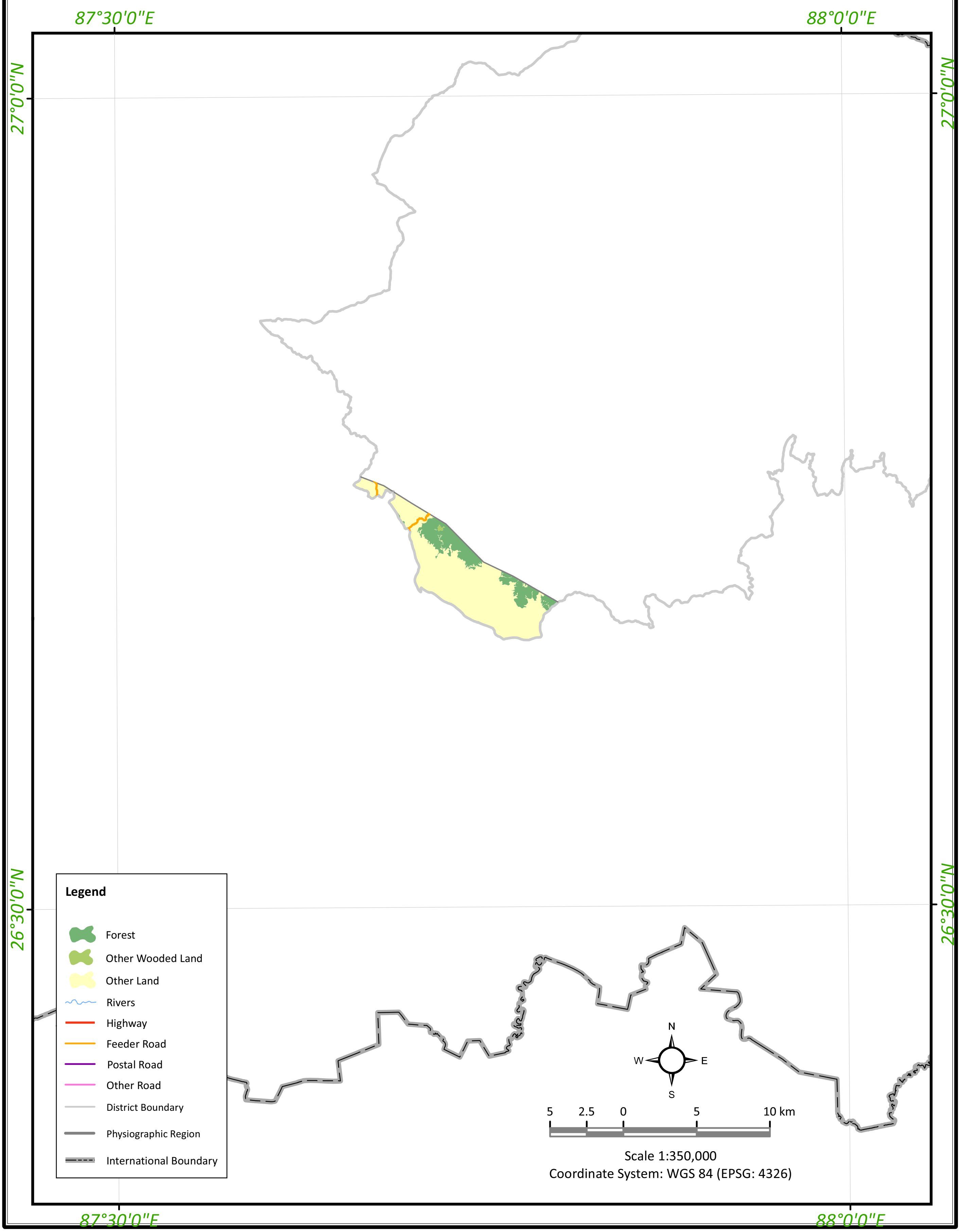
Annex 4: District-wise forest cover maps of the Terai



