



**Forestry Department**

Food and Agriculture Organization of the United Nations

**FOREST RESOURCES ASSESSMENT**

**NATIONAL FOREST ASSESSMENT:  
WORKING PAPER**

**NATIONAL FOREST AND TREE  
RESOURCES ASSESSMENT 2003-05**

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*The Forest Resources Assessment Programme*

Forests are crucial for the well being of humanity. They provide foundations for life on earth through ecological functions, by regulating the climate and water resources and by serving as habitats for plants and animals. Forests also furnish a wide range of essential goods such as wood, food, fodder and medicines, in addition to opportunities for recreation, spiritual renewal and other services.

Today, forests are under pressure from increasing demands of land-based products and services, which frequently leads to the conversion or degradation of forests into unsustainable forms of land use. When forests are lost or severely degraded, their capacity to function as regulators of the environment is also lost, increasing flood and erosion hazards, reducing soil fertility and contributing to the loss of plant and animal life. As a result, the sustainable provision of goods and services from forests is jeopardized.

In response to the growing demand for reliable information on forest and tree resources at country and global levels, FAO initiated a programme to provide support to national forest assessments (NFA). The programme includes developing a harmonized approach to NFAs, information management and support to policy impact analysis for national level decision-making.

The purpose of the initiative is to introduce countries to an alternative approach designed to generate cost-effective information on forests and trees outside forests, including all benefits, uses and users of the resources and their management. Special attention is placed on monitoring the state and changes of forests, and on their social, economic and environmental functions. Another main objective is to build national capacities and harmonize methods, forest related definitions and classification systems among countries.

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### List of Acronym/Abbreviation

<b>CBD</b>	Conservation on Biological Diversity
<b>CBFM</b>	Community-Based Forest Management
<b>CENRO</b>	Community Environment and Natural Resources Office
<b>COFO</b>	Committee on Forestry
<b>DENR</b>	Department of Environment and Natural Resources
<b>ENR</b>	Environment and Natural Resources
<b>EPE</b>	Estimated Position Error
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FASPO</b>	Foreign Assisted and Special Projects Office
<b>FMB</b>	Forest Management Bureau
<b>FRA</b>	Forest Resources Assessment
<b>FRA-NCO</b>	