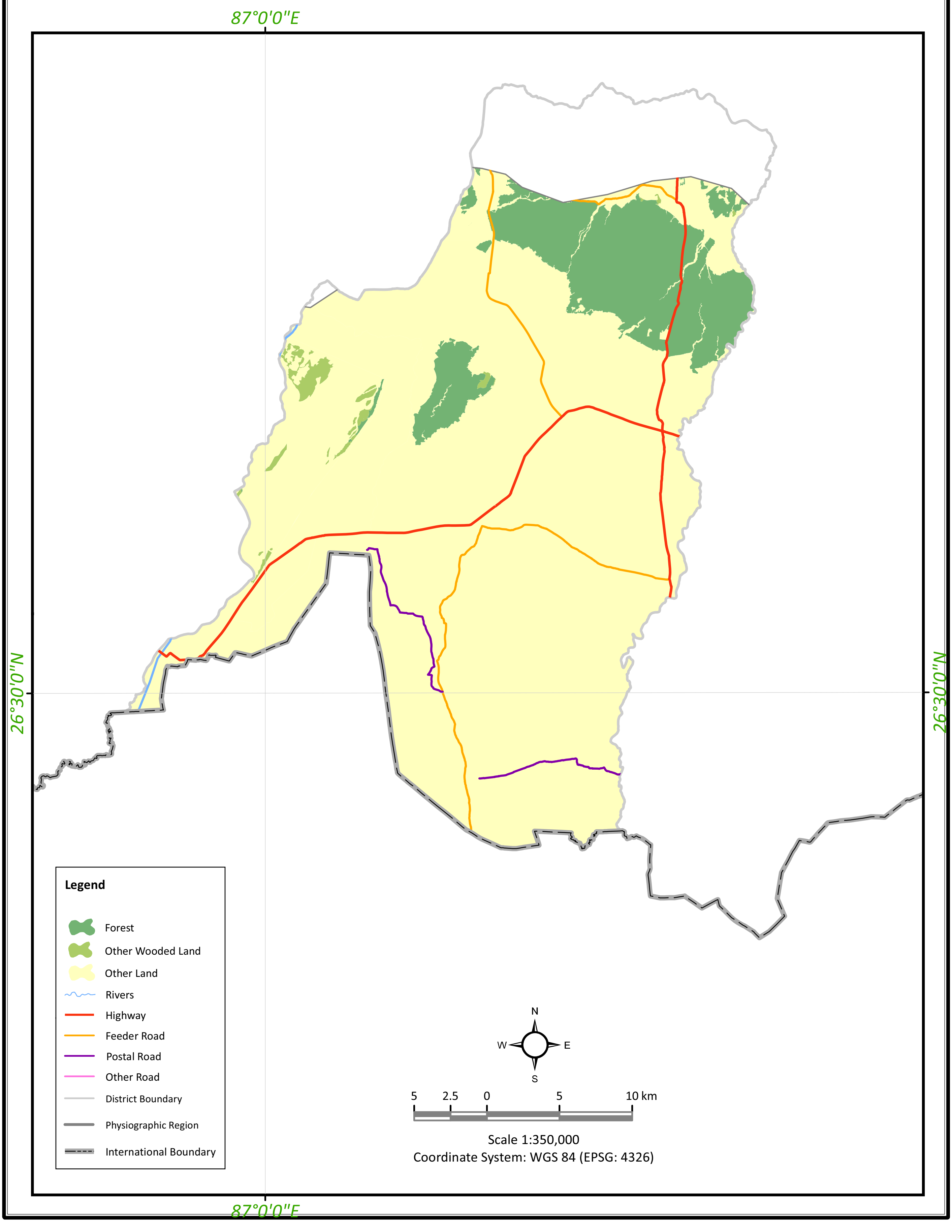
Terai Forests in Morang District



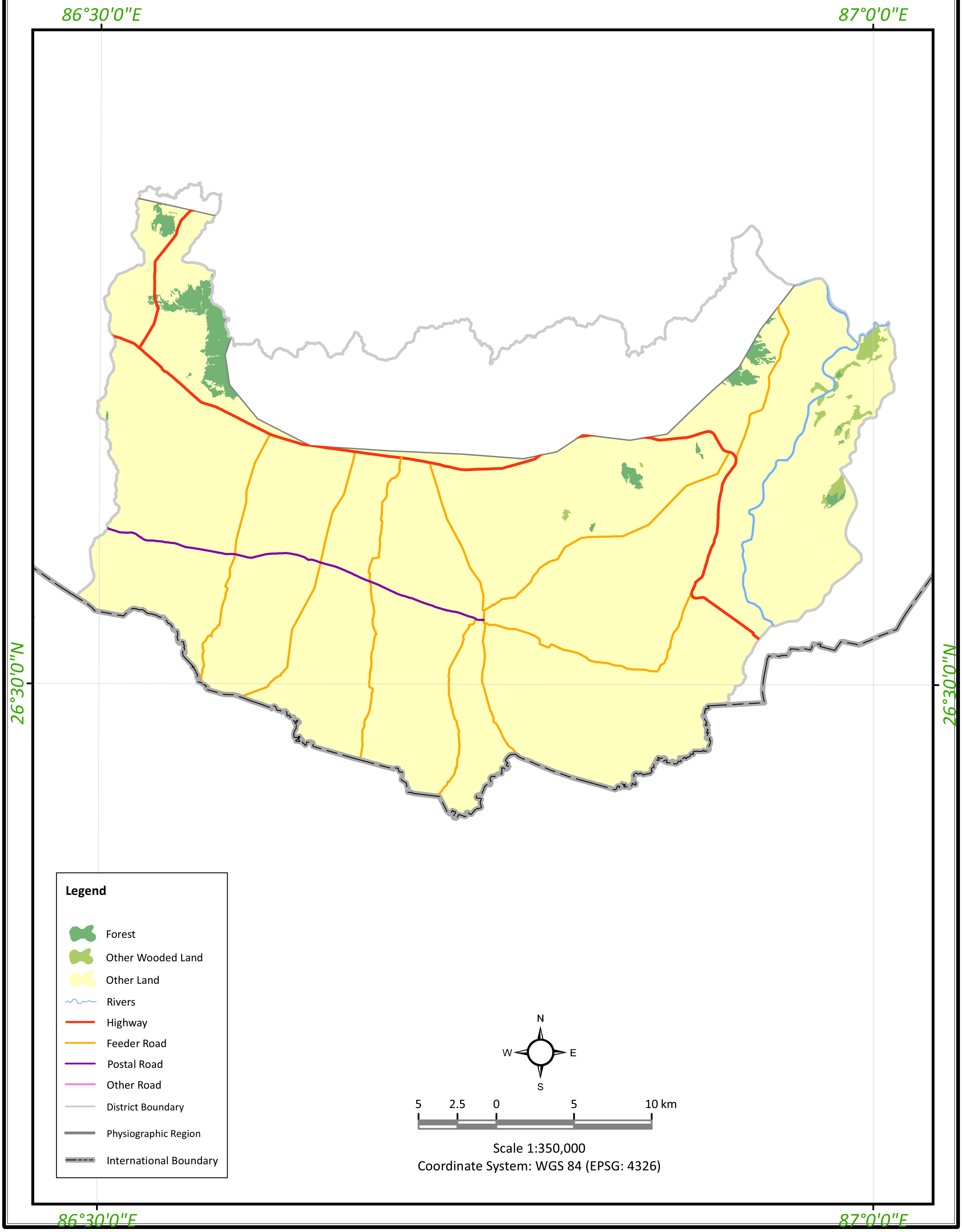
Terai Forests in Ilam District



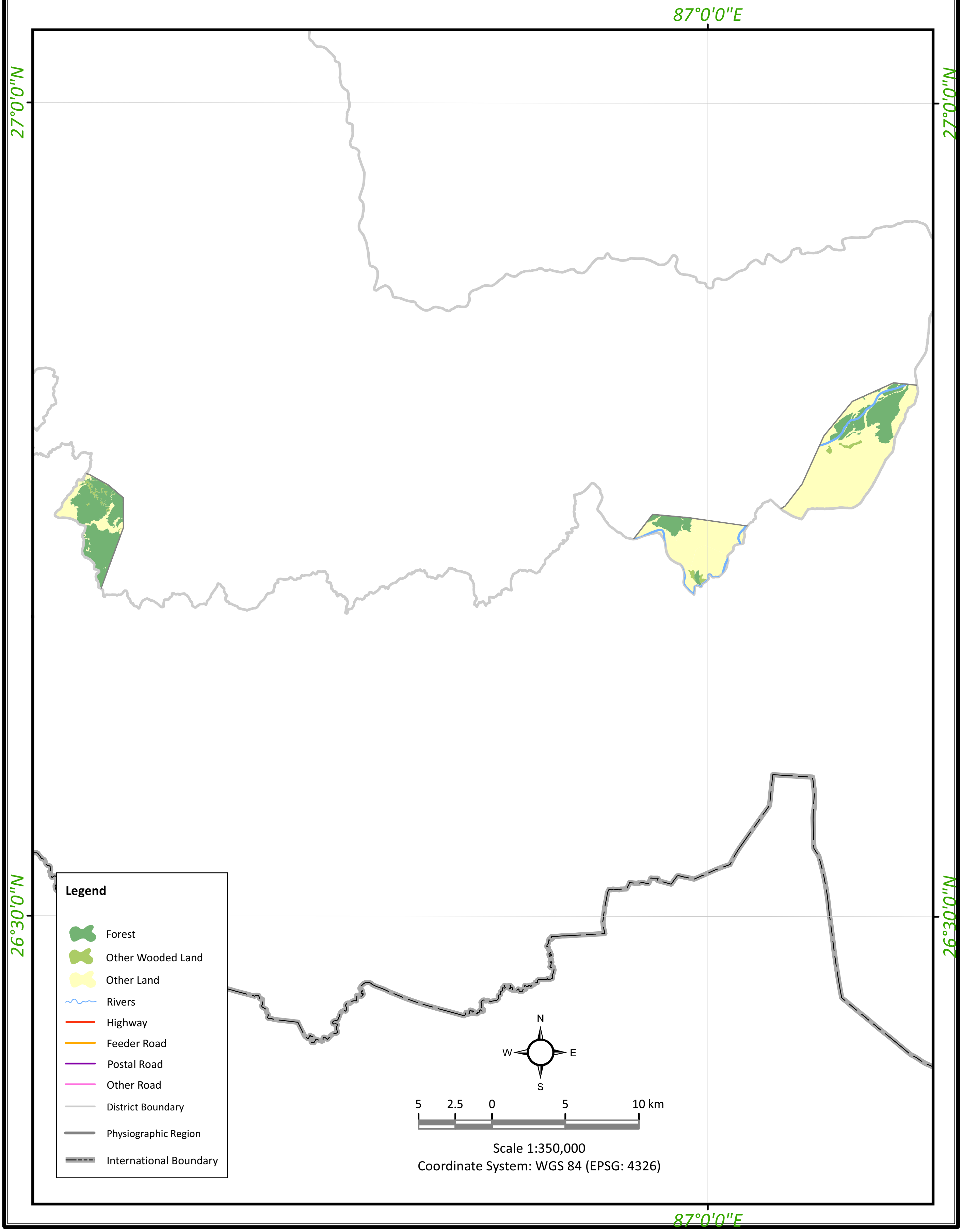
Terai Forests in Sunsari District



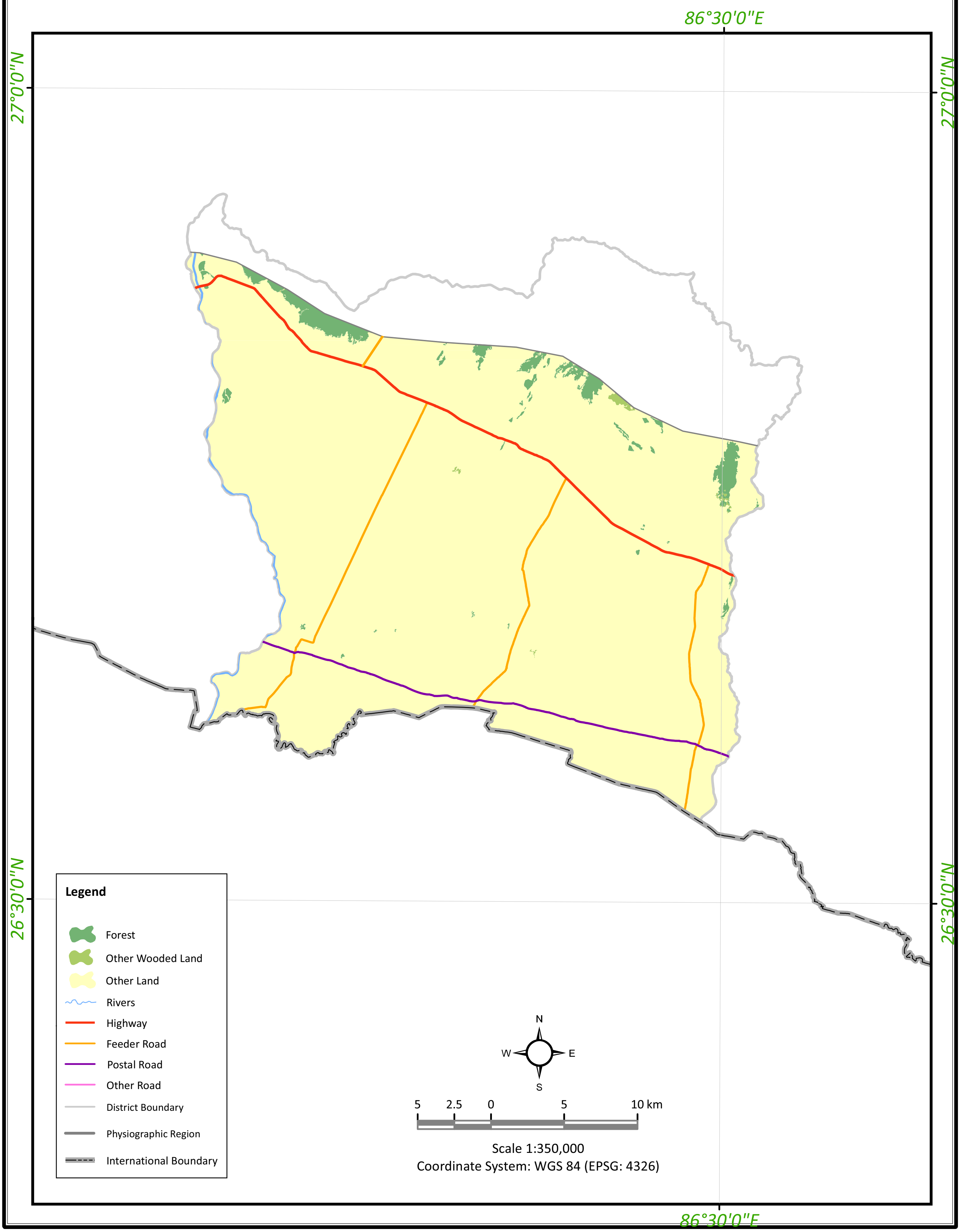
Terai Forests in Saptari District



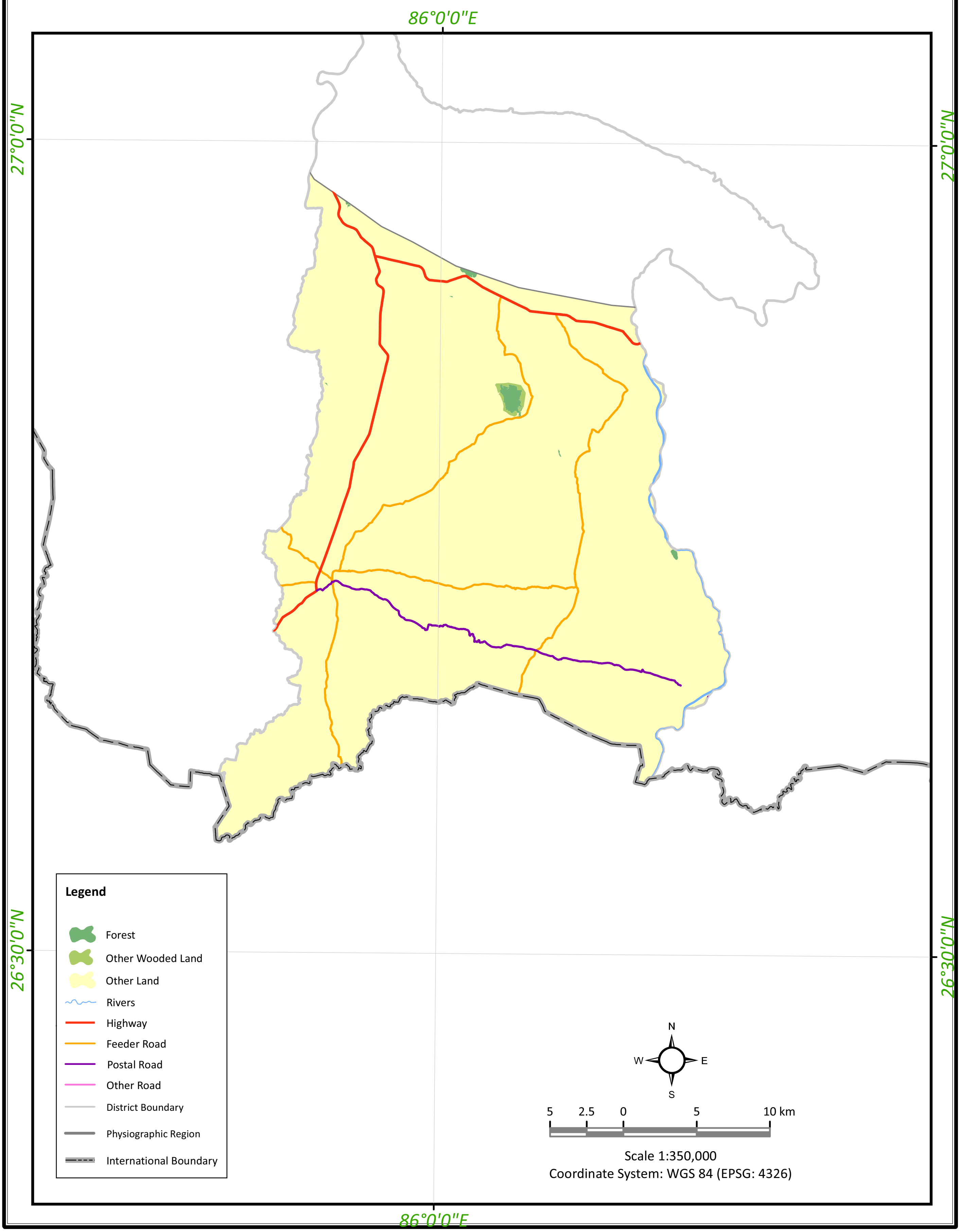
Terai Forests in Udayapur District



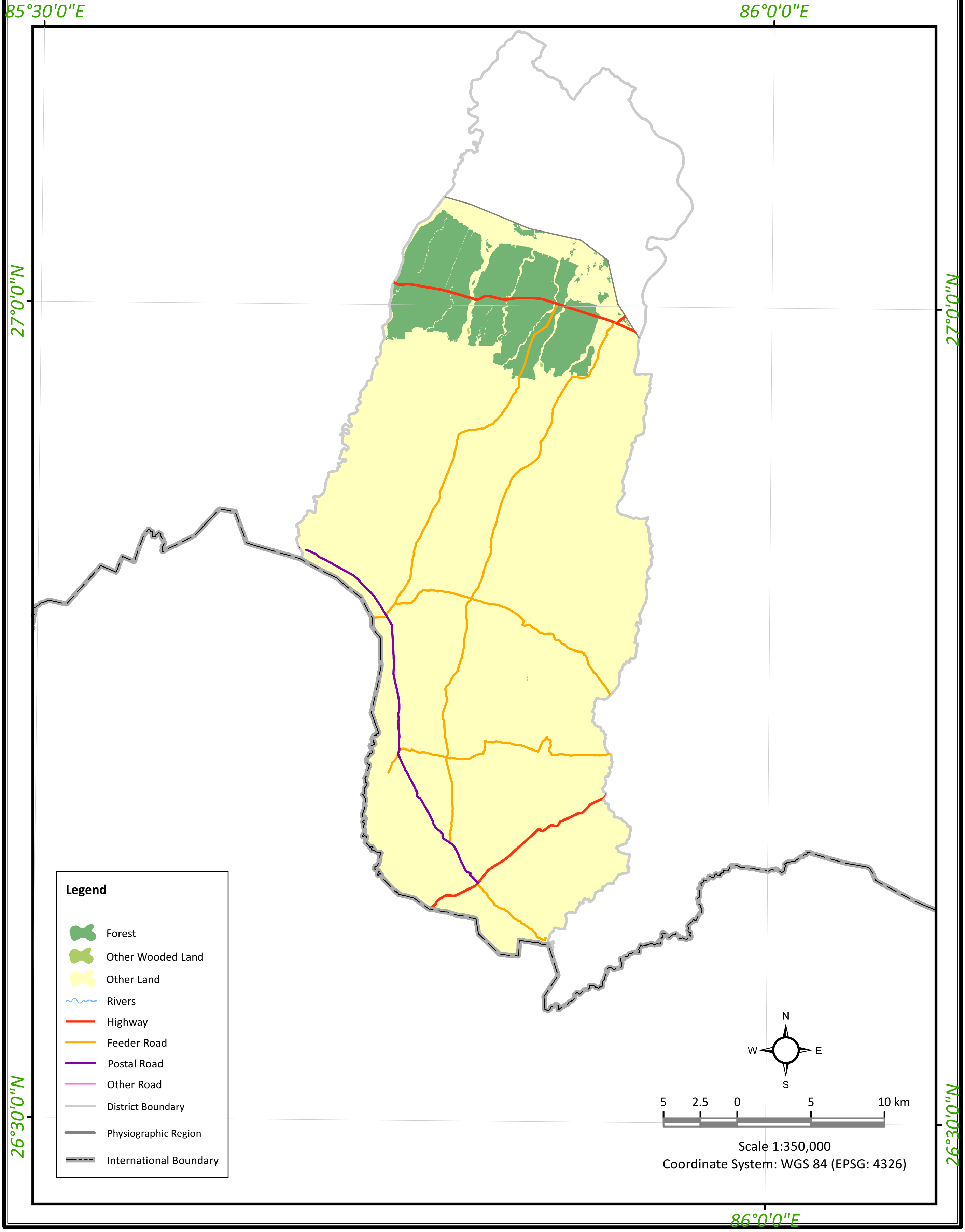
Terai Forests in Siraha District



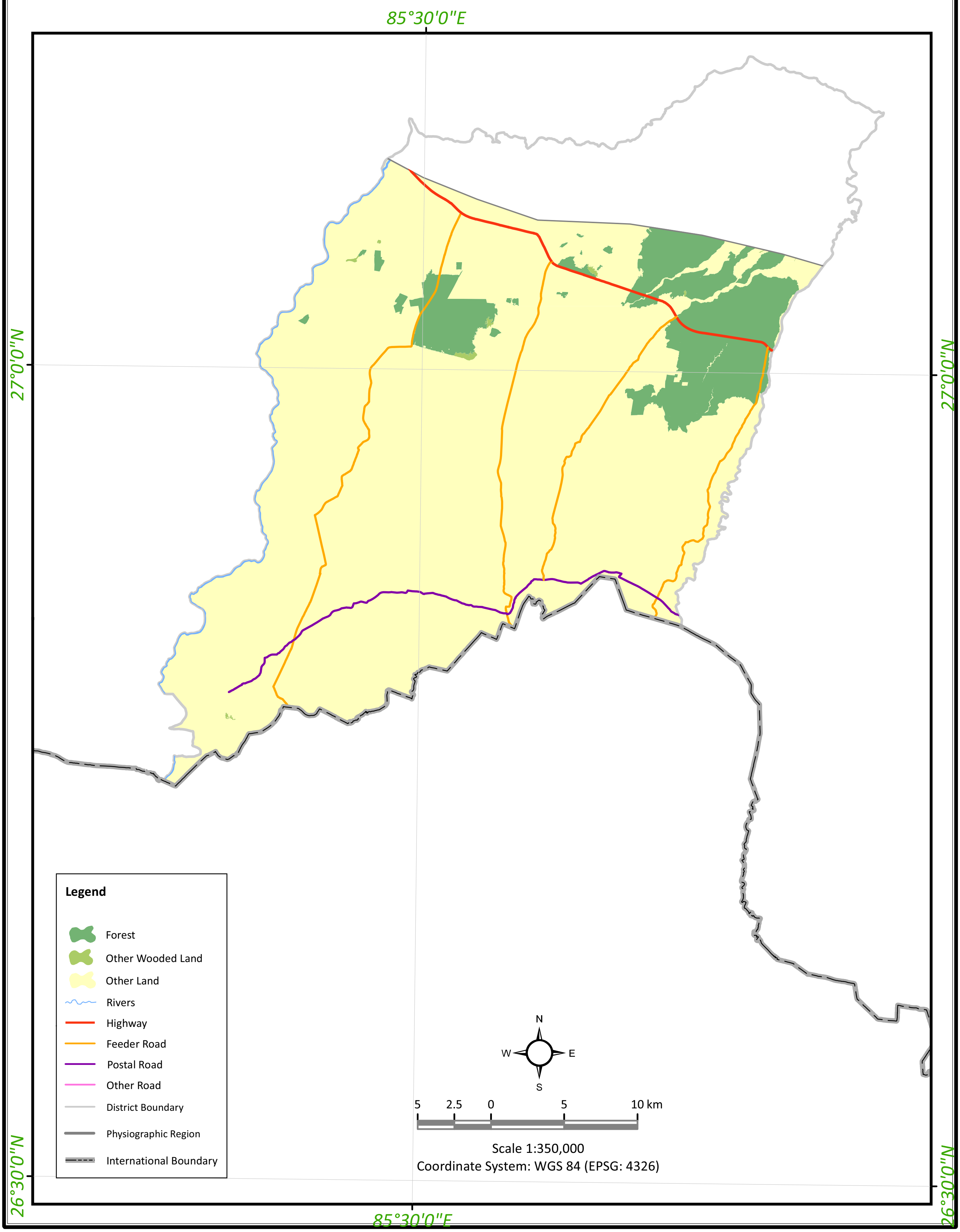
Terai Forests in Dhanusha District



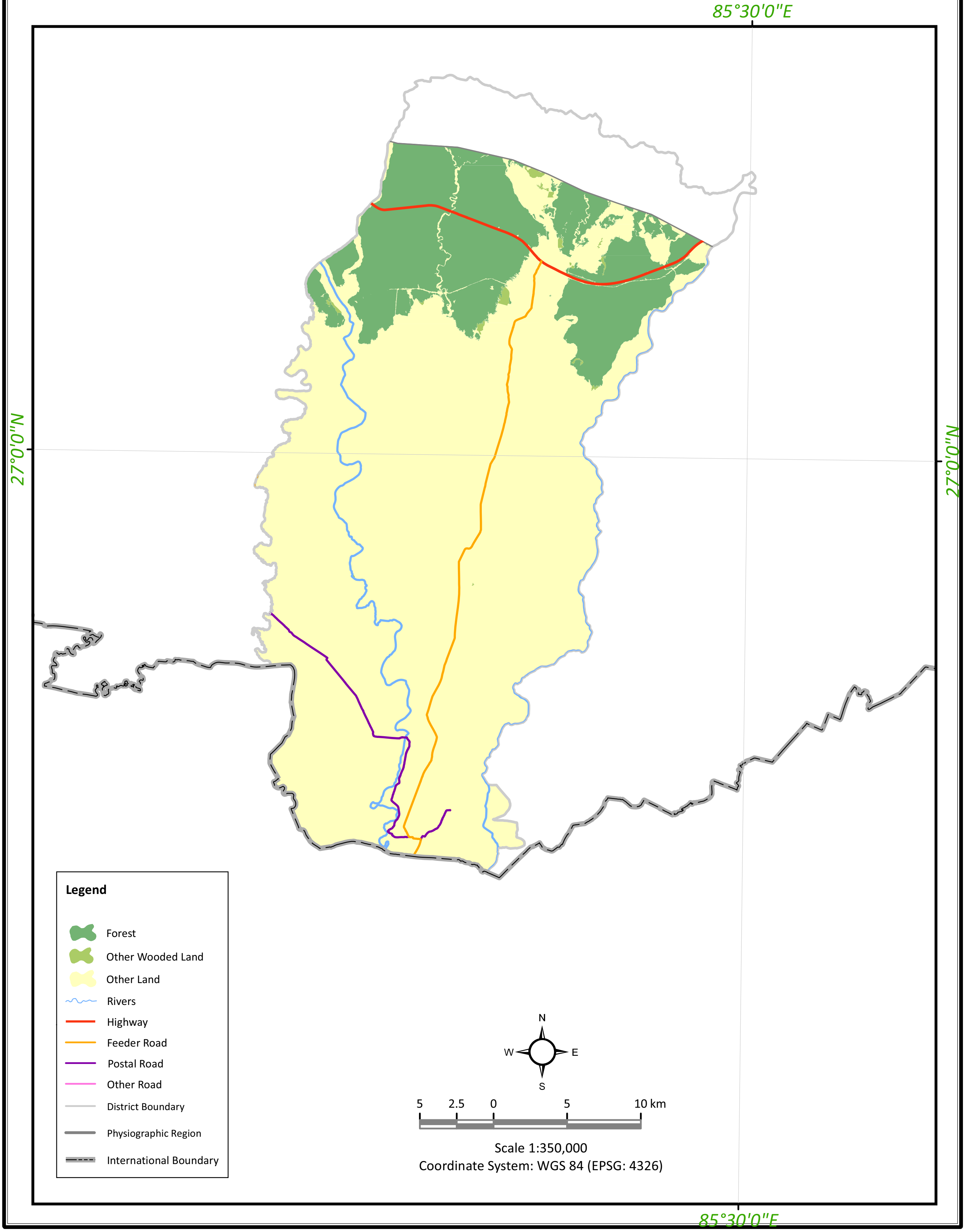
Terai Forests in Mahottari District



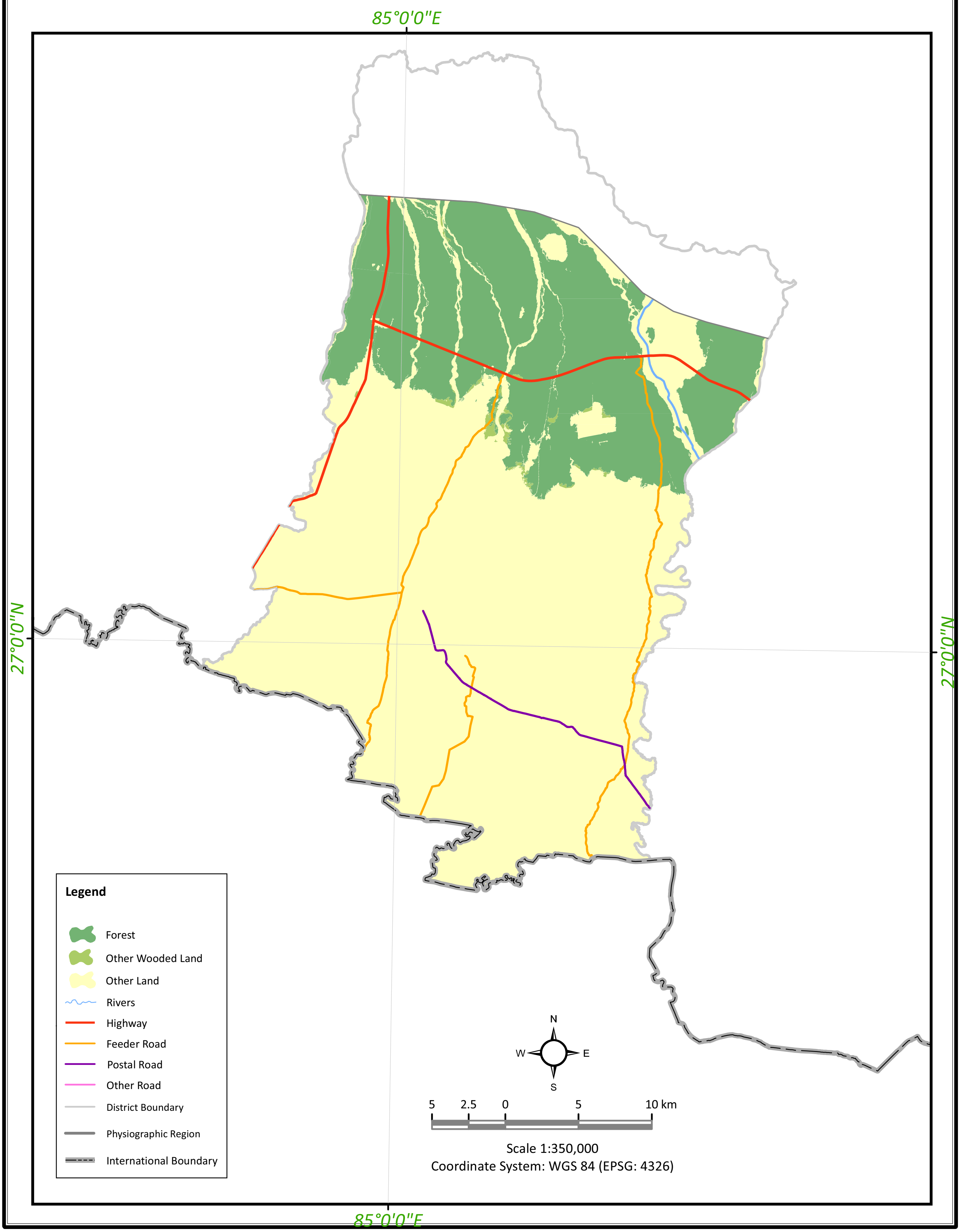
Terai Forests in Sarlahi District



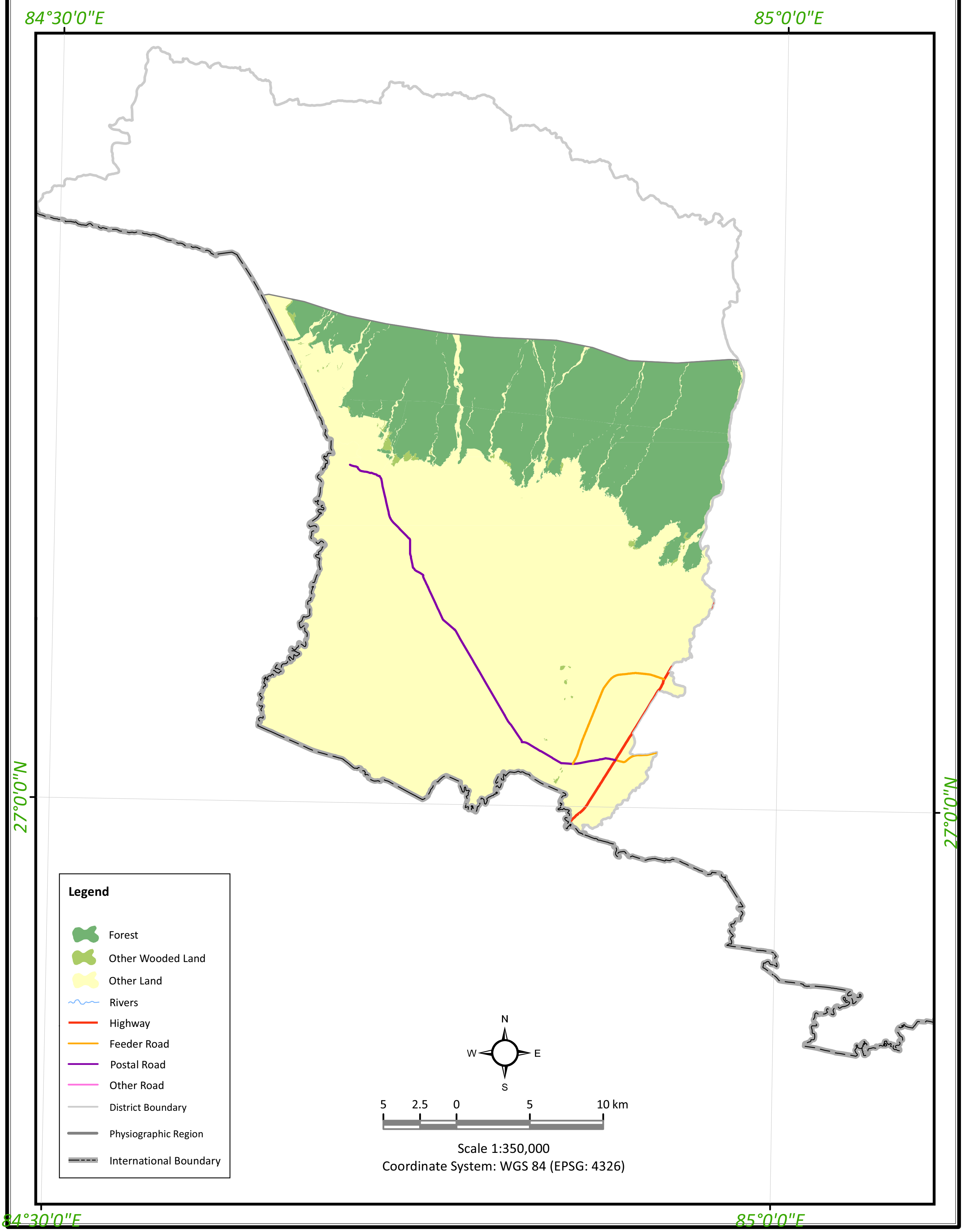
Terai Forests in Rautahat District



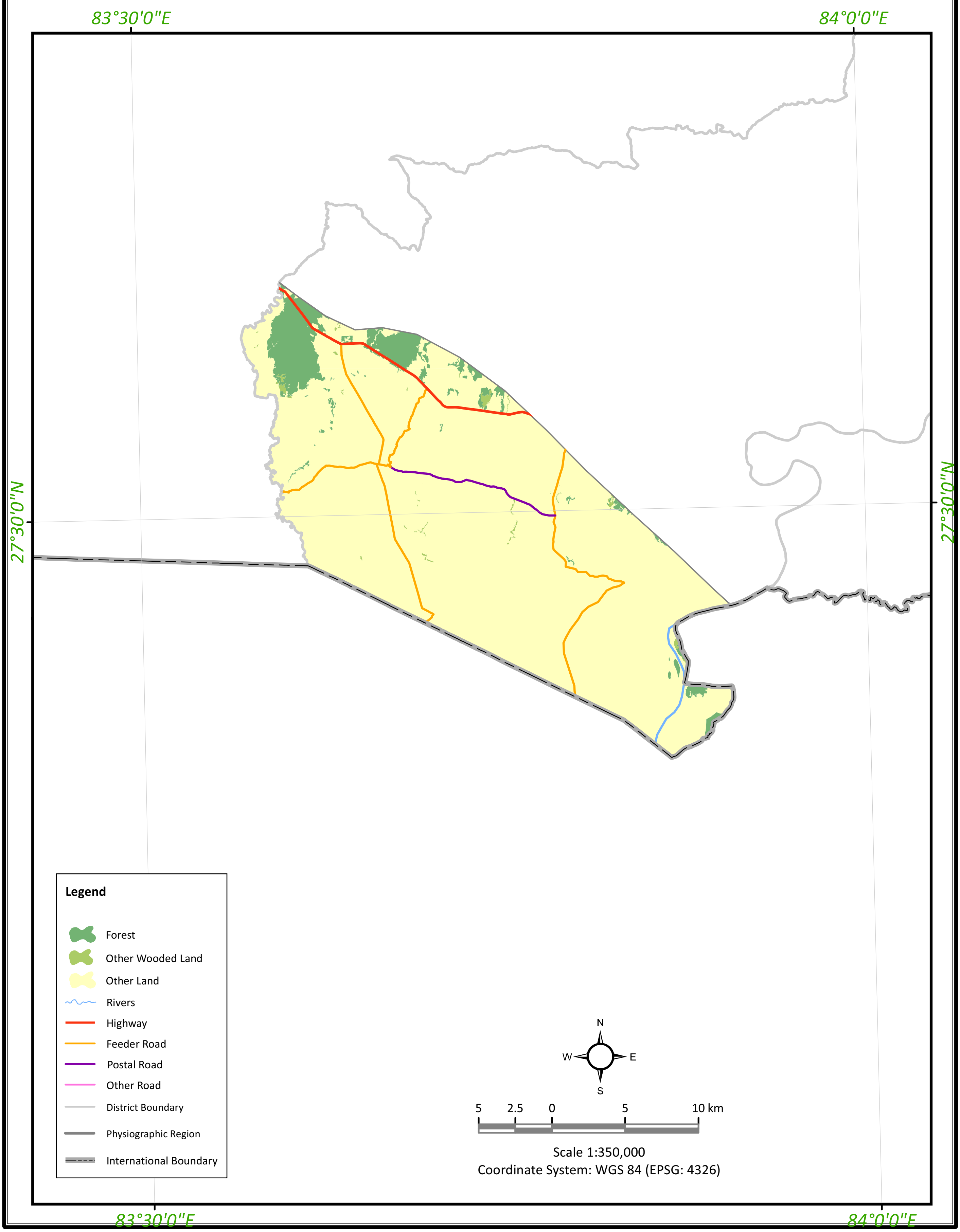
Terai Forests in Bara District



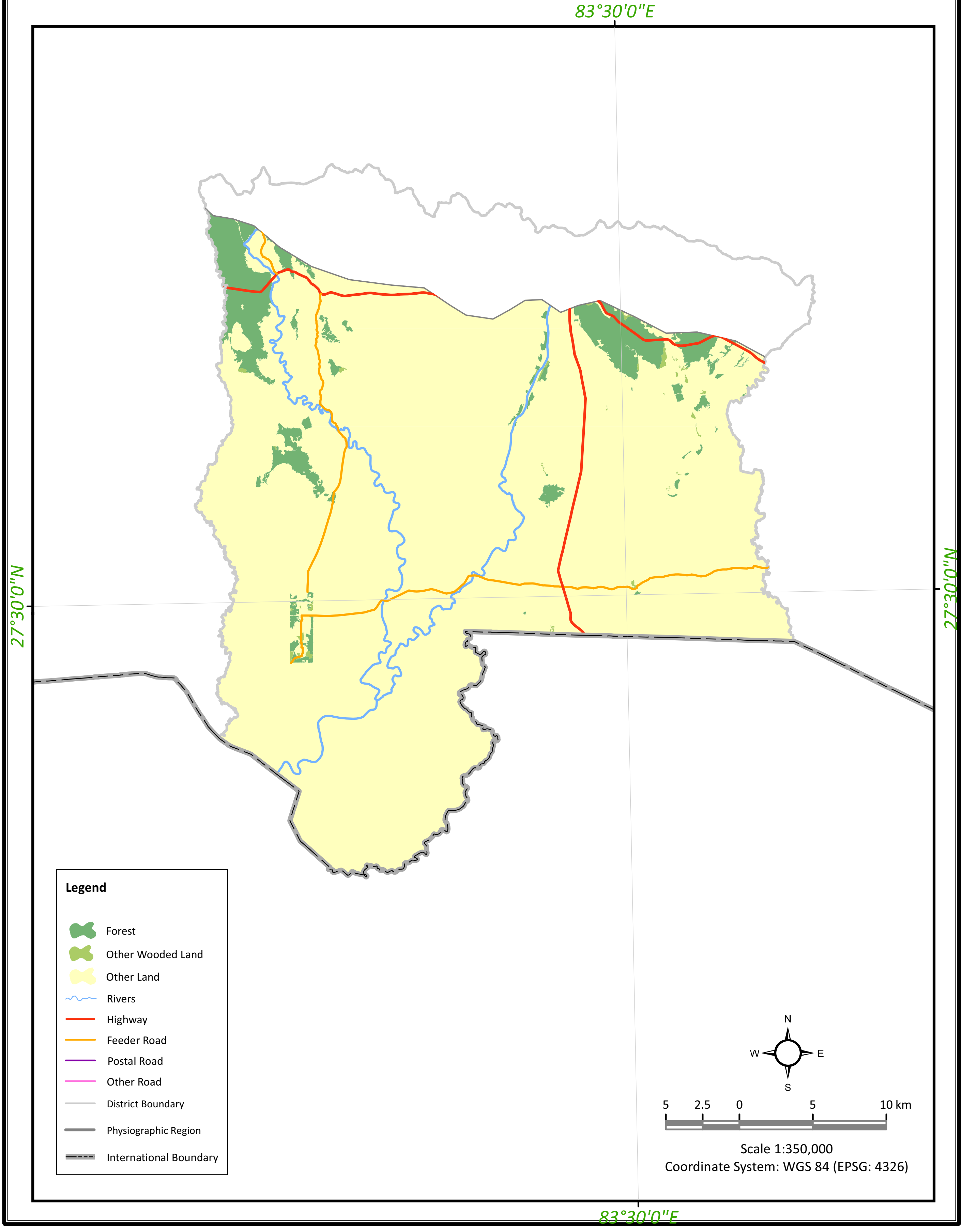
Terai Forests in Parsa District



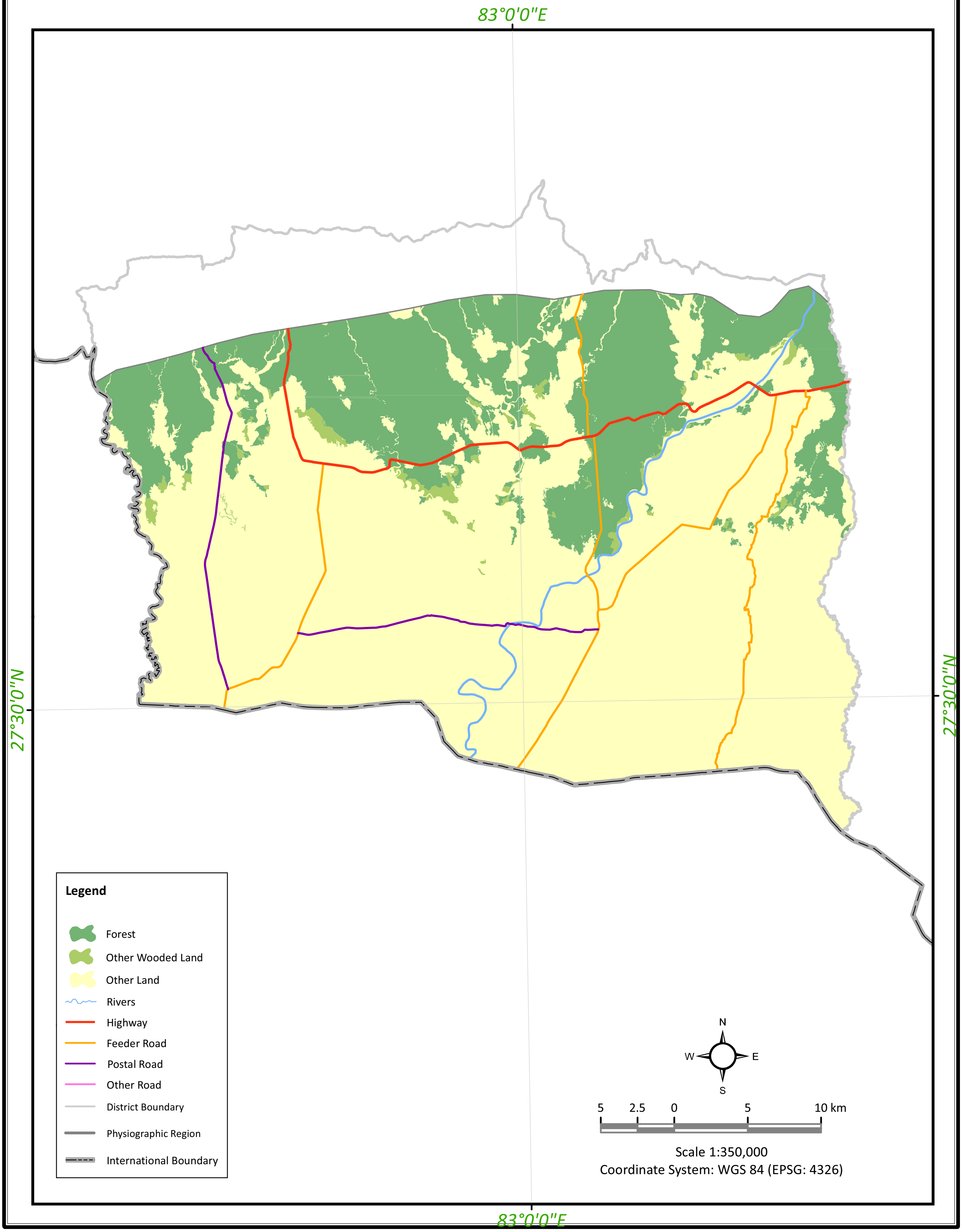
Terai Forests in Nawalparasi District



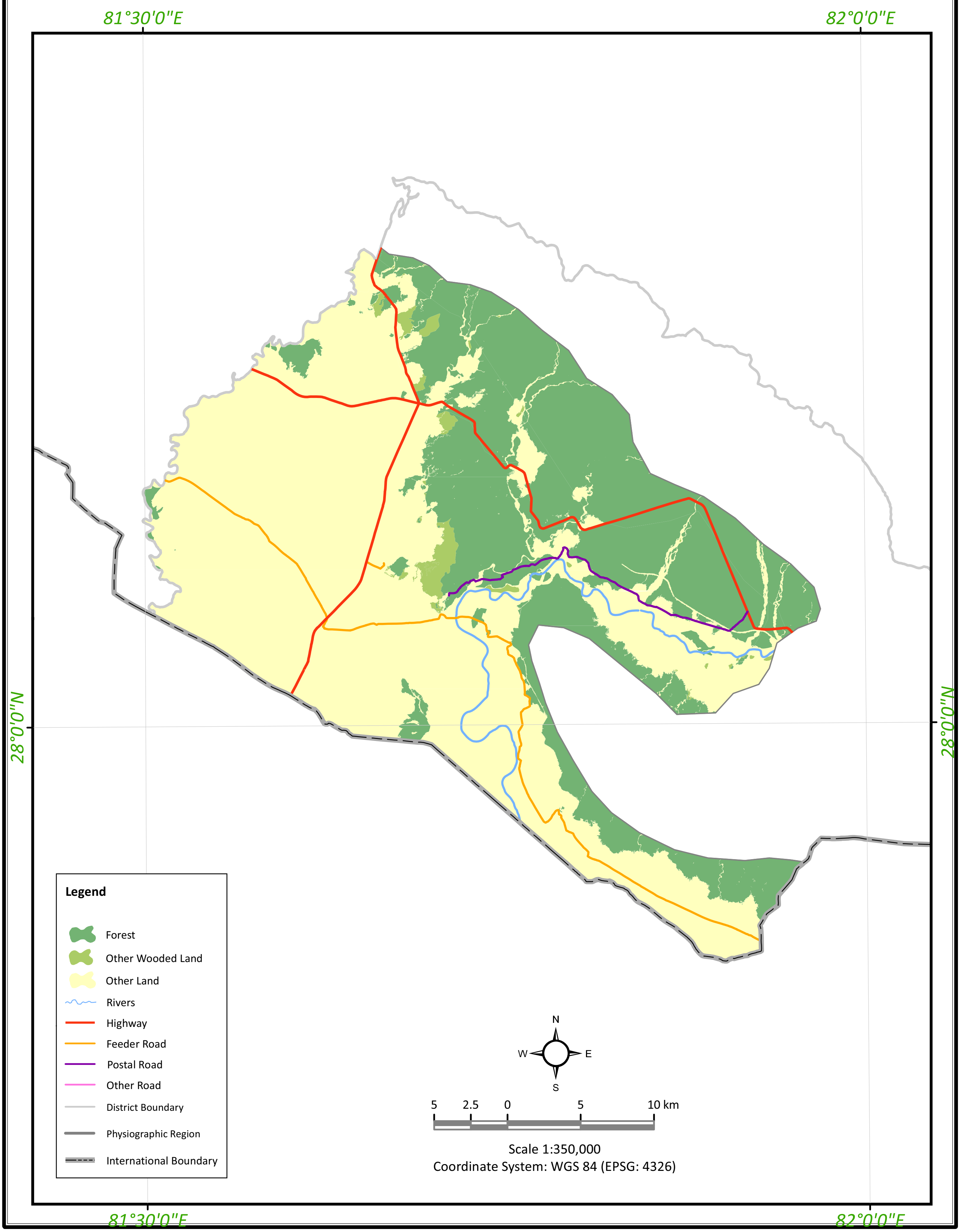
Terai Forests in Rupandehi District



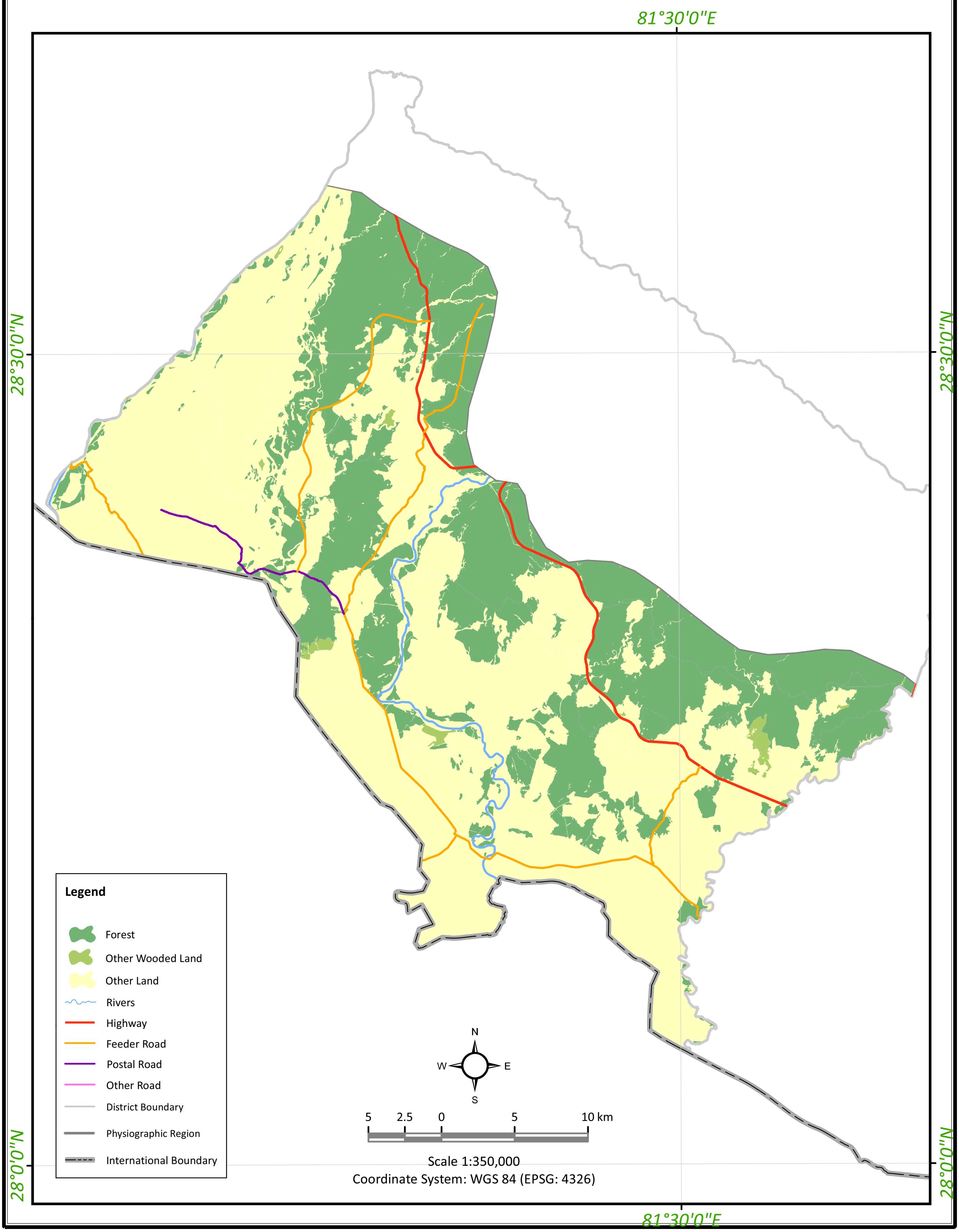
Terai Forests in Kapilvastu District



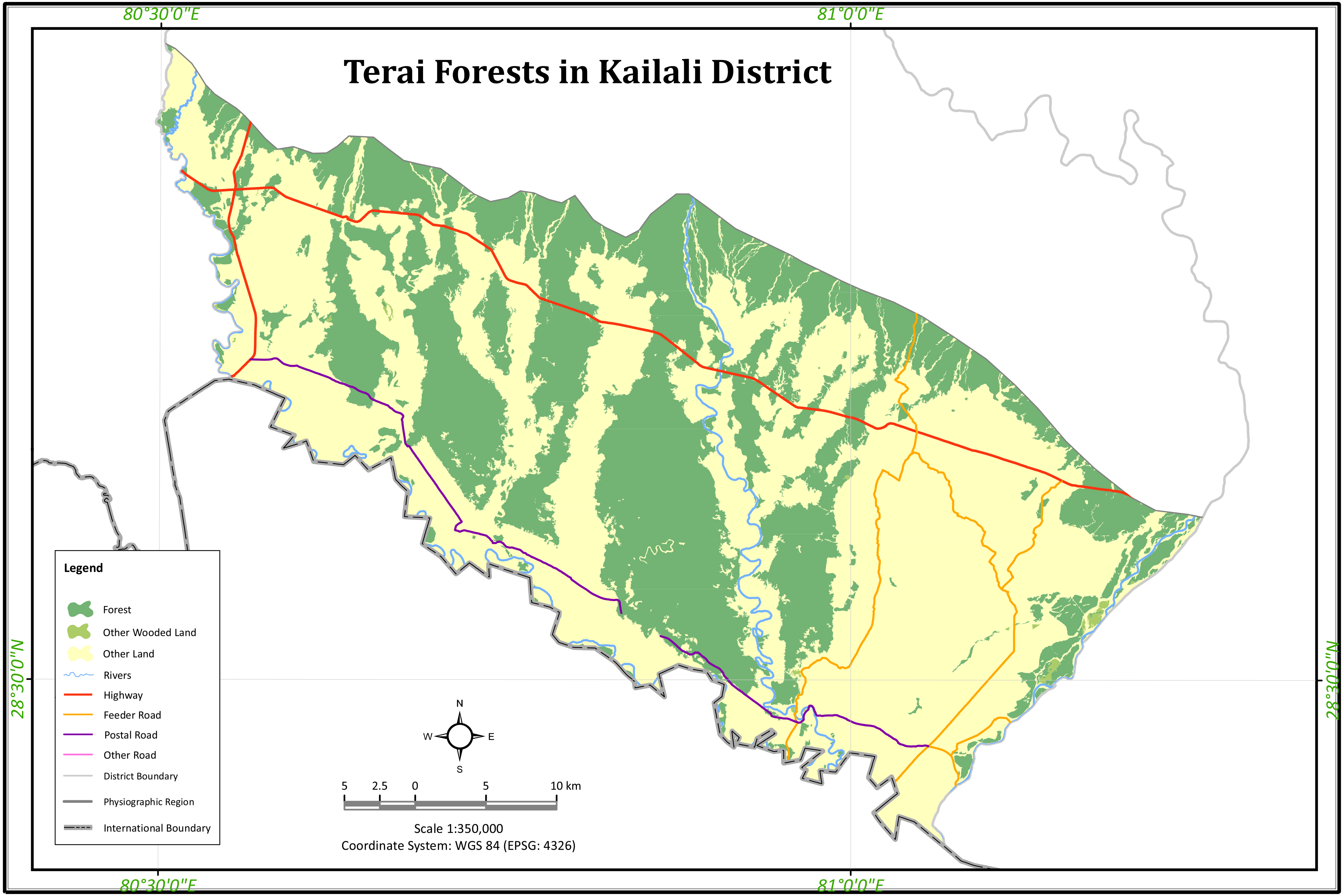
Terai Forests in Banke District



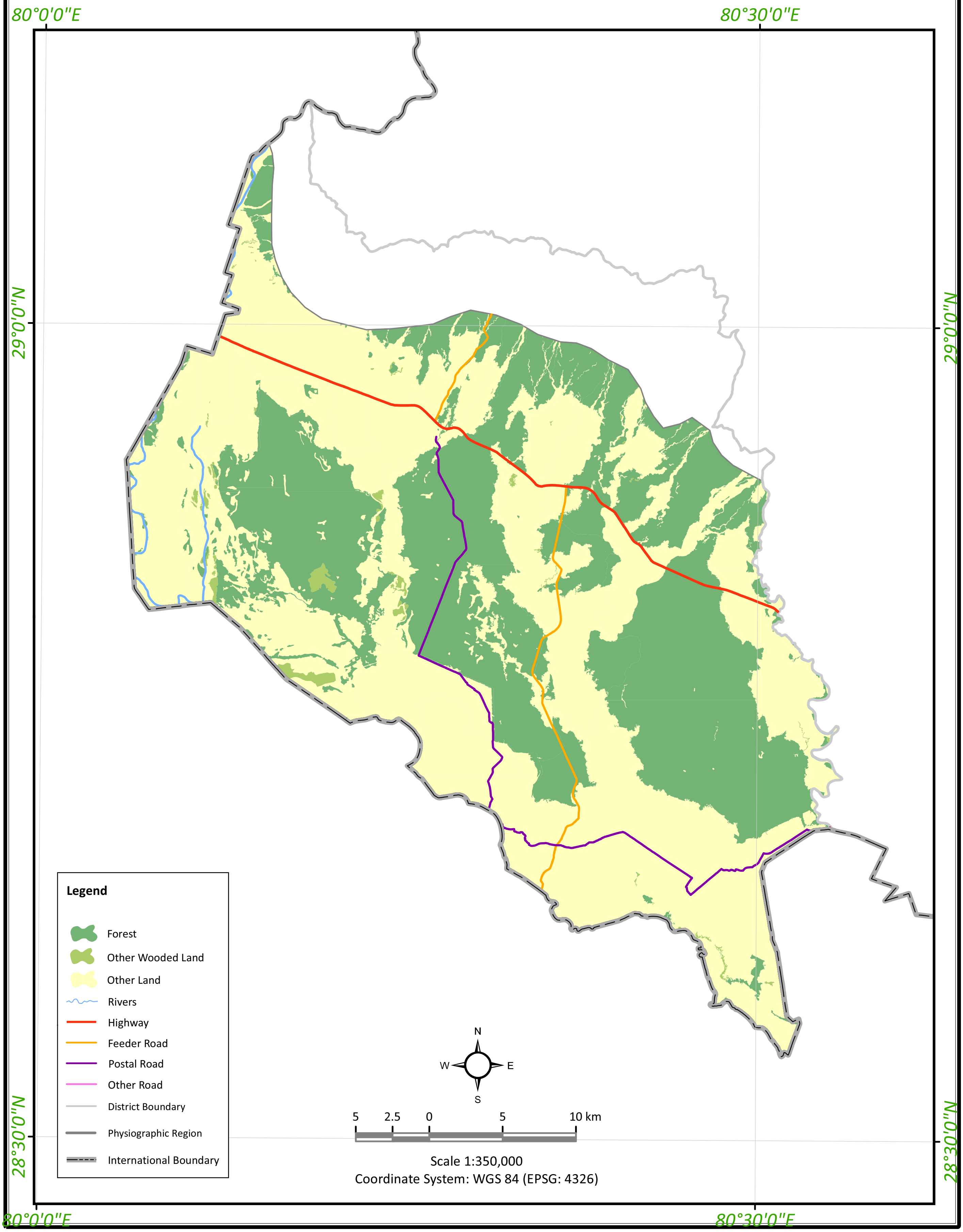
Terai Forests in Bardiya District



Terai Forests in Kailali District



Terai Forests in Kanchanpur District



Annex: 5. Forest Cover Changed Areas (polygons>100 ha) between 1991 and 2010/11, and Their Spatial Location in the Terai Physiographic Region

Location/VDCs	Districts	Area (ha)	Current status
Beladevipur	Kailali	131	Agriculture
Chaumala	Kailali	140	Agriculture
Chaumala	Kailali	106	Agriculture/ Realigned water courses
Chaumala	Kailali	116	Agriculture
Masuriya	Kailali	253	Agriculture/ Realigned water courses
Sandepani	Kailali	322	Agriculture / Forest less than 10%
Dododhara	Kailali	106	Realigned water courses
Urma	Kailali	111	Agriculture
Khailad	Kailali	147	Agriculture
Tikapur Municipality	Kailali	171	Agriculture / Forest less than 10%
Khailad/Lalbojhi	Kailali	125	Agriculture
Daiji	Kanchanpur	112	Agriculture
Daiji	Kanchanpur	110	Agriculture
Jhalari	Kanchanpur	224	Agriculture
Jhalari	Kanchanpur	184	Agriculture
Jhalari	Kanchanpur	197	Agriculture
Krishnapur	Kanchanpur	111	Agriculture
Shuklaphanta Wildlife Reserve	Kanchanpur	194	Realigned water courses/ Shrubs
Krishnapur	Kanchanpur	207	Agriculture
Shuklaphanta Wildlife Reserve	Kanchanpur	148	Realigned water courses/ Shrubs
Krishnapur	Kanchanpur	110	Agriculture
Krishnapur	Kanchanpur	359	Agriculture
Pipaladi_B	Kanchanpur	123	Agriculture
Dekhatbhuli	Kanchanpur	187	Agriculture
Gugauli	Kapilbastu	103	Agriculture
Patna	Kapilbastu	164	Infrastructure
Shivagadhi	Kapilbastu	126	Agriculture
Chanai/Birpur	Kapilbastu	415	Mixed categories
Shivapur	Kapilbastu	116	Agriculture
Patthardehiya	Kapilbastu	130	Mixed categories
Gugauli	Kapilbastu	136	Agriculture
Tilaurakot/Niglihawa	Kapilbastu	186	Mixed categories
Shivapur	Kapilbastu	231	Forest less than 10%/ Shrubs
Barkulpur	Kapilbastu	275	Shrubs
Gajedi	Rupandehi	578	Agriculture
Kerwani	Rupandehi	218	Agriculture
Suryapatuwa	Bardiya	105	Agriculture / Shrubs
Kohalpur	Banke	124	Shrubs
Dhadhawar	Bardiya	314	Agriculture / Shrubs
Gulariya Municipality	Bardiya	196	Mixed categories
Gulariya Municipality	Bardiya	128	Forest less than 10%/ Shrubs
Rajapur	Bardiya	165	Agriculture
Belawa_B	Bardiya	118	Shrubs
Belawa_B	Bardiya	163	Shrubs
Kamdi	Banke	631	Forest less than 10%/ Shrubs
Thakurdwara	Bardiya	107	Agriculture/ Forest less than 10%
Gulariya Municipality	Bardiya	220	Agriculture/ Realigned water courses
Sorhawa	Bardiya	121	Agriculture
Laksminiya	Mahottari	274	Agriculture/ Shrubs

Chandranigahapur	Rautahat	126	Forest less than 10%
Karmaiya	Sarlahi	304	Agriculture
Karmaiya	Sarlahi	436	Agriculture
Lakshminiya	Rautahat	159	Agriculture
Haraiya	Bara	121	Agriculture/ Shrubs
Gauribas	Mahottari	111	Forest less than 10%/ Shrubs
Nirmalbasti	Parsa	200	Agriculture
Sonbarsa_B	Parsa	161	Agriculture
Santapur (Matiyon)	Rautahat	240	Agriculture
Rangapur	Rautahat	174	Agriculture/ Forest less than 10%
Shankarpur	Sarlahi	682	Agriculture
Ghurkauli/Janaki Nagar	Sarlahi	701	Agriculture/ Forest less than 10%
Murtiya	Sarlahi	156	Agriculture
Jalthal	Jhapa	122	Agriculture
Indrapur	Morang	122	Agriculture
Koshi Tappu Wildlife Reserve	Sunsari	753	Realigned water courses
Bharaul	Sunsari	144	Agriculture/ Shrubs
Shantinagar	Jhapa	227	Agriculture
Lakhanpur	Jhapa	185	Shrubs/ Infrastructure
Jalthal	Jhapa	108	Agriculture

Annex 6: Quality Assurance Report

1.1 Introduction

There were, altogether, 56 clusters measured in the Terai Region; each cluster consisting of 4 plots, 224 in total. Out of them, 179 sub-plots were found to be in forest and the remaining 45 sub-plots were in other land uses. Among the 179 forested sub-plots, 175 sub-plots were accessible whereas 4 sub-plots were inaccessible due to different obstacles such as dense rattan and creeks in the field. The regular forest inventory work was carried out in three consecutive missions from December, 2010 to March, 2011. Nine teams for field measurement were involved to collect data from entire Terai Region.

Table 1: Time gap between regular measurements and quality assurance measurements

Plot No.	Sub-plot ID	Development Region	Time lag (Months)	Field Mission
1	178-16-1	EDR	2.6	III
2	182-15-3	EDR	4.8	I
3	185-14-6	EDR	2.6	III
4	198-10-6	EDR	5.3	I
5	123-28-1	CDR	2.1	II
6	135-23-1	CDR	1.1	III
7	142-22-4	CDR	3.2	I
8	74-42-3	WDR	8.6	I
9	77-42-6	WDR	6.3	III
10	85-40-1	WDR	8.4	I
11	31-62-1	MWDR	14.5	I
12	33-61-6	MWDR	12.2	III
13	41-58-1	MWDR	12.3	III
14	44-48-4	MWDR	12.2	III
15	6-76-6	FWDR	2.7	II
16	11-73-1	FWDR	3.1	II
17	16-69-4	FWDR	3.0	II
18	19-72-6	FWDR	2.8	II
19	24-70-1	FWDR	4.1	I

About 10% of the forested sample sub-plots were selected and measured in the field for quality assurance. Altogether, 19 sub-plots were selected for re-measurement by the Quality Assurance Teams. The plots were selected systematically so that there were at least three plots within each Development Region. The details of the plots assigned for re-measurement are highlighted in Table 1. The time gap between regular measurement and quality assurance measurement has also been presented in Table 1. The number of trees and basal area per hectare were compared between the regular measurements and the quality assurance measurements.

1.2 Objectives

The objectives of the quality assurance measurement were to:

- assure the quality of the forest inventory field measurement; and
- provide feedback to the crew members and thereby improve the FRA Nepal Field Manual.

1.3 Methodology

For systematic selection, the plots were sorted out with respective IDs in ascending order. At least 10% of the measured plots were selected for quality assurance re-measurement. The sample plots for the quality assurance measurement were selected systematically.

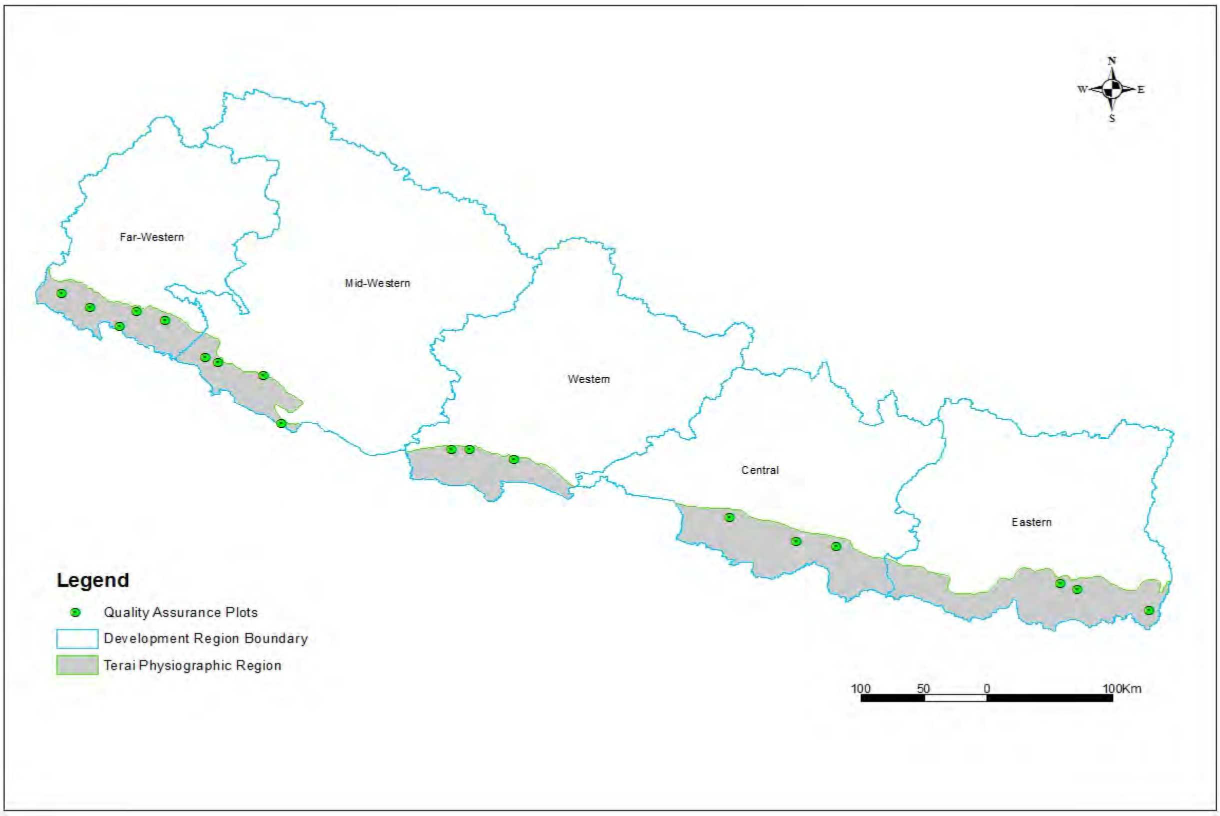


Figure 1: Distribution of quality assurance plots in the Terai region

The locations of the sample plots were detected with the help of GPS units while the center points of the plots were re-located with the help of reference trees (Fixed points) and Metal Detector. Only the tree-level characteristics- the positions of the trees (bearing and distance from center point), species name, DBH, tree height, crown height, quality class and crown classes- were re-measured in the field according to FRA Nepal Field Manual. Out of the 19 forested plots, 5 were in the FWDR, 4 in the MWDR, 3 in the WDR, 3 in the CDR and the remaining 4 in the EDR. Similarly, in terms of mission-wise measurement, 7 plots were re-measured from the first mission, 5 from the second mission and 7 from the third mission. The locations of the re-measured plots are depicted in Figure 1.

1.4 General observations from the field

The following general observations were made during re-measurement.

1. Sample plots were correctly located at the prescribed GPS coordinates;
2. Iron pegs were found to be rightly inserted both at the centres of the plots and 5m apart towards the North (0^o);

3. Reference Trees (Fixed Points) were found to be properly selected;

4. All the sample trees were selected properly;

5. Measurement was found to be done in systematically as prescribed by the inventory field manual;

6. CCSP rules were found to be applied;

7. DBHs were found to be measured properly and precisely;

8. Bearings and distances from the plot-centres for the individual trees were found to be properly measured; and

9. The total tree heights and the crown heights of the trees measured were found to be slightly different.

In few cases, some differences were still observed between regular and quality assurance measurements due to the following reasons:

1. The distances from the plot-centres to the bases of the leaning trees were found to be measured vertically down from 1.3 m height on the ground surface rather than measuring at the tree bases.
2. The distances from the plot-centres to the trees were found to be measured at their edges rather at the centres of the tree trunks.
3. DBHs were found to be measured at small swellings on the trunks at breast heights.
4. Some species were found to be mis-recorded in terms of species code, eg: Bhalayo sometimes as *Semicarpus anacardium* and sometimes as *Rhus* spp. even if the species is the same.
5. DBHs measured using Calipers and D-Tapes were found to be slightly different
6. There was confusion for measurement of climbers; sometimes they were measured as per the CCSP rules and sometimes measured within 20 m radius plots.
7. Up to a centimeter difference was noticed between the regular and the quality assurance DBH measurements because of diameter increments over the time period. As a result, out or borderline-trees were found to be inside the CCSPs.
8. DBHs along with climbers were found to have been measured.
9. DBHs were recorded wrongly, eg. 66.3 cm for 56.3 cm.
10. The trees were found to be missing even the distance was 14.7 m and the DBH 52.0 cm although the CCSP rule has clearly instructed to consider the tree to be in.

1.5 Results

Out of the 19 sub-plots, 7 sub-plots had same number of trees per hectare. The maximum difference in the number of trees per hectare was found to be 462. In totality, the average number of trees per hectare was found to be 1061.0 from the regular field measurements and 1059.5 trees from the quality assurance measurements respectively. Similarly, the basal area was found to be the same in two sub-plots in the case of both the measurements. The maximum difference in the basal area was found to be 4.1 m^2/ha. On an average, the basal area per hectare was found to be 23.0 m^2/ha on the basis of the regular field measurements whereas it was 23.1 m^2/ha based on the quality assurance measurements (Table 2). Those differences between measurements were not found statistically significant when independent sample t-test (P-value =0.96) was applied.

Table 2. Comparison between regular and quality assurance measurements

Plot No.	Plot ID	Regular Measurements		Quality Assurance Measurements		Differences	
		No. of trees/ha	BA (m^2/ha)	No. of trees/ha	BA (m^2/ha)	No. of trees/ha	BA (m^2/ha)
1	178-16-1	1592.0	33.9	1556.4	32.8	35.6	1.1
2	182-15-3	1703.4	33.6	1703.4	33.2	0.0	0.4
3	185-14-6	1408.7	31.6	1010.9	29.0	397.8	2.6
4	198-10-6	2735.5	19.4	2799.4	19.2	-63.9	0.2
5	123-28-1	697.4	19.1	697.4	18.9	0.0	0.2
6	135-23-1	1317.0	26.4	1366.7	26.0	-49.7	0.4
7	142-22-4	1514.2	11.1	1315.2	10.3	199.0	0.8
8	74-42-3	543.1	22.6	543.1	22.8	0.0	-0.2
9	77-42-6	466.0	15.2	515.7	15.9	-49.7	-0.7
10	85-40-1	610.5	14.8	638.8	17.5	-28.3	-2.7
11	31-62-1	1636.4	17.8	1772.1	21.9	-135.7	-4.1
12	33-61-6	515.5	25.4	316.5	25.0	199.0	0.4
13	41-58-1	1108.8	16.1	1570.5	18.6	-461.7	-2.5
14	44-48-4	111.4	32.9	111.4	32.9	0.0	0.0
15	6-76-6	151.2	28.9	151.2	28.9	0.0	0.0
16	11-73-1	631.5	19.3	631.5	19.9	0.0	-0.6
17	16-69-4	1996.1	29.0	1960.5	26.8	35.6	2.2
18	19-72-6	162.7	20.6	162.7	20.2	0.0	0.4
19	24-70-1	1257.3	19.8	1307.1	19.6	-49.8	0.2
Total		**20158.7**	**437.5**	**20130.7**	**439.5**	**28.0**	**-2.0**
Average		**1061.0**	**23.0**	**1059.5**	**23.1**	**1.5**	**-0.1**

1.6 Feedback for field measurement

The weaknesses observed during the quality assurance measurements were shared among the field crew members so that there would not be repetitions of such errors in future. In addition, the Field Manual was also revised for its improvement.

Annex 7. Annotated Checklist of Plant

Trees

ID	Family	Botanical Name	Local Name
6069	Aceraceae	*Acer campbellii* Hook.f. & Thomson ex Hiern	Kapashi, Yali, Yarla, Kabasi
6071	Aceraceae	*Acer cappadocicum* Gled.	Yali
6075	Aceraceae	*Acer oblongum* Wall. ex DC.	Firfire, Putali Phool
6094	Agavaceae	*Agave cantula* Roxb.	Ketuki
6097	Alangiaceae	*Alangium chinense* (Lour.) Harms	Baman patti
6147	Anacardiaceae	*Buchanania latifolia* Roxb.	Piyari, Kaja, Gayo, Char, Achar,Chiraunji, Piyal, Kath Bilawa
6184	Anacardiaceae	*Choerospondias axillaris* (Roxb.) B.L. Burtt&A.W. Hill	Lapsi, Amali, Laalang, Kalang
6370	Anacardiaceae	*Lannea coromandelica* (Houtt.) Merr.	Dabdabe, Chainchuinge, hallaure, Dabdabi,Jhigan, Jhigini, Jhighat
6425	Anacardiaceae	*Mangifera indica* Linn.	Aanp, Amchur, Yam, Aam, Aamba Kyungba
6591	Anacardiaceae	*Rhus wallichii* Hook.f.	Thulo Bhalayo,Bhalayo, Chosi, Dotiyal
6611	Anacardiaceae	*Semecarpus anacardium* L.f	Bhalayo, Bhela, Kumbha, Kage Bhalayo
6632	Anacardiaceae	*Spondias pinnata* (L.f.) Kurz	Amaro, Yamar
6446	Annonaceae	*Miliusa velutina* (Dunal) Hook. F.& Thoms.	Karyauta, kalikath
6109	Apocynaceae	*Alstonia scholaris* (L.) R. Br.	Chalamain, Chativan
6163	Apocynaceae	*Carissa carandas* L.	Paner, Karonda, Karauna
6164	Apocynaceae	*Carissa spinarum* L.	Karauna
6691	Apocynaceae	*Vallaris solanacea* (Roth) Kuntze	Saphed Bel, Dudhe Bel
6117	Arecaceae	*Areca catechu* (L. f.) Willd.	Supari
6501	Arecaceae	*Phoenix acaulis* Roxb.	Khajur, Thakal, Khajuriya, Khajuri, Takul
6502	Arecaceae	*Phoenix dactylifera* L.	Chhohara
6503	Arecaceae	*Phoenix humilis* Royle ex Becc. & Hook. f.	Khajur, Thakal
6134	Betulaceae	*Betula alnoides* Buch.-Ham. ex D. Don	Saur, Painyu, Lekh Saur
6638	Bignoniaceae	*Stereospermum chelonoides* (L.f.) DC.	Kuber Kach, Pandari
6639	Bignoniaceae	*Stereospermum personatum* (Hassk.) Chatterjee	Padari, Parari, padari, Kunda, Kuber Kacha, Kuber Bacha
6139	Bombacaceae	*Bombax ceiba* L.	Simal, Simar
6141	Burseraceae	*Boswellia serrata* Roxb. ex Colebr.	Salai
6335	Burseraceae	*Garuga pinnata* Roxb.	Dabdabe, Ramsin, Aule dabdabe, Kharpat
6224	Capparaceae	*Crateva unilocularis* Buch.-Ham.	Siplikan, Khaichola
6435	Clusiaceae	*Mesua ferrea* L.	Nageswar, Phalame, Ruk Kesar, Potal
6660	Combretaceae	*Terminalia alata* Heyne ex Roth	Asna, Saj, Yasal, Sajha, Asan
6661	Combretaceae	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Arjun, Kahulo, Kahu
6662	Combretaceae	*Terminalia bellirica* (Gaertn.) Roxb.	Barro, Barai, Bahera
6664	Combretaceae	*Terminalia chebula* Retz.	Harro, Harai, Thulo Harro, Jangali Harro, Jange Harro
6665	Combretaceae	*Terminalia myriocarpa* Van Heurck & Mull. Arg.	Pani Saj
6113	Combretaceae	*Anogeissus latifolius* (Roxb. ex DC.) Bedd.	Banjhi, Bod dhaera, Vakli, Dhavadan
6220	Cordiaceae	*Cordia dichotoma* Forster	Bohoree, Lasoraa
6266	Cordiaceae	*Ehretia acuminata* R. Br.	Cille,Dhatarunga,Nalsuna
6269	Cordiaceae	*Ehretia laevis* Roxb.	Loro, Pan, Datrung, Datingal, Chamror
6270	Cordiaceae	*Ehretia macrophylla* Wall.	Lodo
6221	Cornaceae	*Cornus oblonga* (Wall.) Sojak	Lati kath
6668	Cupressaceae	*Thuja orientalis* L.	Mayur Pankhi
6248	Dilleniaceae	*Dillenia aurea* Sm.	
6250	Dilleniaceae	*Dillenia pentagyna* Roxb.	Tantari, Agai, Chalta
6615	Dipterocarpaceae	*Shorea robusta* Gaertn.	Sal, Sakhuwa, Agrakh, Chimar, Sakhu
6252	Ebenaceae	*Diospyros ebenum* Roxb.	Abnush

Annex 7. Annotated Checklist of Plant

ID	Family	Botanical Name	Local Name
6256	Ebenaceae	*Diospyros malabarica* (Desr.) Kostel.	Allo, Kalo Tendu, Khallu, Teju, Halabed
6259	Ebenaceae	*Diospyros tomentosa* Roxb.	Abinas,Bidi Pat, Tendu
6405	Ericaceae	*Lyonia ovalifolia* (Wall.) Drude	Angeri, Angir, Chele, jaggu Chal, Gobre, Tissi
6406	Ericaceae	*Lyonia villosa* (Hook.f.) Hand.- Mazz.	Angeri
6115	Euphorbiaceae	*Aporusa octandra* (Buch.- ham. Ex D. Don) A. R. Vickery	Hade
6144	Euphorbiaceae	*Bridelia retusa* (L.) Spreng.	Gayo, kaja
6419	Euphorbiaceae	*Mallotus philippensis* (Lam.) Mull.- Arg.	Rohini, Ruina, Sindur, Sindure
6507	Euphorbiaceae	*Phyllanthus emblica* Linn.	Amala
6602	Euphorbiaceae	*Sapium insigne* (Royle) benth. Ex Hook.f.	Ban Peepal, Khirro, Kherra
6676	Euphorbiaceae	*Trewia nudiflora* Linn.	Gutel, Vellor, Ramrittha, Aule Kapasi, Gamari, Velthar, Gurel,Pitha
6063	Fabaceae	*Acacia catechu* (L. f.) Willd.	Khayar
6066	Fabaceae	*Acacia rugata* (Lam.) Voigt	Rasula, Sikakai
6083	Fabaceae	*Acrocarpus fraxinifolius* Arn. ex Wight	Mundani
6153	Fabaceae	*Butea monosperma* (Lam.) Kuntze	Palas, Dhak, Tesu, Hastakarni, palas, Bulyatra
6172	Fabaceae	*Cassia fistula* L.	Rajbrikshya, Bandar lathi, Amaltas, banarak lathi, Kirala, Sinara
6176	Fabaceae	*Castanopsis lancifolia* (Kurz) Hickel & A. Camus	Aaule Katus, Patle Katus
6239	Fabaceae	*Dalbergia sissoo* Roxb. ex DC.	Sisam, Sissoo, Sisawa
6240	Fabaceae	*Dalbergia stipulacea* Roxb.	Tantebiri, Tate vari
6287	Fabaceae	*Erythrina stricta* Roxb.	Mandar, Panjir, Parijat, Phaledo
6549	Fabaceae	*Pterocarpus marsupium* Roxb.	Bijaya Sal, Bijaya Sar, Bandhuk Puspa
6564	Fabaceae	*Quercus lanata* Sm.	Banjh, Phalant, Thulo Banjh, Banga, Sano Phalat
6612	Fabaceae	*Sesbania bispinosa* (Jacq.) W.F.Wight	Kanda Dhaicha
6614	Fabaceae	*Sesbania sesban* (L.) Merr.	Sital Chini, Agasti, Jayanti, Jayanta
6613	Fabaceae	*Sesbania grandiflora* (L.) Poir.	Agasti
6065	Fabaceae	*Acacia nilotica* (L.) Willd. ex Delile	Babul, kikar, Babur, Jharkat
6103	Fabaceae	*Albizia odoratissima* (L. f.) Benth.	Karkur, Sirish, Siran, Padke, karkure Siris
6126	Fabaceae	*Bauhinia malabarica* Roxb.	Tanki,, Amil Tanki, Asoti, Khatta Jhinjhora, Jhinjhora, Khatuwa
6127	Fabaceae	*Bauhinia purpurea* L.	Tanki, Rato Koiralo, Koiralo, Kachnar
6131	Fabaceae	*Bauhinia variegata* L.	Koiralo, Kanabu, Seto Koiralo,Koirar, kachnar, Aanbu
6246	Fabaceae	*Desmodium oojenense* (Roxb.) Ohashi	Sadan, Pandan, Tinkire, Sandan pipli, Sadhan, Panjan, Panan
6603	Fabaceae	*Saraca asoca* (Roxb.) De Wilde	Ashok, Asau
6098	Fabaceae	*Albizia chinensis* (Osbeck) Merr.	Kalo Siris
6104	Fabaceae	*Albizia procera* (Roxb.) Benth.	Seto Siris
6235	Fabaceae	*Dalbergia latifolia* Roxb.*	Satisal
6168	Flacourtiaceae	*Casearia elliptica* Willd.	Thulo Deri, Sano Bethe, Chilla, Deri, Beri
6170	Flacourtiaceae	*Casearia graveolens* Dalzell	Badkaule, Pipane
6329	Flacourtiaceae	*Flacourtia jangomas* (Lour.) Raeusch.	Taalishpatree
5767	Grossulariaceae	*Ribes glaciale* Wall.	Kembu, Tomaru, Tonmaru
6299	Hamamelidaceae	*Exbucklandia populnea* (R. Br. ex Griff.) R. W. Br.	Piple, Pipli
6398	Lauraceae	*Litsea glutinosa* (Lour.) C.B.Rob.	Kutmero,Kadmero, Ratmati
6401	Lauraceae	*Litsea monopetala* (Roxb.) pers.	Kutmero, Ghante Phool, Ratmate, Kadmero, Putmero
6465	Lauraceae	*Neolitsea umbrosa* (Nees) Gamble	Putali, Khapate,Phephe, Potele
6491	Lauraceae	*Persea duthiei* (kingex Hook.f.) Kosterm	Kaulo, Mahilo Kaulo

Annex 7. Annotated Checklist of Plant

ID	Family	Botanical Name	Local Name
6493	Lauraceae	*Persea odoratissima* (Nees) Kosterm.	Seti kaulo, Kaulo, Roro
6160	Lecythidaceae	*Careya herbacea* Roxb.	Kumbhi, Kuma, Bodar
6148	Loganiaceae	*Buddleja asiatica* Lour.	Sina Swan, Bhimsen Pate, Narayan Pati, Cheule
6151	Loganiaceae	*Buddleja macrostachya* Benth.	Bhimsen pati
6449	Loganiaceae	*Mitrasacme pygmaea* R. Br.	
6369	Lythraceae	*Lagerstroemia parviflora* Roxb.	Bot Dhaiyaro, Asare, Sidda, Hade
6373	Lythraceae	*Lawsonia inermis* Linn.	Mehandi, Mehari
6415	Magnoliaceae	*Magnolia globosa* Hook f. & Thoms.	
6418	Magnoliaceae	*Magnolia pterocarpa* Roxb.	Patpate
6367	Malvaceae	*Kydia calycina* Roxb.	Kubhinde, Bori, Pali, Pala, Pulu, Puli
6123	Meliaceae	*Azadirachta indica* A. Juss.	Nim
6264	Meliaceae	*Dysoxylum binectariferum* (Roxb.) Hook. f. ex Bedd.	Bauri Phal, Dhamina, Sano Dhamina
6265	Meliaceae	*Dysoxylum gobara* (Buch.-Ham.) Merr.	Lasune, Thulo Dhamina, Dhamina
6428	Meliaceae	*Melia azedarach* Linn.	Bakenu, Bakaino, Khaibasi, Bakain
6429	Meliaceae	*Melia dubia* Cav.	
6631	Meliaceae	*Sphaerosacme decandra* (Wall.) Pennington	Bandare Phal, Lahare Lalgedi
6669	Meliaceae	*Toona ciliata* M. Roem.	Tooni, Tuna, Tuni
6677	Meliaceae	*Trichilia connaroides* (Wight & Arn) Benfvelzen	Chaichunge, Singmur, Aankha taruwa, Ankha Tare, Komal Siuli
6105	Mimosaceae	*Albizia lebbeck* (L.) Benth.	Kalo Sirish
6119	Moraceae	*Artocarpus chaplasha* Roxb.	Later
6120	Moraceae	*Artocarpus heterophyllus* Lam.	Katahar
6122	Moraceae	*Artocarpus lakoocha* Wall. ex Roxb.	Badahar
6306	Moraceae	*Ficus auriculata* Lour.	Nibharo, Timilo, Bhemala, Nimaro, Timile, Khamare, Anjir
6307	Moraceae	*Ficus benghalensis* Linn.	Bar
6308	Moraceae	*Ficus benjamina* L.	Sami, Swami, Chonkar
6315	Moraceae	*Ficus hispida* L.	Kharseto, Kharawa, Kharseto, Thotne, Tote
6316	Moraceae	*Ficus lacor* Buch.-Ham.	Kabhro, Pakadi, Palaksa, Pilkhan
6317	Moraceae	*Ficus neriifolia* Sm.	Dudhilo, Dudh Karaiya, Magoo(Tam.)
6322	Moraceae	*Ficus racemosa* L.	Pakar, Dumri, Gullar, Dumari
6323	Moraceae	*Ficus religiosa* L.	Pipal, Pipar
6325	Moraceae	*Ficus semicordata* Buch.-Ham. ex Sm.	Khanya, Khanayo, Khaniyo, Khurhuri
6641	Moraceae	*Streblus asper* Lour.	Bedula,Kakshi
6455	Moringaceae	*Moringa oleifera* Lam.	Shovanjan, Sahijan
6207	Myrtaceae	*Cleistocalyx operculatus* (Roxb.) Meer. & Perry	Kyamuna, Phulepa, Phandir
6290	Myrtaceae	*Eucalyptus camaldulensis* Dehn.	Masala
6548	Myrtaceae	*Psidium guajava* Linn.	Amba, belauti, Ambak, Runi, latam, Amarud
6651	Myrtaceae	*Syzygium cumini* (L.) Skeels	Jamuna, Jambu, Phadir, Kalo Jamun, Karki Jamun, Jam, Jambu
6652	Myrtaceae	*Syzygium jambos* (L.) Alston	Jamun, Gulaf Jamun
6470	Ochnaceae	*Ochna obtusata* DC.	
6473	Olacaceae	*Olax nana* Wall. ex Benth.	Sigrot
6375	Oleaceae	*Ligustrum confusum* Decne.	Kanike phul
6469	Oleaceae	*Nyctanthes arbor-tristis* Linn.	Parijat, Ratgamki, Kurri, Harsingar, Harsingar, Harsingha,Budilo
6513	Pinaceae	*Pinus roxburghii* Sarg.	Rani Salla, Khote Salla, Salla, Aule Salla
6339	Proteaceae	*Grevillea robusta* A.Cunn. ex R. Br.	Kagiyo, Kagiyo Rukh
6055	Rhamnaceae	*Zizyphus oenoplia* (L.) Mill.	Aule Bayar
6701	Rhamnaceae	*Zizyphus mauritiana* Lam.	Bayar, Bayari, Pewandi, Pemdi Ber

Annex 7. Annotated Checklist of Plant

ID	Family	Botanical Name	Local Name
6702	Rhamnaceae	*Zizyphus rugosa* Lam.	Kanta Bayar, harra Bayar, Ban Bagero, Rukh Bayari, Phander, Kath Ber
6534	Rosaceae	*Prunus cerasoides* D.Don	Paiyun
6541	Rosaceae	*Prunus persica* (L.) Batsch	Aaru, Aadu, Khale
6556	Rosaceae	*Pyrus pashia* Buch.- Ham. Ex D.Don	Mayal, Pana
6089	Rubiaceae	*Adina cordifolia* (Willd. ex Roxb.) Benth. & Hook. f. ex Brandis	Karam, Haldu, Karma
6114	Rubiaceae	*Anthocephalus chinensis* (Lam.) A. Rich. Ex Walp.	Kadam
6349	Rubiaceae	*Hymenodictyon flaccidum* Wall.	Lati Karam, Seti Kath, Bhurkul,Bhudkul
6448	Rubiaceae	*Mitragyna parviflora* (Roxb.) Korth.	Tikul, Sano Haldu, Phaldu, Kaim
6695	Rubiaceae	*Xeromphis spinosa* (Thunb) Keay	Main kanda, Main Phal, Maidal, Madan Phal, Amuki
6696	Rubiaceae	*Xeromphis uliginosa* (Retz.) Maheshwari	Pindar, Pirar, Maidal
6090	Rutaceae	*Aegle marmelos* (L.) Correa	Bel, Bel patra
6195	Rutaceae	*Citrus aurantifolia* (Christ.) Swingle	Jyameer
6201	Rutaceae	*Citrus limon* (L.) Burm.f.	Nibuwa, Lembakyumba
6202	Rutaceae	*Citrus maxima* (Burm. ex Rumph.) Merr.	Bhogate
6301	Rutaceae	*Feronia limonia* (L.) Swingle	Amilobel, Kaitho,Karanda,Karanta, Kentho
6526	Salicaceae	*Populus jacquemontiana* Dode	Pipal lagara
6610	Sapindaceae	*Schleichera oleosa* (Lour.) Oken	Kusum, Gosum, Gausam
6261	Sapotaceae	*Diploknema butyracea* (Roxb.) H.J. Lam	Chyuree
6411	Sapotaceae	*Madhuca latifolia* (Roxb.) Macbride	Latimauwa, Mahuwa
6412	Sapotaceae	*Madhuca longifolia* (Koeing) Macbride	Mahuwa, Chiuri
6607	Saurauiaceae	*Saurauia tristyla* DC.	
6263	Sonneratiaceae	*Duabanga grandiflora* (Roxb. ex DC.) Walp.	Lampate, Odhane, Lampatiya
6551	Sterculiaceae	*Pterospermum acerifolium* (L.) Willd.	Hatti Pailo,Golaicho, Mayang, Kanak, Champa
6637	Sterculiaceae	*Sterculia villosa* Roxb.	Odal, Odane, Andal
6226	Taxodiaceae	*Cryptomeria japonica* (L. f.) D. Don	Dhupi, Dhupi Salla
6341	Tiliaceae	*Grewia subinaequalis* DC.	Falsa, Fussi, Syal Phusro, Phosro, Harsa-Pharsa, Phalsa
6345	Ulmaceae	*Holoptelea integrifolia* (Roxb.) Planch.	Khamari, kanju, papari, Methe Phal, Sano Pangre, Papri
6337	Verbenaceae	*Gmelina arborea* Roxb.	Khamari, Gambari, Gamhari, Khamar
6659	Verbenaceae	*Tectona grandis* L.f.	Teak, Sagawan, Saguan
9999		Unidentified species	

Note: *Vulnerable (IUCN Redlist)

Shrubs			
5412	Acanthaceae	*Justicia adhatoda* Linn.	Asuro, kalo Bhasak, Yasur, Aleha
5923	Acanthaceae	*Strobilanthes angustifrons* C.B Clarke	Kibbu
5184	Anacardiaceae	*Dobinea vulgaris* Buch.-Ham. ex D.Don	Sangle
5669	Anacardiaceae	*Pistacia chinensis* Bunge	Karkata shringi
5765	Anacardiaceae	*Rhus parviflora* Roxb.	Sativayar
5347	Apocynaceae	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don	Indra jau, Kurchi, Kebat, Madise Khirro, Dudh Khirro, Dudh Kira
5715	Apocynaceae	*Rauvolfia serpentina* (L.) Benth. ex Kurz	Sarpagandha, Chand Maruwa,, Jhar Mauro, Dhar Maruwa, Chandmari
6040	Apocynaceae	*Wrightia arborea* (Dennst.) Mabberly	Ban Kera, Thulo Bankera, Thulo kuro, Kiringi, Kaling

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ID	Family	Botanical Name	Local Name
4983	Asclepiadaceae	*Calotropis gigantea* (L.) Dryand.	Aank, Seto Aank, Baramase Aank, Arka, Aakon, Arka, Madar, Safed
5647	Asclepiadaceae	*Pergularia daemia* (Forssk) Chiov.	Dure
4893	Berberidaceae	*Berberis aristata* DC.	Chutro, Kinsi, Kirmando, Kirmundo, Marpyasi, Kerpark
5598	Bignoniaceae	*Oroxylum indicum* (L.) Kurz	Tatelo, karam, Kanda, Sauna, Sontat, Totilla, Laamendho
5366	Clusiaceae	*Hypericum japonicum* Thunb. ex Murray	Kanike ghas
5400	Convolvulaceae	*Ipomoea carnea* Jacq.	Ajambari, Bisari Jhar
4842	Euphorbiaceae	*Antidesma acidum* Retz.	Archale, Himalcheri, Amari, Imili, Kali Katai
4963	Euphorbiaceae	*Bridelia stipularis* (L.) Blume	
5189	Euphorbiaceae	*Drypetes roxburghii* (Wall.) Hurusawa	Putranjeevaa, Pitmaaree
5251	Euphorbiaceae	*Euphorbia royleana* Boiss.	Siundi
5405	Euphorbiaceae	*Jatropha curcas* Linn.	Sajiwa, nirguni, Ratanjot, Saruwa, Sajiyon, Hatti Kane, Baghandi, Arin
5777	Euphorbiaceae	*Ricinus communis* Linn.	Andir, Adir, Ander, Arin, Anderi, Andel, Aderi
4813	Fabaceae	*Acacia pennata* (L.) Willd.	Aradi, Atare, Arphu
5283	Fabaceae	*Flemingia macrophylla* (Willd) Corner	Bhatvasi
5386	Fabaceae	*Indigofera pulchella* Roxb.	Mirmire, Phusre ghas, Rato mirmire, Sakhinu
5447	Fabaceae	*Leucaena leucocephala* (Lam.) De Wit	Ipil Ipil
4974	Fabaceae	*Caesalpinia cucullata* Roxb.	
5168	Fabaceae	*Desmodium gangeticum* (L.) DC.	Salparni, Ban gahate, Presni Panni, karochi jhar
5284	Fabaceae	*Flemingia strobilifera* (L.) Ait.	Sano Bansapti, Bansapti, Bisahari jhar
5547	Fabaceae	*Millettia extensa* (Benth.) Baker	Gonjo, Gauj
5080	Lamiaceae	*Colebrookea oppositifolia* Sm.	Dhursul, Dhursule, Sitroma, Dosul
5654	Lauraceae	*Persea gamblei* (King ex Hook. f.) Kosterm.	Kathe kaulo
5430	Leeaceae	*Leea indica* (Burm.f.) Merr.	Kukur Jibre
5163	Loranthaceae	*Dendrophthoe falcata* (L.f.) Etring.	Ainjeru, Riniya, Ajeru
6019	Loranthaceae	*Viscum articulatum* Burm. F.	Harchu,Hadchure
6039	Lythraceae	*Woodfordia fruticosa* (L.) Kurz.	Dhaiyaro, Dhuinya, Amar Phool, Dhayaro
4802	Malvaceae	*Abelmoschus manihot* (L.) Moench.	Ban Nalu, Odal, Odale
5337	Malvaceae	*Hibiscus manihot* L.	Ban lasun
5529	Melastomaceae	*Melastoma melabathricum* Linn.	Angeri, Culesi
5269	Moraceae	*Ficus palmata* Forssk.	Bedu, Berulo
5272	Moraceae	*Ficus sarmentosa* Buch.-Ham. ex Sm.	Berulo, Ban Timilo, Kathe Dumri, Bihar Khanyau
5556	Moraceae	*Morus australis* Poir.	Kimbu, Kut Simal
5572	Musaceae	*Musa paradisiaca* L.	Kera, Moje
5349	Myristicaceae	*Horsfieldia kingii* (Hook. f.) Warb.	
4848	Myrsinaceae	*Ardisia solanacea* Roxb.	Damai phal, Mamai Phal, Lawathi, Bhanti
5498	Myrsinaceae	*Maesa chisia* Buch.- Ham.ex D. Don	Bilaune
5404	Oleaceae	*Jasminum mesney* Hance	Dabal Jai,Lahare Jai, Jai
6053	Rhamnaceae	*Zizyphus apetala* Hook. F. ex Lawson	
6055	Rhamnaceae	*Zizyphus oenoplia* (L.) Mill.	Foothill Jujube
5129	Rosaceae	*Cotoneaster sandakphuensis* Klotz	
5712	Rubiaceae	*Randia tetrasperma* (Roxb.) Benth. & Hook.f.ex Brandis	Hakukeda,Kanda
6029	Rubiaceae	*Wendlandia exserta* (Roxb.) DC.	Rato kaiyo, Ban Kaiyo,Badhuwa, Chaulai, Tilko, Tiluko
5061	Rutaceae	*Clausena pentaphylla* DC.	Raunne, Rantanjot, Asare Phool
5569	Rutaceae	*Murraya koenigii* (L.) Spreng.	Asare, Mitho nim, Khole jamun, Machimer, Mechiya Sag

ID	Family	Botanical Name	Local Name
5570	Rutaceae	*Murraya paniculata* (L.) Jack	Kamana phul, Kamini,
6047	Rutaceae	*Zanthoxylum armatum* DC.	Timur, Yerma, Primu
5843	Salicaceae	*Salix plectilis* Kimura	Bainsh
5860	Sambucacaeae	*Sambucus hookeri* Rehder	Galeni
5155	Solanaceae	*Datura metal* Linn.	Kalo Dhatura
5156	Solanaceae	*Datura stramonium* Linn.	Dhaturo, Seto Dhaturo
5890	Solanaceae	*Solanum torvum* Swartz	Thulo Bihi, Kacher, kachera, Chusai, Bihi
5329	Sterculiaceae	*Helicteres isora* Linn.	Kapase
5326	Tiliaceae	*Grewia optiva* Drumm. ex Bturet	Bhimal, Bhebul, Bheol, Syal Phusre
5328	Tiliaceae	*Grewia sclerophylla* Roxb.	Pharso, Pama, Gurveli, Pharsa
5979	Ulmaceae	*Trema politoria* (Planch.) Blume	
4981	Verbenaceae	*Callicarpa macrophylla* Vahl	Daikamla, Daichamle, Guyalo, Datiwanak Phal, mas gede
5069	Verbenaceae	*Clerodendrum japonicum* (Thunb.) Sweet	Dhago Phul
5072	Verbenaceae	*Clerodendrum serratum* (L.) Moon	Anekhi, Akhandi, Andekhi, Chuwa, Golaichi
5075	Verbenaceae	*Clerodendrum viscosum* Vent.	Venta, Chitu, Rajbeli, kalo, Baklepate, Bhati, Bhathi, Dhusi
5077	Verbenaceae	*Clerodendrum viscosum* Vent.	Venta, Chitu, Rajbeli, kalo Baklepate, Bhati, Bhathi, Dhusi
5193	Verbenaceae	*Duranta repens* Linn.	
5422	Verbenaceae	*Lantana camara* Linn.	Masino kanda, Ban Phanda Kanda, Lwang Phool, Ban Phada

	Herbs		
1285	Acanthaceae	*Barleria cristata* Lirur.	Bhede kuro, katsaraiya, lariphool
2766	Acanthaceae	*Justicia procumbens* Linn.	Phool-phar
931	Acoraceae	*Acorus calamus* Linn.	Bojho, Syuada Bach
879	Amaranthaceae	*Achyranthes aspera* Linn.	Datiwan, Apamarga, nak Siruka, Ultakur, Garsabe
882	Amaranthaceae	*Achyranthes bidentata* Blume	Rato Datiwan, Rato Apamarga
1016	Amaranthaceae	*Alternanthera sessilis* (L.) DC.	Bhiringi jhar, Bhringraj, Gibre pate, Saraci
1024	Amaranthaceae	*Amaranthus spinosus* Linn.	Kandelunde, Katari, Kathgaiya, Lunde latte, Bakancha, Ban lunde
1027	Amaranthaceae	*Amaranthus viridis* Linn.	Latte Sag, Lunde, lunde Sag
1634	Apiaceae	*Centella asiatica* (L.) Urb.	Ghodtapre, kholcha Dhaya, Bramhi, Bramha Buti, Chakror
2631	Apiaceae	*Hydrocotyle sibthorpioides* Lam.	Jaluko, Jal, Kumbhi, Pureni, Jaluki
2256	Apiaceae	*Eryngium foetidum* Linn.	Barmeli Dhaniya
1188	Araceae	*Arisaema griffithii* Schott	
1757	Araceae	*Colocasia esculenta* (L.) Schott	Gava, Pindalu, karkalo, Taya
1871	Armaryllidaceae	*Crinum amoenum* Roxb.	Hade lasun
1232	Asclepiadaceae	*Asclepias curassavica* L.	Machha Phul, Khursani Kose Phool, Khursani Phool
1241	Asparagaceae	*Asparagus racemosus* Willd.	Satawari, kurilo, Makuri, Thota
1011	Asphodelaceae	*Aloe vera* (L.) Burm. f.	Ghiu kumari
1257	Asteraceae	*Aster indamellus* Grierson	Lukmik
1319	Asteraceae	*Bidens pilosa* Linn.	Kuro, Thulo kuro, Kurkur, Kalo Kuro, Maha Rathi
1346	Asteraceae	*Blumea lacera* (Burm.f.) DC.	Kurkure, Kukuradra

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ID	Family	Botanical Name	Local Name
2157	Asteraceae	*Elephantopus scaber* Linn.	Halhale, Bhedo Kuro, Gomukhi, Bhiringi Jhar
2496	Asteraceae	*Gnaphalium affine* D. Don	Boke Phool, Kairo jhar, Jyapu Dhaya, Bokre phool
2588	Asteraceae	*Helianthus annus* L.	Suryamukhi, Taramandal
3895	Asteraceae	*Rorippa nasturtium* (L.) Hayek	Sano Ghodtapre
4280	Asteraceae	*Sphaeranthus indicus* Linn.	Gorakhmundi, Bander, Mundi
4285	Asteraceae	*Spilanthes paniculata* Wall.	Lato ghas, Marati
962	Asteraceae	*Ageratum conyzoides* Linn.	Boke Ghas, Ganaune jhar, Ganki, keucha Dhayan, Nayano, Phohare Jhangi
963	Asteraceae	*Ageratum houstonianum* Miller	Nilo gandhe
1212	Asteraceae	*Artemisia dubia* Wall. ex Besser	Tite pati, gandhe jhar
1215	Asteraceae	*Artemisia indica* Willd.	Titepati, Nag Damani, khamba, Gandhe jhar, Dhuswan, Chyanchin
2273	Asteraceae	*Eupatorium adenophorum* Spreng.	Ban mara, Kangresi Jhar, Kal Jhar
2279	Asteraceae	*Chromolena odoratum* Linn.	Kalo Ban mara
1499	Cannabaceae	*Cannabis sativa* Linn.	Bhango, Bhang,Ganja, Charesh, Gajima
2124	Caryophyllaceae	*Drymaria villosa* Chamb. & Schlect.	Abhijalo
4298	Caryophyllaceae	*Stellaria aquatica* (L.) Scop.	
4308	Caryophyllaceae	*Stellaria media* (L.) Vill.	
2308	Convolvulaceae	*Evolvulus alsinoides* (L) Linn.	Ankuri phul
2309	Convolvulaceae	*Evolvulus nummularius* Linn.	
4654	Cyperaceae	*Bulbostylis barbata* (Rottb.) C.B Clarke	Jhuse Jhar
4661	Cyperaceae	*Cyperus compressus* Linn.	Mothe Jhar
4673	Cyperaceae	*Cyperus iria* Linn.	Thulo Mothe, Chhate Mothe, Chhatare
4683	Cyperaceae	*Cyperus rotundus* Linn.	Nagar Mothe, mothe, motha
4688	Cyperaceae	*Cyperus tuberosus* Rottb.	
4771	Cyperaceae	*Mariscus sumatrensis* (Retz.) T. Koyama	Karaunte
2087	Dipsacaceae	*Dipsacus atratus* Hook. f. & Thomson ex C.B. Clarke	Supari Ghas
6937	Dryopteridaceae	*Dryopteris cochleata* (Buch-Ham ex D. Don) C. Chr	Danthe Nyuro, Nyuro, Unau, Pani nyuro
6973	Equisetaceae	*Equisetum ramosissimum* Desfontaines	Aakhle Jhar
1894	Euphorbiaceae	*Croton tiglium* L.	Lapche Bish
2285	Euphorbiaceae	*Euphorbia hirta* Linn.	Ban Dudhe, Dudhe, Rato Mas lahare, Dudhe Jhar, Dudhiya
2287	Euphorbiaceae	*Euphorbia ligularia* Roxb.	Sudi, Sij
1876	Fabaceae	*Crotalaria alata* Buch.- Ham.	Chin chine
1877	Fabaceae	*Crotalaria albida* Heyne ex Roth	Putali phul
2035	Fabaceae	*Desmodium heterocarpon* (L.) DC.	Sakhino
2323	Fabaceae	*Flemingia paniculata* Wall. ex Benth.	
3082	Fabaceae	*Mimosa rubicaulis* Lam.	Banmara, Kangresi jhar, Kal jhar
4579	Fabaceae	*Vicia angustifolia* Linn.	Kutuli kosa, Nekari, kankara, Abanyu, Akata
3081	Fabaceae	*Mimosa pudica* Linn.	Dhaniyan varmeli
4366	Gentianaceae	*Swertia nervosa* (G. Don) C.B. Clarke	Tite, Aulo Ghas, Kalo Chiraito
6897	Gleicheniaceae	*Dicranopteris linearis* (Burm.) Underw.	Unau
6867	Hymenophyllaceae	*Crepidomanes parvifolium* (Barker) K. Iwats	
1902	Hypoxidaceae	*Curculigo capitulata* (Lour.) Kuntze	Musli, Kanda, Datgijari, Musli, Kalo, Musli
1904	Hypoxidaceae	*Curculigo gracilis* (Kurtz) Wall.	
1905	Hypoxidaceae	*Curculigo orchioides* Gaertn.	Musli Kanda, Musli, Kalo Musli
1730	Lamiaceae	*Clinopodium umbrosum* (M.Bieb.) C. Koch	Bilajor
3023	Lamiaceae	*Marmoritis decolorans* (Hemsl.) Li	
2160	Lamiaceae	*Elsholtzia blanda* (Benth.)	Ban Silam, Lha Silam

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ID	Family	Botanical Name	Local Name
3061	Lamiaceae	*Mentha arvensis* Linn.	Babari, Pudina
3063	Lamiaceae	*Mentha spicata* Linn.	Pudina, Patame, Nawa Dhaya, Babari
3178	Lamiaceae	*Ocimum basilicum* Linn.	Tulasi, Babari Phool
3179	Lamiaceae	*Ocimum gratissimum* Linn.	Sudi, Sij
3572	Lamiaceae	*Pogostemon benghalensis* (Burm. f.) Kuntze	Rudilo, Sihuwa
4611	Loranthaceae	*Viscum album* Linn.	Hadchur
7025	Lygodiaceae	*Lygodium flexuosum* (L.) Swartz	Parebamuri, Bakliuki, Lahare Unau
7028	Lygodiaceae	*Lygodium salicifolium* C. Presl	
4194	Malvaceae	*Sida acuta* Burm. f.	Phulphar
4198	Malvaceae	*Sida rhombifolia* Linn.	Khursani jhar
4522	Malvaceae	*Urena lobata* Linn.	Nalu Kuro, Unga, Kuro, Bariyar, Bhere jhar
7053	Nephrolepidaceae	*Nephrolepis auriculata* (L.) K. Presl.	Pani Amala, Pani Saro
2969	Onagraceae	*Ludwigia hyssopifolia* (G. Don) Exell	Khursani jhar
7069	Ophioglossaceae	*Ophioglossum reticulatum* Linn.	Jibre sag
874	Orchidaceae	*Acampe papillosa* (Lindl.) Lindl.	
3231	Oxalidaceae	*Oxalis acetosella* Linn.	Dudhe, Dudhe jhar, Dudhiya, Rato mas lahara
3233	Oxalidaceae	*Oxalis corniculata* Linn.	Ankuri phul
1173	Papavaraceae	*Argemone mexicana* Linn.	Thakal, Sungure kanda, Satyanashi, Palanti kanda
3531	Plantaginaceae	*Plantago major* Linn.	Isabgol
923	Polygonaceae	*Aconogonum molle* (D. Don) Hara	Thotne, Tuknu, Patu Swan, Tipun
3385	Polygonaceae	*Persicaria barbata* (L.) Hara	Pire, Totaiya, Ratnyaule Jhar
3386	Polygonaceae	*Persicaria barbata* (L.) Hara Var. barbata	Pire, Totaiya, Machharimara Jhar
2138	Pontederiaceae	*Eichhornia crassipes* (Martius) Solms	Jaluko, Jal, Kumbhi, Pureni, Jaluki
7137	Pteridaceae	*Pteris biaurita* (Linn.) Hook.	
7138	Pteridaceae	*Pteris cretica* Linn.	Unau
3151	Ranunculaceae	*Nigelia sativa* L.	Kaljira, Mungrelo
2127	Rosaceae	*Duchesnea indica* (Andrews) Focke	Sarpe Kaphal, Sarpako Kaphal
1367	Rubiaceae	*Borreria articularis* (L. f.) F. N. Williams	
1369	Rubiaceae	*Borreria pusilla* (Wall.) DC.	
4104	Scrophulariaceae	*Scoparia dulcis* Linn.	Sano ghodtapre
4457	Scrophulariaceae	*Torenia cordifolia* Roxb.	
4257	Solanaceae	*Solanum surattense* Burm.f.	Kantakari, Bad bedi, Bhat Kataiya, gurmi kant, kachchido, Chherhatta
7201	Thelypteridaceae	*Thelypteris dentata* (Forrsk.) E.P. St. John.	
4498	Tiliaceae	*Triumfetta annua* Linn.	Dalle Kuro, Jhinjhatiya, Khangra
2019	Urticaceae	*Dendrocnide sinuata* (Blume) Chew	Maringe
2151	Urticaceae	*Elatostema rupestre* (Buch-Ham ex D. Don)	
3459	Verbenaceae	*Lippia nodiflora* (L.) Rich.	Kurkure Jhar
6904	Woodsiaceae	*Diplazium esculentum* (Retz.) Sw.	Nyuro, Pani Nyuro, Kochaiya, Khatilak sag, Kuta
1906	Zingiberaceae	*Curcuma angustifolia* Roxb.	Kaledo, Kalo Haledo, Katahare Phool, Ban Besar
1907	Zingiberaceae	*Curcuma aromatica* Salisb.	Ban Haledo, Ban Dhale, Haledo, Hardi, Ban Hardi
1908	Zingiberaceae	*Curcuma zedoaria* Rosc.	Ban Haledo, Sathi, Kachur
3902	Zingiberaceae	*Roscoea purpurea* (K. Schum.) Hara	Suryamukhi, Taramandal

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ID	Family	Botanical Name	Local Name
	Climbers / Epiphytes		
197	Apocynaceae	*Ichnocarpus frutescens* (L.) R. Br.	Dudhe lahara
381	Apocynaceae	*Trachelospermum lucidum* (D. Don) K. Schum.	Dwari lahara
256	Asclepiadaceae	*Marsdenia tenacissima* (Roxb.) Moon	Bahunee lahara
259	Asclepiadaceae	*Marsdenia tinctoria* R. Br.	Kali laharo
125	Asclepiadaceae	*Cryptolepis buchananin* Roem.& Schult.	
261	Asteraceae	*Mikania micrantha* Kunth	Banmara
263	Cucurbitaceae	*Momordica charantia* L.	Tite karela
146	Dioscoreaceae	*Dioscorea alata* L.	Ghar tarul
147	Dioscoreaceae	*Dioscorea belophylla* (Prain) Voigt ex Haines	
148	Dioscoreaceae	*Dioscorea bulbifera* L.	Gitthe tarul
149	Dioscoreaceae	*Dioscorea deltoidea* Wall. ex Griseb.	Bhyakur tarul
150	Dioscoreaceae	*Dioscorea esculenta* (Lour.) Burkill	Suthnee tarul
156	Dioscoreaceae	*Dioscorea pentaphylla* L.	Mithe- tarul
157	Dioscoreaceae	*Dioscorea prazeri* Prain & Burkill,	Kukur tarul
2	Fabaceae	*Abrus precatorius* L.	Ratigedi
36	Fabaceae	*Bauhinia vahlii* Wight & Arn	Bhorla
269	Fabaceae	*Mucuna pruriens* (L.) DC.	Kauso
358	Fabaceae	*Spatholobus parviflorus* (Roxb.) Kuntze	Debre lahara
334	Liliaceae	*Smilax aspera* L.	Kukurdaaino
351	Liliaceae	*Smilax ovalifolia* Roxb. ex D. Don	Kukurdaaino
356	Liliaceae	*Smilax zeylanica* L.	Kukur daino
183	Malphiaghiaceae	*Hiptage benghalensis* (L.) Kurz	Charpate laharo
68	Menispermaceae	*Cissampelos pareira* L.	Batulpate, Gudurganu
379	Menispermaceae	*Tinospora sinensis* (Lour.) Merr.	Gurjo-ko-laharaa
225	Oleaceae	*Jasminum multifolrum* (Burm. f.) Andrews	Tare jasmine
874	Orchidaceae	*Acampe papillosa* (Lindl.) Lindl.	Sungava
2056	Orchidaceae	*Desmotrichum fimbriatum* Bl.	
291	Piperaceae	*Piper longum* L.	Pipla
103	Ranunculaceae	*Clematis triloba* Thunb.	
7025	Schizaeaceae	*Lygodium flexuosum* (Linn) Sw.	
7026	Schizaeaceae	*Lygodium japonicum* (Thunb.) Sw.	
58	Vitaceae	*Cayratia trifolia* (L.) Domin	Karaunja
73	Vitaceae	*Cissus repens* Lam.	Charchare laharo, Pureni
372	Vitaceae	*Tetrastigma serrulatum* (Roxb.)	
401	Vitaceae	*Vitis vinifera* L.	

Annex 8. Tree species Abundance in Sampling Sub-plots in the Terai Forest

Plot/Spp. ID	-9999	4848	5160	5427	6028	6039	6063	6065	6083	6089	6090	6097	6098	6104	6109	6113	6114	6115	6126	6127	6139	6144	6147	6153	6160	6163	6168	6170	6172	6207	6221	6235	6239	6246	6250	6256	6259	6264	6265	6266	6269	6287	6299	6301
10_75:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10_75:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11_73:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
11_73:3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11_73:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
11_73:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115_29:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
115_29:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
115_29:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
115_29:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117_29:1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117_29:3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117_29:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	2	1	0
117_29:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0
119_29:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
119_29:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	2	1	0	0	0	0	0	1	0	0	0
119_29:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119_29:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
12_72:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12_72:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121_28:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
121_28:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	1	2	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
121_28:4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
121_28:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	2	2	0	0	0	0	0	0	0	0	0
123_28:1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	2	0	0	3	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
123_28:3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0
123_28:4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
123_28:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125_25:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
125_25:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125_25:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
125_25:6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126_26:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
126_26:3	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	4	0	0	0	0	0	0	0	0	0	0	1	0	0	6	0	2	0	0	2	0	0	0	0	0	0	0	0	0
126_26:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
126_26:6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
128_26:1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
128_26:4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0
128_26:6	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
130_24:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132_24:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132_24:3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132_24:4	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132_24:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135_23:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135_23:3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
135_23:4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135_23:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14_74:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 8. Tree species Abundance in Sampling Sub-plots in the Terai Forest

	-9999	4848	5160	5427	6028	6039	6063	6065	6083	6089	6090	6097	6098	6104	6109	6113	6114	6115	6126	6127	6139	6144	6147	6153	6160	6163	6168	6170	6172	6207	6221	6235	6239	6246	6250	6256	6259	6264	6265	6266	6269	6287	6299	6301
14_74:3	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14_74:6	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142_22:1	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142_22:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142_22:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142_22:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
152_19:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
152_19:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16_69:1	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16_69:3	0	0	0	0	0	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16_69:4	0	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
16_69:6	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
17_70:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17_70:3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17_70:4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17_70:6	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
174_14:3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0
178_16:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
178_16:3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
178_16:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
178_16:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18_70:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18_70:6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180_15:6	3	0	0	0	0	0	0	0	0	0	0	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
182_15:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
182_15:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
182_15:4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
182_15:6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
185_14:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
185_14:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
185_14:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	3	0	0	0	0	0	0	0	0	0
185_14:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19_72:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
19_72:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19_72:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19_72:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
190_16:1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
190_16:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
198_10:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
198_10:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
198_10:6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20_72:3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21_70:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22_69:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22_69:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22_69:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23_67:1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23_67:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23_67:4	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23_67:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0

Annex 8. Tree species Abundance in Sampling Sub-plots in the Terai Forest

	-9999	4848	5160	5427	6028	6039	6063	6065	6083	6089	6090	6097	6098	6104	6109	6113	6114	6115	6126	6127	6139	6144	6147	6153	6160	6163	6168	6170	6172	6207	6221	6235	6239	6246	6250	6256	6259	6264	6265	6266	6269	6287	6299	6301
24_70:1	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24_70:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24_70:6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26_63:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0
3_76:1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3_76:3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3_76:4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3_76:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30_64:3	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
31_62:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31_62:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
31_62:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31_62:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32_63:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32_63:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32_63:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33_61:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
33_61:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33_61:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33_61:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
35_56:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0
35_56:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0
37_52:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
37_52:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39_58:1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39_58:3	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39_58:4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
39_58:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41_58:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41_58:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41_58:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41_58:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43_50:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43_50:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
43_50:4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43_50:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44_48:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
44_48:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44_48:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44_48:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45_52:4	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45_52:6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
5_73:4	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6_76:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6_76:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6_76:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66_41:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66_41:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66_41:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66_41:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Annex 8. Tree species Abundance in Sampling Sub-plots in the Terai Forest

	-9999	4848	5160	5427	6028	6039	6063	6065	6083	6089	6090	6097	6098	6104	6109	6113	6114	6115	6126	6127	6139	6144
70_42:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
70_42:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
70_42:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0
70_42:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
72_41:1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
72_41:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
74_42:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74_42:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
74_42:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74_42:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9_76:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9_76:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9_76:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9_76:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	6147	6153	6160	6163	6168	6170	6172	6207	6221	6235	6239	6246	6250	6256	6259	6264	6265	6266	6269	6287	6299	6301
70_42:1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
70_42:3	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
70_42:4	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
70_42:6	0	0	1	0	0	0	0	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0
72_41:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72_41:3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74_42:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74_42:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74_42:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74_42:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:1	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9_76:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9_76:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
9_76:4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9_76:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 8. Tree species Abundance in Sampling Sub-plots in the Terai Forest

Plot/Spp.	6307	6315	6322	6323	6325	6335	6337	6341	6349	6367	6369	6370	6375	6398	6401	6411	6412	6419	6446	6448	6465	6469	6470	6503	6507	6526	6549	6602	6610	6611	6613	6615	6639	6641	6651	6659	6660	6662	6664	6669	6676	6695	6701	6702	9910
10_75:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	1	0	0	0	0	0	0	0	0
10_75:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	2	0	0	0	0	0	0	0	0
11_73:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	21	0	0	0	0	3	0	0	0	0	0	0	0	0
11_73:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	6	0	0	0	0	4	0	0	0	0	0	0	0	0
11_73:4	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	5	0	0	0	0	0	0	0	0
11_73:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	4	0	0	0	0	0	0	0	0
115_29:1	0	0	0	0	0	0	0	0	1	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
115_29:3	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	7	0	0	0	0	0	1	0	0	4	0	0	0	0
115_29:4	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0	0	0	21	0	0	0	0	0	0	0	0	2	0	0	0	0
115_29:6	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	17	0	0	0	0	0	1	0	0	2	0	0	0	0
117_29:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0
117_29:3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0
117_29:4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0
117_29:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	8	0	0	2	0	1	1	0	0	0	0	0	0	0
119_29:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	13	0	0	0	0	2	0	1	0	0	0	0	0	0
119_29:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	14	0	0	0	0	1	0	0	0	0	0	0	0	0
119_29:4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	1	0	0	0	0	0	0	0	0
119_29:6	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	2	0	0	0	0	0	0	0	0
12_72:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
12_72:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
121_28:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	8	0	0	0	0	3	2	0	0	0	0	0	0	0
121_28:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	1	0	0	0	3	1	0	0	0	4	0	0	0	0	0	0	0	0
121_28:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	9	0	1	1	0	6	0	0	0	0	0	0	0	0
121_28:6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1	0	1	0	4	0	1	0	0	0	0	0	0
123_28:1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0
123_28:3	0	0	0	0	0	0	0	2	0	0	2	4	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
123_28:4	0	0	0	0	0	0	0	0	1	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	4	2	0	0	2	0	0	0	0
123_28:6	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0
125_25:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
125_25:3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	12	0	0	1	0	0	0	0	0	0	0	0	0	0
125_25:4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	1	0	0	1	0	0	0	0	0	0	0
125_25:6	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	1	0	0	1	0	0	0	0	0	0	0
126_26:1	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0
126_26:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
126_26:4	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	0	0	2	0	0	0	0	0	0	0
126_26:6	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0
128_26:1	0	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
128_26:4	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0
128_26:6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
130_24:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
132_24:1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	3
132_24:3	0	0	0	0	0	0	0	1	0	1	0	1	1	0	2	0	0	13	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
132_24:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
132_24:6	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
135_23:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	1	0	0	0	0	0	0	0
135_23:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
135_23:4	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	20	0	0	0	0	0	3	0	0	0	0	0	0	0
135_23:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	1	0	0	0	5	0	0	0	0	0	2	1	0	0	0	0	0	0
14_74:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0

Annex 8. Tree species Abundance in Sampling Sub-plots in the Terai Forest

	6307	6315	6322	6323	6325	6335	6337	6341	6349	6367	6369	6370	6375	6398	6401	6411	6412	6419	6446	6448	6465	6469	6470	6503	6507	6526	6549	6602	6610	6611	6613	6615	6639	6641	6651	6659	6660	6662	6664	6669	6676	6695	6701	6702	9910
14_74:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14_74:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142_22:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
142_22:3	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
142_22:4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0
142_22:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0
152_19:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
152_19:3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16_69:1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0
16_69:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0
16_69:4	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
16_69:6	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0
17_70:1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	3	0	0	0	0	0	0	0	0
17_70:3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0
17_70:4	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	8	0	0	0	0	0	0	0	0
17_70:6	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	8	0	0	0	0	0	0	0	0
174_14:3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
178_16:1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	4	0	0	0	0	0	0	0	0
178_16:3	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	2	2	0	0	0	0	0	0	0
178_16:4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	19	0	0	0	0	1	1	0	0	0	0	0	0	0
178_16:6	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	1	2	1	0	0	0	0	0	0
18_70:4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	2	0	0	0	0	0	1	0	0
18_70:6	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
180_15:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
182_15:1	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5	0	0	0	0	6	1	0	0	0	0	0	0	0
182_15:3	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	2	0	0	21	0	0	0	0	2	0	0	0	2	0	0	0	0
182_15:4	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	5	0	0	1	0	1	0	0	0	0	0	0	0	0
182_15:6	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0	0	0
185_14:1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
185_14:3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	14	0	0	0	0	0	1	0	0	0	0	0	0	0
185_14:4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	11	0	0	1	0	0	0	0	0	0	0	0	0	0
185_14:6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	17	0	0	0	0	8	0	0	0	0	0	0	0	0
19_72:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	17	0	0	1	0	4	0	0	0	0	0	0	0	0
19_72:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	1	0	0	0	0	0	0	0	0	0	0
19_72:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0
19_72:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	2	0	0	0	2	0	0	0	0
190_16:1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	2	0	0	0	0	0	0	0	0
190_16:6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	9	0	0	0	0	1	0	0	0	0	0	0	0	0
198_10:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
198_10:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
198_10:6	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	2	0	0	0	0	0	0	0	0
20_72:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	5	0	0	0	0	0	0	0	0
21_70:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	1	0	0	0	0	0	0	0	0
22_69:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
22_69:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	1	0	0	0	0	0	0	0
22_69:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0
23_67:1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
23_67:3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	9	1	0	0	0	0	0	0	0
23_67:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0
23_67:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	2	0	0	0	0	0	0	0

Annex 8. Tree species Abundance in Sampling Sub-plots in the Terai Forest

	6307	6315	6322	6323	6325	6335	6337	6341	6349	6367	6369	6370	6375	6398	6401	6411	6412	6419	6446	6448	6465	6469	6470	6503	6507	6526	6549	6602	6610	6611	6613	6615	6639	6641	6651	6659	6660	6662	6664	6669	6676	6695	6701	6702	9910
24_70:1	0	0	0	0	0	0	0	0	1	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0
24_70:4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	1	0	0	0	0	0	0	0	0
24_70:6	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26_63:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3_76:1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	4	0	0	0	0
3_76:3	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0
3_76:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3_76:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
30_64:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0	0
31_62:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0
31_62:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
31_62:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0
31_62:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	1	0	0	0	0	0	0	0	0
32_63:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	2	0	0	0	0	0	0	0	0
32_63:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	7	0	0	1	0	0	0	0	0	0	0	0	0	0
32_63:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	1	0	1	0	0	0	0	0	0
33_61:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	1	1	0	0	0	0	0	0	0
33_61:3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0
33_61:4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	1	0	2	0	0	0	0	0	0	0	0
33_61:6	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	1	0	0	0	0	0	0	0	0
35_56:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
35_56:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
37_52:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
37_52:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7	1	0	0	0	0	0	0	0	0
39_58:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0
39_58:3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39_58:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
39_58:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	5	0	0	0	0	0	0	0	0
41_58:1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	0	0	12	0	0	0	0	0	0	0	0
41_58:3	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	2	0	0	0	0	0	0	0	0
41_58:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	2	0	7	1	0	0	0	0	0	0	0
41_58:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	0	0	3	0	9	0	0	0	0	0	0	0	0
43_50:1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
43_50:3	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1	0	0	0	10	0	0	0	0	0	1	0	0	0	0	0	0	0
43_50:4	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
43_50:6	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0
44_48:1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
44_48:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	1	0	0	0	0	0	0	0	0	0	0
44_48:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0
44_48:6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	1	0	0	0	0	0	0	0	0	0	0
45_52:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	2	0	0	0	0	0	0	0	0
45_52:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	2	0	0	0	0	0	0	0	0	0	0
5_73:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	13	0	0	0	0
6_76:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	1	0	1	0	0	0	0	0	0	0	0
6_76:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	2	0	0	0	0	0	0	0	0
6_76:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	2	0	0	0	0	0	0	0	0
66_41:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0
66_41:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	1	0	0	0	0	0	0	0	0
66_41:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
66_41:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex 8. Tree species Abundance in Sampling Sub-plots in the Terai Forest

	6307	6315	6322	6323	6325	6335	6337	6341	6349	6367	6369	6370	6375	6398	6401	6411	6412	6419	6446	6448	6465	6469	6470	6503	6507	6526	6549	6602	6610	6611	6613	6615	6639	6641	6651	6659	6660	6662	6664	6669	6676	6695	6701	6702	9910
70_42:1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	9	0	0	0	0	3	0	0	0	0	0	0	0	0
70_42:3	0	1	0	0	0	0	0	1	0	0	4	1	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	2	1	0	0	0	1	1	0	0	0	0	1	0	0
70_42:4	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	8	2	0	0	0	0	1	0	0
70_42:6	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
72_41:1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
72_41:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
74_42:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
74_42:3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0
74_42:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	1	0	3	0	0	0	0	0	0	0	0
74_42:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0
77_42:1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	7	0	0	2	0	2	0	0	0	0	0	0	0	0
77_42:3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
77_42:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	1	0	0	0	0	0	0	0	0	0	0
8_72:1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
8_72:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0
85_40:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0
9_76:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0
9_76:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0
9_76:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	3	0	1	0	0	0	0	0	0
9_76:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0	0	0

Sample Sub-plots and Their Location in the Terai

Plot-ID	Longitude	Latitude	Altitude	V.D.C.	Forest name	District
10_75:3	80.413257	28.870557	184	Krishnapur	Birendra Adarsha CF	Kanchanpur
10_75:6	80.416333	28.870571	185	Bani	Birendra Adarsha CF	Kanchanpur
11_73:1	80.456627	28.796717	190	Raikwar bichuwa	Lal jhadi	Kanchanpur
11_73:3	80.456613	28.799425	182	RaikawarBichhwa	Laljhadi	Kanchanpur
11_73:4	80.459701	28.79673	182	Raikawar Bichhwa	Laljhadi	Kanchanpur
11_73:6	80.459687	28.799437	190	Raikahar , Bichwa	Lal jhadi	Kanchanpur
115_29:1	84.708621	27.250919	150	Sonbarsa	Parsa WR	Parsa
115_29:3	84.708565	27.253626	150	Sonbarsa	Parsa WR	Parsa
115_29:4	84.711649	27.250969	146	Sonbarsa	Parsa WR	Parsa
115_29:6	84.711593	27.253675	150	Sonbarsa	Parsa WR	Parsa
117_29:1	84.789382	27.250474	160	Sonbarsa	Parsa WR	Parsa
117_29:3	84.789329	27.25318	160	Sonbarsa	Charbhaiya forest	Parsa
117_29:4	84.792411	27.250521	160	Sonbarsa	Charbhaiya forest	Parsa
117_29:6	84.792357	27.253228	161	Sonbarsa	Charbhaiya Forest	Parsa
119_29:1	84.870147	27.249981	188	Sonbarsa	Parsa WR	Parsa
119_29:3	84.870095	27.252688	183	Sonbarsa	Parsa WR	Parsa
119_29:4	84.873175	27.250027	186	Sonbarsa	Parsa WR	Parsa
119_29:6	84.873124	27.252734	188	Sonbarsa	Parsa WR	Parsa
12_72:1	80.49876	28.761659	175	Raikar Bichhuwa	Laljhadi	Kanchanpur
12_72:3	80.498747	28.764367	175	Raikwar Bichawa	Laljhadi	Kanchanpur
121_28:1	84.950599	27.213348	182	Biruwa guthi	Jhakiya	Parsa
121_28:3	84.95055	27.216055	185	Beluwa	Khajuriya	Parsa
121_28:4	84.953627	27.213392	180	Beluwa	Khajuriya	Parsa
121_28:6	84.953577	27.216099	185	Beluwa	Khajuriya	Parsa
123_28:1	85.031343	27.212761	160	Dumarbana	Parsa WR	Bara
123_28:3	85.031295	27.215468	160	Dumarbana	Pasaha Forest	Bara
123_28:4	85.03437	27.212804	160	Dumarbana	Halkhoriya	Bara
123_28:6	85.034323	27.21551	175	Dumarbana	Halkhoriya	Bara
125_25:1	85.110984	27.103838	112	Pursauna	Kakadi	Bara
125_25:3	85.110938	27.106545	112	Parsauna	Sahajnath Collaborative F	Bara
125_25:4	85.114008	27.103879	107	Parsauna	Sahajnath Collaborative F	Bara
125_25:6	85.113963	27.106586	109	Parsauna	Sahajnath Collaborative F	Bara
126_26:1	85.1517	27.139599	108	Dumarwana	Tamagadhi	Bara
126_26:3	85.151655	27.142306	109	Dumarwana	Paintalis Forest	Bara
126_26:4	85.154726	27.139639	125	Parsauna	Tamagadhi Forest	Bara
126_26:6	85.154681	27.142346	120	Dumarbana	Bhim sakhuwa	Bara
128_26:1	85.232397	27.138894	138	Kanakpur	Jungle saija	Rautahat
128_26:4	85.235423	27.138931	140	Kanakpur	Jangal saiya	Rautahat
128_26:6	85.23538	27.141639	141	Kanakpur	Jangal saiya	Rautahat
130_24:3	85.312187	27.06865	161	santapur		Rautahat
132_24:1	85.392876	27.065142	108	Dumariya	Ramlal Brindawan	Rautahat
132_24:3	85.392837	27.06785	101	Dumariya`	Ramlal Brindawan	Rautahat
132_24:4	85.3959	27.065177	98	Dumariya	Ramlal Brindawan	Rautahat
132_24:6	85.395861	27.067884	98	Dumariya	Ramlal Brindawan	Rautahat
135_23:1	85.513351	27.027753	110	Janaki Nagar	Murtiya Bit	Sarlahi
135_23:3	85.513316	27.03046	110	Janakinagar	Murtiya	Sarlahi
135_23:4	85.516375	27.027785	110	Badahara Mal	Murtiya	Sarlahi
135_23:6	85.516339	27.030492	110	Janakinagar	Paini Pari Danda	Sarlahi
14_74:1	80.578404	28.835864	208	Malakheti	Baskota Jangal	Kailali
14_74:3	80.578393	28.838572	210	Malakheti	Baskota jungle	Kailali
14_74:6	80.581468	28.838582	212	Malakheti	Khairana CF	Kailali
142_22:1	85.794954	26.988237	164	Belgachhi	Sagarnath Green Belt	Mahottari

Sample Sub-plots and Their Location in the Terai

Plot-ID	Longitude	Latitude	Altitude	V.D.C.	Forest name	District
142_22:3	85.794925	26.990945	167	Belgachhi	Sagarnath Green Belt	Mahottari
142_22:4	85.797976	26.988263	163	Belgachhi	Sagarnath Green Belt	Mahottari
142_22:6	85.797948	26.990971	167	Belgachi	Sagarnath Green Belt	Mahottari
152_19:1	86.195808	26.87406	120	Badaharamal	Bhediya Khola	Siraha
152_19:3	86.195789	26.876768	125	Badaharamal	Bastipur CF	Siraha
16_69:1	80.665909	28.657383	165	Urma	Kanari	Kailali
16_69:3	80.6659	28.660091	165	Urma	Kanari	Kailali
16_69:4	80.668979	28.65739	165	Urma	Kanariya CF	Kailali
16_69:6	80.66897	28.660098	165	urma	Kanari CF	Kailali
17_70:1	80.705737	28.694443	174	urma	Kalika shivadharsan CF	Kailali
17_70:3	80.70573	28.697151	174	Urma	Kalika CF	Kailali
17_70:4	80.708809	28.69445	176	Urma	Kalika CF	Kailali
17_70:6	80.708801	28.697158	174	Urma	Kalika CF	Kailali
174_14:3	87.076512	26.679307	85	prakashpur	Saptakoshi BZ CF	Sunsari
178_16:1	87.239358	26.745135	142	Baklauri	Charkoshe Jhandi	Sunsari
178_16:3	87.239364	26.747844	145	Backlauri	Charkoshe Jhandi	Sunsari
178_16:4	87.242375	26.745131	145	Baclauri	Panchayan CF	Sunsari
178_16:6	87.242381	26.747839	149	Backlauri	Charkoshe Jhandi	Sunsari
18_70:4	80.749742	28.695404	172	Chaumala	Kharariya	Kailali
18_70:6	80.749735	28.698112	172	Chaumala	Kharariya	Kailali
180_15:6	87.321731	26.70983	140	Sundarpur	Focklandtapu	Morang
182_15:1	87.399102	26.705179	160	Indrapur	Charkose Jhadi	Morang
182_15:3	87.399112	26.707888	80	Indrapur	Charkose Jhadi	Morang
182_15:4	87.402118	26.705171	180	Indrapur	Sukuna CF	Morang
182_15:6	87.402127	26.707879	170	Indrapur	Charkose Jhadi	Morang
185_14:1	87.518552	26.66607	157	Bayarban	Chihan dada	Morang
185_14:3	87.518564	26.668779	161	Bayer Ban	Bayer Ban	Morang
185_14:4	87.521567	26.666059	155	Bayer Ban	Chihandanda	Morang
185_14:6	87.521579	26.668767	160	Bayer Ban	Bayer Ban	Morang
19_72:1	80.785478	28.768527	200	Chaumala	Kalika	Kailali
19_72:3	80.785473	28.771235	203	Chaumala	Kalika	Kailali
19_72:4	80.788551	28.768532	210	Chaumala	Kalika	Kailali
19_72:6	80.788546	28.77124	210	Chaumala	Kalika	Kailali
190_16:1	87.721843	26.733025	380	Chulachule	Kali Aodhar	Ilam
190_16:6	87.724876	26.735719	400	Chulachule	Dhade Mathi	Ilam
198_10:3	88.035658	26.510194	88	Jal thal	Mayalu CF	Jhapa
198_10:4	88.038644	26.507463	90	Jal thal	Mayalu CF	Jhapa
198_10:6	88.038668	26.510172	90	Jal thal	Rankali	Jhapa
20_72:3	80.826437	28.772167	190	Mahanayala	Kailaspur	Kailali
21_70:1	80.869476	28.69819	170	Pahalmanpur-2	Loharkharita Jangal	Kailali
22_69:1	80.911433	28.663002	165	Ram Shikhar, Jhala-8	Bademalika	Kailali
22_69:4	80.914503	28.663004	166	Ram Shikhar jhala	Basemalika	Kailali
22_69:6	80.914501	28.665712	166	Ram Shikhar Jhalla-8	Badimalika CF	Kailali
23_67:1	80.954366	28.591705	104	Khailad	Kautihuwa	Kailali
23_67:3	80.954365	28.594413	112	Khailod-2	Loukaha Bhoukaha	Kailali
23_67:4	80.957434	28.591706	112	Khailad	Loukaha Bhoukaha	Kailali
23_67:6	80.957433	28.594414	107	Khailod -2	Lauka bhauka	Kailali
24_70:1	80.992288	28.700871	179	Sadepani	Sadepani	Kailali
24_70:4	80.995359	28.700871	174	Sadepani	Dipjyoti	Kailali
24_70:6	80.995359	28.703579	179	Sadepani	Sadepani	Kailali
26_63:6	81.083967	28.45263	88	Narayanpur	Masanghat	Kailali
3_76:1	80.125029	28.89627	141	Bhimdatta MP	Kota jungle	Kanchanpur
3_76:3	80.125006	28.898978	181	Bhim Datta MP	Suklaphanta	Kanchanpur

Sample Sub-plots and Their Location in the Terai

Plot-ID	Longitude	Latitude	Altitude	V.D.C.	Forest name	District
3_76:4	80.128105	28.89629	140	Bhimadatta	Pipariya	Kanchanpur
3_76:6	80.128083	28.898998	145	Suklaphanta WR	Suklaphanta WR	Kanchanpur
30_64:3	81.243376	28.492025	110	Thakurdwara	Bardia NP	Bardiya
31_62:1	81.286009	28.417915	162	Bagnaha	Khodau CF	Bardiya
31_62:3	81.286016	28.420623	165	Bagnaha	Khodau CF	Bardiya
31_62:4	81.289072	28.417908	162	Bagnaha	Khodau CF	Bardiya
31_62:6	81.28908	28.420616	163	Bagnaha	Khodau CF	Bardiya
32_63:3	81.325972	28.457501	121	Neulapur	Bhurigaun	Bardiya
32_63:4	81.329028	28.454786	120	Neulapur-5	Bardiya NP BZ	Bardiya
32_63:6	81.329036	28.457494	121	Neulapur-5	Bhurigaun Forest	Bardiya
33_61:1	81.368534	28.383366	157	Baniyabhar	Karalia BZCF	Bardiya
33_61:3	81.368544	28.386073	119	Baniyabhar	Baniyabhar	Bardiya
33_61:4	81.371596	28.383357	120	Magaragadi	Bania BZCF	Bardiya
33_61:6	81.371606	28.386065	120	Baniyabhar	Baniyabhar	Bardiya
35_56:4	81.457395	28.204359	149	Kalika	Bhadui CF	Bardiya
35_56:6	81.457407	28.207067	94	Mainapokhari	Bhadui CF	Bardiya
37_52:1	81.539057	28.061419	145	Radhapur	Bahadurpur	Banke
37_52:6	81.542123	28.064115	146	Radhapur	Bahadurpur Forest	Banke
39_58:1	81.615786	28.279422	180	Beluwa	Sorgadwari	Bardiya
39_58:3	81.615801	28.28213	163	Beluwa	Sworgadwari	Bardiya
39_58:4	81.618845	28.279408	177	Beluwa	Swargadwari BZCF	Bardiya
39_58:6	81.61886	28.282116	176	Beluwa	Sworgadwari	Bardiya
41_58:1	81.697344	28.280775	165	Chisapani	Rara Madhuwan	Banke
41_58:3	81.697362	28.283483	170	Chisapani	Hattigauda	Banke
41_58:4	81.700403	28.280759	166	Chisapani	Rara Madhu	Banke
41_58:6	81.700421	28.283467	183	Chisapani	Hattigauda	Banke
43_50:1	81.784683	27.993278	143	Phattepur	Mandapwa Proposed CF	Banke
43_50:3	81.784702	27.995986	133	Phattepur	Mandaphwa Proposed CF	Banke
43_50:4	81.787733	27.993261	133	Phattepur	Mandaphwa Proposed CF	Banke
43_50:6	81.787753	27.995969	133	Phattepur	Mandaphwa Proposed CF	Banke
44_48:1	81.826769	27.921711	90	Narayanpur	Pampapur	Banke
44_48:3	81.82679	27.924419	90	Narayanpur	Khudama ki jungle	Banke
44_48:4	81.829818	27.921693	145	Narayanpur	Sadabahar CF	Banke
44_48:6	81.829839	27.924401	146	Narayanpur	Sadabahar CF	Banke
45_52:4	81.867687	28.066718	147	Kachanapur-4	Ashok CF	Banke
45_52:6	81.867709	28.069425	127	Kachanapur-4	Madui Forest	Banke
5_73:4	80.213903	28.790287	117	Shulklaphanta WR	Shulklaphanta WR	Kanchanpur
6_76:3	80.248023	28.902339	140	Bhimdutta	Suklaphanta WR	Kanchanpur
6_76:4	80.25112	28.899648	178	Vimdatta municipality	Badni Kheda	Kanchanpur
6_76:6	80.2511	28.902356	144	Vimdatta municipality	Shuklaphanta	Kanchanpur
66_41:1	82.723802	27.67997	124	Gugauli	Gautam Buddha Collaborative I	Kapilbastu
66_41:3	82.723845	27.682677	117	Gugauli	Gautam Buddha Collaborative I	Kapilbastu
66_41:4	82.726843	27.679932	142	Gugauli	Gautam Budhha Collaborative I	Kapilbastu
66_41:6	82.726886	27.682639	142	Gugauli	Gautam Buddha Collaborative I	Kapilbastu
70_42:1	82.885626	27.71744	134	Shivapur	Sapath	Kapilbastu
70_42:3	82.885672	27.720147	134	Shivapur	Sapath	Kapilbastu
70_42:4	82.888668	27.717399	134	Shivapur	Bijasal Bagar	Kapilbastu
70_42:6	82.888714	27.720106	145	Shivapur	Bijasal Bagar	Kapilbastu
72_41:1	82.967074	27.681963	109	Barkulpur	Kisan CF	Kapilbastu
72_41:3	82.967123	27.68467	114	Barkalpur	Kisan CF	Kapilbastu
74_42:1	83.047854	27.718625	121	Mahendrakot	Kundra CF	Kapilbastu
74_42:3	83.047905	27.721331	125	Mahendrakot	Kundra CF	Kapilbastu
74_42:4	83.050896	27.718579	122	Mahendrakot	Kundra CF	Kapilbastu

Sample Sub-plots and Their Location in the Terai

Plot-ID	Longitude	Latitude	Altitude	V.D.C.	Forest name	District
74_42:6	83.050947	27.721287	122	Mahendrakot	Kundra CF	Kapilbastu
77_42:1	83.169519	27.719388	146	Motipur	Madhuban CF	Kapilbastu
77_42:3	83.169573	27.722094	145	Motipur	Madhuban CF	Kapilbastu
77_42:4	83.172561	27.71934	158	Motipur	Madhuwan CF	Kapilbastu
77_42:6	83.172614	27.722046	147	Motipur	Madhuwan CF	Kapilbastu
8_72:1	80.334943	28.757462	177	Dekhat Bhuli		Kanchanpur
8_72:3	80.334925	28.760169	169	Dekhat Bhuli	Hariyali	Kanchanpur
8_72:4	80.338015	28.757477	177	Dekhat Bhuli	Suklaphanta	Kanchanpur
8_72:6	80.337998	28.760184	170	Dekhat Bhuli	Hariyali CF	Kanchanpur
85_40:1	83.494247	27.648732	132	Shankarnagar	Shankarnagar	Rupandehi
85_40:3	83.494308	27.651437	134	Shankarnagar	Shankarnagar	Rupandehi
85_40:4	83.497285	27.648677	126	shankarnagar	Shankarnagar	Rupandehi
85_40:6	83.497347	27.651383	131	shankarnagar	Shankarnagar	Rupandehi
9_76:1	80.371067	28.902879	210	Jhalari	Krishna CF	Kanchanpur
9_76:3	80.371051	28.905587	204	Jhalari	Krishna CF	Kanchanpur
9_76:4	80.374144	28.902894	173	Jhalari	Krishna CF	Kanchanpur
9_76:6	80.374128	28.905601	228	Jhalari	Krishna CF	Kanchanpur

Annex 9. Checklist of Mammals in the Terai Forest

SN	Order/Family/Common Name	Scientific Name	GoN	CITES	IUCN	NRDB
	ORDER - PHOLIDOTA					
	Family - Manidae					
1	Indian Pangolin	*Manis crassicaudata**	P		NT v3.1	EN
2	Chinese Pangolin	*Manis pentadactyla**			EN v3.1	EN
	ORDER : INSECTIVORA					
	Family - Soricidae					
3	House Shrew	*Suncus murinus*			LC v3.1	LC
4	Long-tailed Brown-toothed Shrew	*Soriculus leucops*			LC v3.1	LC
	ORDER : CHIROPTERA					
	Family - Pteropodidae					
5	Indian Flying Fox	*Pteropus giganteus*		II	LC v3.1	LC
	Family - Vespertilionidae					
6	Common Serotine	*Eptesicus serotinus*			LC v3.1	LC
7	Round-eared Tube-nosed Bat	*Murina cyclotis*			LC v3.1	LC
8	Mountain Noctule	*Nyctalus montanus*			LC v3.1	DD
9	Indian Pipistrelle	*Pipistrellus coromandra*			LC v3.1	LC
10	Least Pipistrelle	*Pipistrellus tenuis*			LC v3.1	LC
	ORDER : PRIMATES					
	Family - Cercopithecidae					
11	Assamese Macaque	*Macaca assamensis**	P	II	NT v3.1	VU
12	Rhesus Macaque	*Macaca mulatta**		II	LC v3.1	LC
13	Hanuman Langur	*Semnopithecus entellus**		I	LC v3.1	LC
	ORDER : CARNIVORA					
	Family - Canidae					
14	Golden Jackal	*Canis aureus**		III	LC v3.1	LC
15	Asiatic Wild-dog, Dhole	*Cuon alpinus**		II	EN v3.1	EN
16	Bengal Fox	*Vulpes bengalensis**		III	LC v3.1	VU
	Family - Ursidae					
17	Sloth Bear	*Melursus ursinus**		I	VU v3.1	EN
	Family - Mustelidae					
18	Common Otter	*Lutra lutra*		I	NT v3.1	NT
19	Smooth Coated Otter	*Lutrogale perspicillata*		II	VU v3.1	EN
20	Yellow-throated Marten	*Martes flavigula**		III	LC v3.1	LC
21	Honey Badger, Ratel	*Mellivora capensis*		III	LC v3.1	EN
	Family - Viverridae					
22	Masked Palm Civet	*Paguma larvata**		III	LC v3.1	LC
23	Toddy Cat (Common Palm Civet)	*Paradoxurus hermaphroditus*		III	LC v3.1	LC
24	Spotted Lingsang	*Prionodon pardicolor*	P	I	LC v3.1	EN
25	Small Indian Civet	*Viverricula indica*		III	LC v3.1	LC
	Family - Herpestidae					
26	Indian Grey Mongoose	*Herpestes edwardsii**		III	LC v3.1	LC
27	Crab-eating Mongoose	*Herpestes urva**		III	LC v3.1	LC
	Family - Hyaenidae					
28	Striped Hyaena	*Hyaena hyaena**		III	NT v3.1	EN
	Family - Felidae					
29	Leopard Cat	*Prionailurus bengalensis**	P	I	LC v3.1	VU
30	Jungle Cat	*Felis chaus**		II	LC v3.1	LC
31	Marbled Cat	*Felis marmorata*		I	VU v3.1	DD
32	Fishing Cat	*Felis viverrinus*		II	VU v3.1	EN
33	Common Leopard	*Panthera pardus**		I	NT v3.1	VU
34	Bengal Tiger	*Panthera tigris**	P	I	EN v3.1	EN
35	Clouded Leopard	*Neofelis nebulosa**	P	I	VU v3.1	EN
	ORDER - CETACEA					
	Family - Platanistidae					
36	Gangetic Dolphin	*Platanista gangetica*	P	I	EN v3.1	CR
	ORDER - PROBOSCIDAE					
	Family - Elephantidae					
37	Asiatic Elephant	*Elephas maximus**	P	I	EN v3.1	EN

Annex 9. Checklist of Mammals in the Terai Forest

SN	Order/Family/Common Name	Scientific Name	GoN	CITES	IUCN	NRDB
	ORDER : PERISSODACTYLA					
	Family - Rhinocerotidae					
38	One-horned Rhinoceros	*Rhinoceros unicornis**	P	I	VU v3.1	EN
	ORDER : ARTIODACTYLA					
	Family - Suidae					
39	Wild Boar	*Sus scrofa**			LC v3.1	LC
	Family - Cervidae					
40	Indian Spotted Chevrotain	*Moschiola meminna*			LC v3.1	CR
41	Spotted Deer	*Axis axis**			LC v3.1	VU
42	Hog Deer	*Axis porcinus**		I	EN v3.1	EN
43	Swamp Deer	*Rucervus duvaucelii**	P	I	VU v3.1	EN
44	Sambar Deer	*Rusa unicolor**			VU v3.1	VU
45	Barking Deer	*Muntiacus muntjak**			LC v3.1	VU
	Family - Bovidae					
46	Black Buck	*Antilope cervicapra**	P	III	NT v3.1	CR
47	Gaur Bison	*Bos gaurus**	P	I	VU v3.1	VU
48	Nilgai	*Boselaphus tragocamelus**			LC v3.1	VU
49	Wild Water Buffalo	*Bubalus arnee**	P	III	EN v3.1	EN
50	Himalayan Goral	*Naemorhedus goral**		I	NT v3.1	NT
51	Four-horned Antelope	*Tetracerus quadricornis**	P	III	VU v3.1	DD
	ORDER : RODENTIA					
	Family - Scuiridae					
52	Irrawaddy Squirrel	*Callosciurus pygerythrus*			LC v3.1	LC
53	Five-stripe Palm Squirrel	*Funambulus pennantii**			LC v3.1	LC
	Family - Pteromyidae					
54	Red Flying Squirrel	*Petaurista petaurista*			LC v3.1	LC
	Family - Muridae					
55	Indian Bush Rat	*Golunda ellioti*			LC v3.1	LC
56	Metad	*Millardia meltada*			LC v3.1	LC
57	House Rat	*Mus musculus**			LC v3.1	LC
58	Short-tailed Bandicoot Rat	*Nesokia indica*			LC v3.1	LC
59	Himlayan Field Rat	*Rattus nitidus*			LC v3.1	LC
60	Indian Gerbil, Antelope Rat	*Tatera indica*			LC v3.1	LC
61	Indian Long-lailed Tree Mouse	*Vandeleuria oleracea*			LC v3.1	LC
	Family - Hystricidae					
62	Indian Crested Porcupine	*Hystrix indica**			LC v3.1	DD
63	Malayan Porcupine	*Hystrix brachyura*			LC v3.1	DD
	ORDER : LAGOMORPHA					
	Family - Leporidae					
64	Hispid Hare	*Caprolagus hispidus*	P	I	EN v3.1	EN
65	Indian Hare	*Lepus nigricollis**			LC v3.1	LC

Sources: Suwal et al. 1995, Bhuju et al. 2007, Baral & Shah 2008 and Jnawali et al. 2011.

Note:

* = 38 species were verified by FRA Nepal, field crew

Legends and Summary

GoN = Government of Nepal

P = Protected by NPWC Act 1973

CITES

Appendix I

Appendix II

Appendix III

IUCN = IUCN Red List Category

EN = Endangered

VU = Vulnerable

NT = Near Threatened

LC = Least Concern

v3.1 = IUCN Red List of Threatened Species-Version 2013.2

NRDB (National Red Data Book) Status

CR = Critically endangered

EN = Endangered

NT = Near Threatened

VU = Vulnerable

DD = Susceptible

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage												
Abrus precatorius L.	Ratigedi	20	18	11										
Bauhinia vahlii Wight & Arn	Bhorla	7	6	5	8	1	24	4	19	18	16	10		
Cayratia trifolia (L.) Domin	Karaunja	7	5	20	19	18	12							
Cissampelos pareira L.	Batulpate, Gudurganu	11												
Cissus repens Lam.	Charchare laharo, Pureni	5	23	14										
Cucumis melo L.	Kakri, Kakadi, Ghiraule Kakri	17												
Cuscuta reflexa Roxb.	Akashbeli, Amarlata, Amarbel	6	24	23	11									
Cyamopsis tetragonaloba (L.) Taub.	Gwar Simi, Gaurgam	11												
Dioscorea alata L.	Ghar tarul	15												
Dioscorea belophylla (Prain) Voigt ex Haines		7	17											
Dioscorea bulbifera L.	Gitthe tarul	7	17	15	11									
Dioscorea deltoidea Wall. ex Griseb.	Bhyakur tarul	27	17	15	11									
Dioscorea pentaphylla L.	Mithe- tarul	7	17	15										
Hiptage benghalensis (L.) Kurz	Charpate laharo	6	11											
Marsdenia tenacissima (Roxb.) Moon	Bahunee lahara	6												
Momordica balsamina L.	Barela, Kupre, Karela	17												
Momordica cochinchinensis Spr.	Jhuse Karela, Chattel, Kheksa	17	12											
Momordica dioica Roxb. ex Willd.	Jangali Karela, Sano Tite Karela	7												
Mucuna nigricans (Lour.) Steud.	Kauso, Jhauwa, Kauchir, Kauchho, Koche	13												
Mucuna pruriens (L.) DC.	Kauso	11												
Peperomia pellucida (L.) Kunth	Hadchur	11												
Pericampylus glaucus (Lam.) Merr.	Pati Lahara, Pipal Pati	7	11											
Piper betle L.	Pan, Nag Balli	2	20											
Piper longum L.	Pipla	6	8	22	4	15	14	13	11					
Porana grandiflora Wall.	Aakashbeli, Chamero Laharo	11												
Pueraria peduncularis (Benth.) Grah.	Bidari Laharo, Kaduju Ghas	6												
Smilax ovalifolia Roxb. ex D. Don	Kukurdaaino	24	17											
Spatholobus parviflorus (Roxb.) Kuntze	Debre lahara	6	5	16	10									
Stephania elegans Hook. f. & Thoms.	Batulpate	6	16											
Tetrastigma dubium (Lowson) Planch.	Chyrchyare Laharo	5												
Tetrastigma serrulatum (Roxb.)		11												
Tinospora sinensis (Lour.) Merr.	Gurjo-ko-laharaa	7	2	23	11									
Trachelospermum lucidum (D. Don) K. Schum.	Dwari lahara	6	5	18	11									
Trichosanthes ovigera Blume		5												
Bambusa tulda Roxb.	Tama Bas	6	24	23	22	20	19	18	17					
Bambusa vulgare Schrad.	Tama Bas	6	24	19										
Capillipedium assimile (Steudel) A. Camus	Muse Kharuki, Muse Khari	6												

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage												
Coelachne simpliciuscula (Wight & Arn.) Munro ex Benth.		6	16											
Cymbopogon distans (Nees ex Steudel) W. Watson	Pire Ghas	11												
Cymbopogon flexuosus (Nees ex Steudel) W. Watson	Urba, Dhaddi, Kagati Ghas	11												
Cymbopogon jawarancusa (Jones) Schultes		19												
Cymbopogon martinii (Roxb.) W Watson		11												
Cynodon dactylon (L.) Pers.	Doobo, Itu, Panja, Seto Dubo, Dubhi, Gorharki Dubhiya	6	24	20	13	11								
Dendrocalamus hamiltonii Nees & Arn. ex Munro	Tamabans, Choya Bans, Dhungre Bans	18	15											
Dendrocalamus strictus (Roxb.) Nees		6	24	20	19	18	17							
Deschampsia caespitosa (L.) Beauvois		6	19											
Desmostachya bipinnata (L.) Stapf	Kush	6	5	24	19	13	11							
Digitaria abludens (Roemer & Schultes) Veldkamp		6												
Digitaria ciliaris (Retz.) Koeler	Banso, Chitre Banso	6												
Drepanostachyum intermedium (Munro) Keng f.	Nigalo, Ma	19	18											
Eulaliopsia binata (Retz.) C. E. Hubbard	Babiyo	6	5	24	4	19	18							
Hemarthrua compressa (L. f.) R. Br.	Ghode Dubo	6	24											
Heteropogon contortus (L.) Beauvois ex Roemer & Schultes	Arthunge	6	19											
Imperata cylindrica (L.) Beauvois	Siro, Khar, Dabhi	6	5	2	23	19	11							
Isachne miliacea Roth		1												
Imperata cylindrica (L.) Beauvois *var. cylindrica*	Siro, Khar, Dabhi	6												
Phragmites karka (Retz.) Trin. ex Steudel	Narkat, Larkat	19												
Saccharum spontaneum L.	Kans, Jhaksi, Selme	6	24	19	18									
Themeda arundinacea (Roxb.) Ridley	Ureli, Dhaddi	19												
Themeda quadrivalvis (L.) Kuntze		11												
Themeda triandra Forssk.	Khar	6	19											
Thysanolaena maxima (Roxb.) Kuntze	Amriso, Amliso, Mujo, Gerai, Amreso, Phya	6	5	24	23	18	11							
Typha angustifolia L.	Pater, Khar	19												
Achyranthes aspera Linn.	Datiwan, Apamarga, nak Siruka	6	24	11	9									
Achyranthes aspera L. var. aspera	Datiwan, Apamarga, Nak Siruka	6	24	11										
Achyranthes bidentata Blume	Rato Datiwan, Rato Apamarga	24												
Aconitum angulatum		14												
Aconitum balfourii		6												
Acorus calamus Linn.	Bojho, Syuada Bach	23	11	9										

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage												
Ageratum conyzoides Linn.	Boke Ghas, Ganaune jhar, Ganki	6	1	11										
Ageratum houstonianum Miller	Nilo gandhe	5	21											
Allium wallichii	Ban lasun	11												
Aloe vera (L.) Burm. f.	Ghiu kumari	11												
Alternanthera sessilis (L.) DC.	Bhiringi jhar, Bhringraj, Gibre pate, Saraci	17												
Amaranthus spinosus Linn.	Kandelunde, Katari, Kathgaiya	5	19											
Amaranthus viridis Linn.	Latte Sag, Lunde, lunde Sag	17												
Argemone mexicana Linn.	Thakal, Sungure kanda,	20												
Arisaema griffithii		17												
Arisaema tortuosum		17	9											
Artemisia dubia Wall. ex Besser	Tite pati, gandhe jhar	11												
Artemisia indica Willd.	Titepati, Nag Damani, khamba	6	2	3	1	24	11	9						
Asparagus filicinus		17												
Asparagus penicillatus		17	15	11										
Asparagus racemosus Willd.	Satawari, kurilo, Makuri, Thota	24	7	1	23	19	17	15	14	13	12	11		
Aster indamellus Grierson	Lukmik	2												
Axyris prostrata		17												
Barleria cristata Lirur.	Bhede kuro, katsaraiya, lariphool	6												
Bidens pilosa Linn.	Kuro, Thulo kuro, Kurkur, Kalo Kuro, Maha Rathi	11												
Bistorta amplexicaulis		9												
Borreria articularis (L. f.) F. N. Williams		11												
Centella asiatica (L.) Urb.	Ghodtapre, kholcha Dhaya	11												
Colocasia esculenta (L.) Schott	Gava, Pindalu, karkalo, Taya	17												
Curculigo capitulata (Lour.) Kuntze	Musli, Kanda, Datgijari, Musli, Kalo, Musli	11												
Curculigo orchioides Gaertn.	Musli Kanda, Musli, Kalo Musli	17	11											
Curcuma angustifolia Roxb.	Kaledo, Kalo Haledo, Katahare Phool, Ban Besar	11												
Curcuma aromatica Salisb.	Ban Haledo, Ban Dhale, Haledo	11												
Curcuma zedoaria Rosc.	Ban Haledo, Sathi, Kachur	17												
Dipsacus atratus Hook. f. & Thomson ex C.B. Clarke	Supari Ghas	10												
Eichhornia crassipes (Martius) Solms	Jaluko, Jal, Kumbhi, Pureni, Jaluki	17	11											
Elephantopus scaber Linn.	Halhale, Bhedo Kuro, Gomukhi, Bhiringi Jhar	28												
Eupatorium adenophorum Spreng.	Ban mara, Kangresi Jhar, Kal Jhar	1	21	19	11	9								
Gentiana Kurroo Royle		6	17	14										
Gnaphalium affine D. Don	Boke Phool, Kairo jhar	6	11											
Hydrocotyle sibthorpioides Lam.	Jaluko, Jal, Kumbhi, Pureni, Jaluki	11												
Matricaria chamomilla		11												
Mentha arvensis Linn.	Babari, Pudina	5	11											
Mentha spicata Linn.	Pudina, Patame, Nawa Dhaya, Babari	24	11											
Mimosa pudica Linn.	Dhaniyan varmeli	11												
Nigelia sativa L.	Kaljira, Mungrelo	11												
Ocimum basilicum Linn.	Tulasi, Babari Phool	24	11											

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage					
Ocimum gratissimum Linn.	Sudi, Sij	11					
Oxalis acetosella Linn.	Dudhe, Dudhe jhar, Dudhiya, Rato mas lahara	11					
Oxalis corniculata Linn.	Ankuri phul	14	11				
Persicaria barbata (L.) Hara Var. barbata	Pire, Totaiya, Machharimara Jhar	9					
Pittosporum nepaulense		6					
Plantago major Linn.	Isabgol	12					
Pogostemon benghalensis (Burm. f.) Kuntze	Rudilo, Sihuwa	6	1	11			
Poulzolzia zeylanica		17					
Rorippa nasturtium (L.) Hayek	Sano Ghodtapre	17					
Scoparia dulcis Linn.	Sano ghodtapre	11					
Sida rhombifolia Linn.	Khursani jhar	5					
Solanum surattense Burm.f.	Kantakari, Bad bedi, Bhat Kataiya	13	11	9			
Spilanthes paniculata Wall.	Lato ghas, Marati	27	11				
Swertia nervosa (G. Don) C.B. Clarke	Tite, Aulo Ghas, Kalo Chiraito	11					
Torenia cordifolia Roxb.		9					
Viscum album Linn.	Hadchur	23	11				
Cyperus rotundus Linn.	Nagar Mothe, mothe, motha	11					
Mariscus sumatrensis (Retz.) T. Koyama	Karaunte	23	9				
Abelmoschus manihot (L.) Moench.	Ban Nalu, Odal, Odale	5	4				
Ammannia bacifera		11					
Antidesma acidum Retz.	Archale, Himalcheri, Amari, Imili, Kali Katai	7	6	8	17	11	10
Ardisia solanacea Roxb.	Damai phal, Mamai Phal, Lawathi, Bhanti	1	23				
Berberis aristata DC.	Chutro, Kinsi, Kirmando, Kirmundo	7					
Bridelia stipularis (L.) Blume		6	11	9			
Callicarpa macrophylla Vahl	Daikamla, Daichamle, Guyalo	7	6	11			
Calotropis gigantea (L.) Dryand.	Aank, Seto Aank, Baramase Aank	7	23	4	11		
Capsicum microcarpum		23					
Clerodendrum serratum (L.) Moon	Anekhi, Akhandi, Andekhi, Chuwa, Golaichi	1	23	17			
Clerodendrum viscosum Vent.	Venta, Chitu, Rajbeli, kalo	1	9				
Clerodendrum viscosum Vent.	Venta, Chitu, Rajbeli	6	1	11			
Colebrookea oppositifolia Sm.	Dhursul, Dhursule, Sitroma, Dosul	6	24				
Corchorus capsularis		6					
Datura metal Linn.	Kalo Dhatura	8	24	23	14	11	
Dendrophthoe falcata (L.f.) Etring.	Ainjeru, Riniya, Ajeru	3					
Desmodium gangeticum (L.) DC.	Salparni, Ban gahate, Presni Panni, karochi jhar	11					
Drypetes roxburghii (Wall.) Hurusawa	Putranjeevaa, Pitmaaree	6	11				
Duranta repens Linn.		20					
Erythrina suberosa		7	6				
Euphorbia royleana Boiss.	Siundi	4	19	17	11		

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage												
Ficus palmata Forssk.	Bedu, Berulo	5	17											
Flemingia strobilifera (L.) Ait.	Sano Bansapti, Bansapti, Bisahari jhar	1												
Grewia optiva Drumm. ex Bturet	Bhimal, Bhebul, Bheol, Syal Phusre	6	5	4										
Hibiscus manihot L.	Ban lasun	11												
Holarrhena pubescens (Buch.-Ham.) Wall. ex G. Don	Indra jau, Kurchi, Kebat, Madise Khirro	6	1	24	22	4	19	18	11					
Ipomoea carnea Jacq.	Ajambari, Bisari Jhar	1	4	19	11	9								
Ipomoea carnea		19	18											
Jasminum mesney Hance	Dabal Jai,Lahare Jai, Jai	6	21	19	11	9								
Jatropha curcas Linn.	Sajiwa, nirguni, Ratanjot, Saruwa	21	19	13	11									
Justicia adhatoda Linn.	Asuro, kalo Bhasak, Yasur, Aleha	22	11	9										
Lantana camara Linn.	Masino kanda, Ban Phanda Kanda	1												
Leea indica (Burm.f.) Merr.	Kukur Jibre	7	6											
Leucaena leucocephala (Lam.) De Wit	Ipil Ipil	6												
Maesa chisia Buch.- Ham.ex D. Don	Bilaune	6												
Millettia extensa (Benth.) Baker	Gonjo, Gauj	6	23	14	11	9								
Morus australis Poir.	Kimbu, Kut Simal	7	6											
Murraya koenigii (L.) Spreng.	Asare, Mitho nim, Khole jamun	7	6	1	23	22	19	16	14	11	9			
Musa paradisiaca L.	Kera, Moje	7	24	20										
Oroxylum indicum (L.) Kurz	Tatelo, karam, Kanda, Sauna	24	11											
Persea gamblei (King ex Hook. f.) Kosterm.	Kathe kaulo	7	14											
Premna barbata		23												
Premna interrupta		9												
Prinsepia utilis		18												
Prunus domestica		7												
Rauvolfia serpentina (L.) Benth. ex Kurz	Sarpagandha, Chand Maruwa	11												
Ricinus communis Linn.	Andir, Adir, Ander, Arin, Anderi, Andel, Aderi	13	11											
Salix plectilis Kimura	Bainsh	11												
Salix sericocarpa		7												
Sambucus hookeri Rehder	Galeni	1												
Strobilanthes angustifrons C.B Clarke	Kibbu	7												
Viscum articulatum Burm. F.	Harchu,Hadchure	11												
Wendlandia exserta (Roxb.) DC.	Rato kaiyo, Ban Kaiyo,Badhuwa	19	17											
Woodfordia fruticosa (L.) Kurz.	Dhaiyaro, Dhuinya, Amar Phool, Dhayaro	7	6	8	1	24	22	19	11					
Wrightia arborea (Dennst.) Mabberly	Ban Kera, Thulo Bankera, Thulo kuro	7	17	11										
Zanthoxylum armatum DC.	Timur, Yerma, Primu	7	14	11										
Zizyphus oenoplia (L.) Mill.	Aule Bayar	7	6	19	14									
Abies spectabilis	Silver Fir	16	13											
Acacia catechu (L. f.) Willd.	Khayar	7	6	2	3	24	21	4	19	18	15	14	9	
Acacia nilotica (L.) Willd. ex Delile	Babul, kikar, Babur, Jharkat	6												
Acacia rugata (Lam.) Voigt	Rasula, Sikakai	13												
Acer cappadocicum Gled.	Yali	7												

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage												
Acer oblongum Wall. ex DC.	Firfire, Putali Phool	5												
Adina cordifolia (Willd. ex Roxb.)	Karam, Haldu, Karma	6	1	22	19	18	14	11						
Aegle marmelos (L.) Correa	Bel, Bel patra	7	2	24	20	19	18	14	13	12	11			
Aesandra butyracea	Butter Fruit, Phulwara	7	6	16										
Albizia odoratissima (L. f.) Benth.	Karkur, Sirish, Siran, Padke, karkure Siris	1	22											
Albizia lebbeck (L.) Benth.	Kalo Sirish	6												
Alstonia scholaris (L.) R. Br.	Chalamain, Chativan	7	6	23	19	17	11	9						
Anogeissus latifolius (Roxb. ex DC.) Bedd.	Banjhi, Bod dhaera, Vakli, Dhavadan	6	1	22	4	19	18							
Anthocephalus chinensis (Lam.) A. Rich. Ex Walp.	Kadam	1	22											
Aporusa octandra (Buch.- ham. Ex D. Don) A. R. Vickery	Hade	19												
Areca catechu (L. f.) Willd.	Supari	7												
Artocarpus chaplasha Roxb.	Later	6												
Artocarpus heterophyllus Lam.	Katahar	7												
Artocarpus lakoocha Wall. ex Roxb.	Badahar	6	24											
Azadirachta indica A. Juss.	Nim	24	16	11	9									
Bauhinia malabarica Roxb.	Tanki,, Amil Tanki, Asoti	6	17											
Bauhinia purpurea L.	Tanki, Rato Koiralo, Koiralo, Kachnar	7	6	1	17	11	10							
Bauhinia variegata L.	Koiralo, Kanabu, Seto Koiralo	6	5	30	17	14	11							
Betula alnoides Buch.-Ham. ex D. Don	Saur, Painyu, Lekh Saur	1	18											
Bixa orelana	Arnotto, Annato, Roucou	22	18											
Bombax ceiba L.	Simal, Simar	6	5	1	24	4	19	18	14	11				
Borassus flabellifer		7	6											
Bridelia retusa (L.) Spreng.	Gayo, kaja	7	6	1	10									
Buchanania latifolia Roxb.	Piyari, Kaja, Gayo, Char	7	6	1	19	18	11							
Buddleja asiatica Lour.	Sina Swan, Bhimsen Pate, Narayan Pati, Cheule	17												
Buddleja macrostachya Benth.	Bhimsen pati	3												
Butea monosperma (Lam.) Kuntze	Palas, Dhak, Tesu, Hastakarni, palas, Bulyatra	7	6	3	8	1	24	14	12	11				
Careya herbacea Roxb.	Kumbhi, Kuma, Bodar	7	6	5	1	4	19	18	11	9				
Carissa carandas L.	Paner, Karonda, Karauna	7	17											
Casearia elliptica Willd.	Thulo Deri, Sano Bethe, Chilla, Deri, Beri	7	6	1	22	19	9							
Casearia graveolens Dalzell	Badkaule, Pipane	22	11											
Cassia fistula L.	Rajbrikshya, Bandar lathi	7	2	23	19	18	11	10	9					
Castanopsis lancifolia (Kurz) Hickel & A. Camus	Aaule Katus, Patle Katus	7	6											
Choerospondias axillaris (Roxb.) B.L. Burtt&A.W. Hill	Lapsi, Amali, Laalang, Kalang	1	19											
Cinnamomum glaucescens		4	11											
Citrus aurantifolia (Christ.) Swingle	Jyameer	7	11											
Citrus limon (L.) Burm.f.	Nibuwa, Lembakyumba	7	1	11	9									
Citrus medica		7	14											
Cleistocalyx operculatus (Roxb.) Meer. & Perry	Kyamuna, Phulepa, Phandir	7	8	1	19	11								
Cordia dichotoma Forster	Bohoree, Lasoraa	4	17	11										
Crateva unilocularis Buch.-Ham.	Siplikan, Khaichola	17												

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage												
Cycas pectinata		20	17											
Dalbergia latifolia Roxb.*	Satisal	24	20	18	11									
Dalbergia sissoo Roxb. ex DC.	Sisam, Sissoo, Sisawa	6	1	22	20	4	19	18	12	11				
Dalbergia stipulacea Roxb.	Tantebiri, Tate vari	9												
Desmodium oojenense (Roxb.) Ohashi	Sadan, Pandan, Tinkire	6	24	4	19	18	11							
Dillenia aurea Sm.		6	18	11										
Dillenia pentagyna Roxb.	Tantari, Agai, Chalta	7	1	24	17	11	9							
Diospyros malabarica (Desr.) Kostel.	Allo, Kalo Tendu, Khallu, Teju, Halabed	8	22	19										
Diospyros tomentosa Roxb.	Abinas,Bidi Pat, Tendu	7	6	8	1	18								
Diploknema butyracea (Roxb.) H.J. Lam	Chyuree	7	16											
Duabanga grandiflora (Roxb. ex DC.) Walp.	Lampate, Odhane, Lampatiya	22												
Dysoxylum gobara (Buch.-Ham.) Merr.	Lasune, Thulo Dhamina, Dhamina	18												
Ehretia laevis Roxb.	Loro, Pan, Datrung, Datingal, Chamror	7	6	1	22	16	14							
Eucalyptus camaldulensis Dehn.	Masala	18	16	14										
Eugenia formosa		7												
Exbucklandia populnea (R. Br. ex Griff.) R. W. Br.	Piple, Pipli	14												
Feronia limonia (L.) Swingle	Amilobel, Kaitho,Karanda,Karanta, Kentho	7	23	9										
Ficus auriculata Lour.	Nibharo, Timilo, Bhemala, Nimaro	7	6	24	17									
Ficus benghalensis Linn.	Bar	7	6	24	4	11								
Ficus benjamina L.	Sami, Swami, Chonkar	6	24	20										
Ficus lacor Buch.-Ham.	Kabhro, Pakadi, Palaksa, Pilkhan	7	6	24	17	14								
Ficus neriifolia Sm.	Dudhilo, Dudh Karaiya, Magoo(Tam.)	6	14	11										
Ficus racemosa L.	Pakar, Dumri, Gullar, Dumari	7	6	1	24	4	11	10						
Ficus religiosa L.	Pipal, Pipar	7	6	3	24	23	20	4						
Ficus semicordata Buch.-Ham. ex Sm.	Khanya, Khanayo, Khaniyo, Khurhuri	7	6	1	23	4	17							
Flacourtia jangomas (Lour.) Raeusch.	Taalishpatree	6	12											
Garuga pinnata Roxb.	Dabdabe, Ramsin, Aule dabdabe, Kharpat	11												
Gmelina arborea Roxb.	Khamari, Gambari, Gamhari, Khamar	19	18											
Grewia subinaequalis DC.	Falsa, Fussi, Syal Phusro, Phosro	7	6	5										
Holoptelea integrifolia (Roxb.) Planch.	Khamari, kanju, papari, Methe Phal	6	22	11										
Hymenodictyon flaccidum Wall.	Lati Karam, Seti Kath, Bhurkul,Bhudkul	6	1	18										
Kydia calycina Roxb.	Kubhinde, Bori, Pali, Pala, Pulu, Puli	1												
Lagerstroemia parviflora Roxb.	Bot Dhaiyaro, Asare, Sidda, Hade	6	8	1	24	22	4	19	18					
Lannea coromandelica (Houtt.) Merr.	Dabdabe, Chainchuinge, hallaure	6	3	1	4	18	11							

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage												
Lawsonia inermis Linn.	Mehandi, Mehari	3	13											
Litsea monopetala (Roxb.) pers.	Kutmero, Ghante Phool, Ratmate	6	1											
Lyonia villosa (Hook.f.) Hand.-Mazz.	Angeri	7												
Madhuca latifolia (Roxb.) Macbride	Latimauwa, Mahuwa	7	2	3	1	16								
Madhuca longifolia (Koeing) Macbride	Mahuwa, Chiuri	2	24	17	16									
Magnolia pterocarpa Roxb.	Patpate	1												
Mallotus philippensis (Lam.) Mull.-Arg.	Rohini, Ruina, Sindur, Sindure	6	3	8	1	22	20	19	18					
Mangifera indica Linn.	Aanp, Amchur, Yam, Aam, Aamba Kyungba	7	6	27	24	20	14	11	9					
Melia azedarach Linn.	Bakenu, Bakaino, Khaibasi, Bakain	6	23	19	11	9								
Melia dubia Cav.		1												
Michelia champaca	Chanp	19												
Miliusa velutina (Dunal) Hook. F.& Thoms.	Karyauta, kalikath	7	6	1	22	19	18							
Mitragyna parviflora (Roxb.) Korth.	Tikul, Sano Haldu, Phaldu, Kaim	7	6	1	22	19								
Moringa oleifera Lam.	Shovanjan, Sahijan	21	14	10										
Nyctanthes arbor-tristis Linn.	Parijat, Ratgamki, Kurri, Harsingar	24	12											
Persea duthiei (kingex Hook.f.) Kosterm	Kaulo, Mahilo Kaulo	5	24	4	15	11								
Phoenix acaulis Roxb.	Khajur, Thakal, Khajuriya, Khajuri, Takul	7	19	9										
Phoenix humilis Royle ex Becc. & Hook. f.	Khajur, Thakal	7	23	20	19	18	15							
Phyllanthus emblica Linn.	Amala	7	6	2	24	22	19	17	15	14	13	12		
Pinus roxburghii Sarg.	Rani Salla, Khote Salla, Salla, Aule Salla	1	4											
Psidium guajava Linn.	Amba, belauti, Ambak, Runi, latam, Amarud	7	11											
Pterocarpus marsupium Roxb.	Bijaya Sal, Bijaya Sar, Bandhuk Puspa	6	2	23	4	19	18	14	12	11				
Quercus lanata Sm.	Banjh, Phalant, Thulo Banjh, Banga, Sano Phalat	6	1											
Rhododendron campanulatum		7	18											
Rhus javanica		11												
Rhus succedanea		23	18											
Rhus wallichii Hook.f.	Thulo Bhalayo,Bhalayo, Chosi, Dotiyal	19	18											
Sapium insigne (Royle) benth. Ex Hook.f.	Ban Peepal, Khirro, Kherra	1	22	18	15	13	11							
Saraca asoca (Roxb.) De Wilde	Ashok, Asau	24	20											
Saurauia tristyla DC.		7	24											
Schima wallichii	Chilaune	1	23	18										
Schleichera oleosa (Lour.) Oken	Kusum, Gosum, Gausam	7	6	2	3	1	23	22	19	17	15	12	9	
Semecarpus anacardium L.f	Bhalayo, Bhela, Kumbha, Kage Bhalayo	7	6	1	24	22	11							
Sesbania bispinosa (Jacq.) W.F.Wight	Kanda Dhaicha	11												

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage												
Sesbania grandiflora (L.) Poir.	Agasti	19												
Sesbania sesban (L.) Merr.	Sital Chini, Agasti, Jayanti, Jayanta	17	10											
Shorea robusta Gaertn.	Sal, Sakhuwa, Agrakh, Chimar, Sakhu	2,3	6	8	1	24	22	20	4	19	18	13	12	11
Sorbus wallichii		7												
Sphaerosacme decandra (Wall.) Pennington	Bandare Phal, Lahare Lalgedi	1												
Spondias pinnata (L.f.) Kurz	Amaro, Yamar	7	8	24	18	17	14	11						
Sterculia villosa Roxb.	Odal, Odane, Andal	5	19	18	14									
Stereospermum chelonoides (L.f.) DC.	Kuber Kach, Pandari	7	6	17										
Stereospermum personatum (Hassk.) Chatterjee	Padari, Parari, padari, Kunda	6	17											
Syzygium cumini (L.) Skeels	Jamuna, Jambu, Phadir, Kalo Jamun	7	6	2	1	27	24	23	22	20	19	14		
Tamarindus indica		7												
Tectona grandis L.f.	Teak, Sagawan, Saguan	6	3	19	18	12								
Terminalia alata Heyne ex Roth	Asna, Saj, Yasal, Sajha, Asan	6	3	8	1	19	18	12	11					
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Arjun, Kahulo, Kahu	32	11											
Terminalia bellirica (Gaertn.) Roxb.	Barro, Barai, Bahera	7	6	2	1	21	19	16	15	11				
Terminalia chebula Retz.	Harro, Harai, Thulo Harro	7	6	2	1	15	11							
Toona ciliata M. Roem.	Tooni, Tuna, Tuni	19	18	11										
Trewia nudiflora Linn.	Gutel, Vellor, Ramrittha, Aule Kapasi,	7	6	1	22	19	18	12	9					
Trichilia connaroides (Wight & Arn) Benfvelzen	Chaichunge, Singmur, Aankha taruwa	21												
Xeromphis spinosa (Thunb) Keay	Main kanda, Main Phal, Maidal	7	6	17	13	9								
Xeromphis uliginosa (Retz.) Maheshwari	Pindar, Pirar, Maidal	10	9											
Zizyphus mauritiana Lam.	Bayar, Bayari, Pewandi, Pemdi Ber	7	6	22	19	17	14	11						
Zizyphus rugosa Lam.	Kanta Bayar, harra Bayar, Ban Bagero	7	6	19	11									
Athyrium gurungae	Unyau	7	24	11										
Crepidomanes parvifolium (Barker) K. Iwats		17												
Diplazium esculentum (Retz.) Sw.	Nyuro, Pani Nyuro, Kochaiya, Khatilak sag, Kuta	17												
Dryopteris cochleata (Buch-Ham ex D. Don) C. Chr	Danthe Nyuro, Nyuro, Unau, Pani nyuro	25	17											
Huperzia phlegmaria	Unyau	4	11											
Lepisorus subconfluens	Unyau	27												
Lygodium japonicum (Thunb.) Sw.		6												
Nephrolepis auriculata (L.) K. Presl.	Pani Amala, Pani Saro	7												
Ophioglossum reticulatum Linn.	Jibre sag	6	17											
Boselaphus tragocamelus	Nilgai	44	27	25										
Canis aureus	Syal	44	32	30	27									
Semnopithecus entellus	Hanuman Langur	32	30	28	27									
Macaca mulatta	Rato Bandar	30	28	27	25									

Annex 10. NTFPs and Their Usage in the Terai

Scientific Name	Common Name	Usage												
Muntiacus muntjak	Ratuwa, Rate	44	33	30	29	27	25							
Axis porcinus	Laguna, Pade	27												
Cervus unicolor	Sambar Deer	32	27											
Axis axis	Chhital	7	44	33	32	30	29	28	27	25				
Cervus duvauceli	Bara Singa	33	32											
Elephas maximus	Hatti	44	30											
Panthera pardus	Chituwa	25	24											
Felis chaus	Ban Biralo	30												
Herpestes edwardsii	Thulo Nyaurimuso	27												
Hystrix indica	Dumsi	2	44	30	29	27	25							
Lepus nigricollis	Khairo Kharayo	32	30	27	25									
Rhinoceros unicornis	Gaida	30												
Sus scrofa	Bandel	7	30	27	25	11								
Nyctalus noctula	Gandhe Chamero	27												
Anser anser	Goose	27												
Vanellus indicus	Huttityaun	30												
Anastomus oscitans	Openbill	27												
Prinia sylvatica	Prinia	27												
Columba palumbus	Ban parewa	44	33	28	27	25								
Streptopelia chinensis	Thople dhukur	28	27	26	25	17								
Streptopelia orientalis	Tame dhukur	28	27											
Treron sphenura	Haleso	28	27	25										
Corvus splendens	Kaag	44												
Hierococcyx fugax	Koieli	30	27	25										
Grus antigone	Sarus	30	27											
Hirundo rustica	Gauthali	25												
Passer rutilans	Bhangera	28	27											
Coturnix coturnix	Common Quail	27												
Francolinus francolinus	Titra	1	30	28	27	25								
Gallus gallus	Ban kukhura	30	28	27	25									
Lophura leucomelanos	Kalij	27												
Pavo cristatus	Mayur	44	33	31	30	29	28	27						
Psittacula himalayana	Suga	33	30	28	27	25	17							
Ninox scutulata	Brown Hawk-Owl	28												
Acridotheres fuscus	Myna	3	44	1	28	27	25							
Orthotomus sutorius	Fisto	27												
Varanus flavescens	Sun gohoro	30	27											
Varanus monitor	Gohoro	32	30	29	28	27								

Usage	Code ID	Usage	Code ID
Animal bedding	**1**	Utensils, handicrafts	**18**
Beverage	**2**	Construction material	**19**
Drying/tanning	**3**	Ornamentals	**20**
Exudates	**4**	Biofuel	**21**
Fibre and fiber yeilding	**5**	Support for climbers/Thankro	**22**
Fodder	**6**	Veterinary medicine	**23**
Fruit and nuts	**7**	Religious plant	**24**
Fumitory and masticator materials	**8**	Living animal	**25**
Insecticieds and herbicides	**9**	Honey, beewax	**26**
Legumes or pulses	**10**	Bushmeat	**27**
Medicinal plants	**11**	Other edible animal products	**28**
Seeds	**12**	Hides, skins for trophies	**29**
Soap/cosmetics	**13**	Medicines from animals	**30**
Spices, condiments and other flavorings	**14**	Drying/tanning	**31**
Starches and cellulose products	**15**	Tools	**32**
Vegetable oils and fats	**16**	Ornaments	**33**
Vegetables	**17**	Religious	**34**

Annex 11: Terai Forest Disturbances

S.N		Government Forest		Protected Forest		Buffer Zone Forest		Community Forest		Collaborative Forest		Private Forest		Total	
	Disturbance Type	No. of Plots	%	No. of Plots	%	No. of Plots	%	No. of Plots	%	No. of Plots	%	No. of Plots	%	No. of Plots	%
1	BC	12	19	1	5	2	13	11	21	6	32	0	0	32	18.3
2	EN	5	8	0	0	1	6	3	6	0	0	0	0	9	5.1
3	FF	32	51	7	32	3	19	12	23	8	42	0	0	62	35.4
4	IA	2	3	2	9	0	0	0	0	2	11	0	0	6	3.4
5	LS	3	5	1	5	1	6	2	4	0	0	0	0	7	4.0
6	LC	31	49	6	27	6	38	22	42	9	47	0	0	74	42.3
7	LP	10	16	4	18	5	31	12	23	2	11	0	0	33	18.9
8	LG	44	70	9	41	5	31	29	55	15	79	1	50	103	58.9
9	LO	31	49	5	23	4	25	19	36	8	42	1	50	68	38.9
10	ND	0	0	1	5	0	0	3	6	0	0	0	0	4	2.3
11	OH	31	49	9	41	7	44	26	49	8	42	1	50	82	46.9
12	PD	1	2	2	9	0	0	0	0	1	5	0	0	4	2.3
13	PP	2	3	0	0	0	0	4	8	2	11	0	0	8	4.6
14	TC	44	70	9	41	4	25	23	43	15	79	1	50	96	54.9
15	WG	20	32	13	59	3	19	7	13	10	53	0	0	53	30.3
16	WI	10	16	6	27	2	13	6	11	1	5	0	0	25	14.3
	Total	**278**		**75**		**43**		**179**		**87**		**4**		**666**	
	Plots		**63**		**22**		**16**		**53**		**19**		**2**		**175**

Note:
BC= Bush cutting, EN= Encroachment, FF= Forest fire, IA= Insect attack, LS= Landslide, LC=Lathra cutting, LP= Litter picking, LG= Livestock grazing, LO= Lopping, ND= No disturbance, OH= Other human induced disturbances, PD= Plant disease, PP= Plant parasite, TC= Tree cutting, WG= Wildlife grazing, WI= Wind, storm, hails (frozen rain)

Annex 12. Project Steering Committee Members

Dr. Ganesh R. Joshi, MoFSC, Chairperson
Mr. Yuvaraj Bhusal, MoFSC, Former Chairperson
Mr. Chhabi R. Pant, MoFSC, Former Chairperson
Mr. Keshab P. Bhattarai, MoFSC, Former Chairperson
Mr. Naveen K. Ghimire, MoFSC, Former Chairperson
Dr. Krishna C. Paudel, MoFSC, Former Chairperson
Dr. Annapurna N. Das, MoFSC, Member
Mr. Krishna P. Acharya, MoFSC, Member
Mr. Braj K. Yadav, MoFSC, Member
Mr. Megh B. Pandey, DNPWC, Member
Mr. Biswo N. Oli, DoF, Member
Mr. Yam B. Thapa, DPR, Member
Mr. Pem N. Kandel, DSCWM, Member
Mr. Pekka Seppala, Embassy of Finland, Member
Dr. Chudamani Joshi, Embassy of Finland, Member
Mr. Kailash Pokharel, MoF, Member
Representative, NFA, Member
Mr. Ramesh Shakya, DFRS, Member
Mr. Hasta B. Thapa, DFRS, Member
Mr. Harihar Sigdel, MoFSC, Former Member
Mr. Bharat P. Pudasaini, MoFSC, Former Member
Mr. Gopal K. Upadhyaya, MoFSC, Former Member
Mr. Madhav P. Acharya, MoFSC, Former Member
Mr. Gopal K. Shrestha, DoF, Former Member
Mr. Kari Leppanen, Embassy of Finland, Former Member
Mr. Yam P. Pokharel, DFRS, Member Secretary

Annex 13. Validation Committee Members

Mr. Krishna P. Acharya, Joint Secretary, MoFSC, Chairperson
Mr. Jisnu M. Bhattarai, Under Secretary (Tech.), CBS, Member
Mr. Gopal P. Bhattarai, Under Secretary (Tech.), DNPWC, Member
Mr. Rabindra Maharjan, Under Secretary (Tech.), DOF, Member
Mr. Kamal Ghimire, Under Secretary (Tech.), Survey Department, Member
Mr. Ramesh Basnet, Under Secretary (Tech.), DPR, Member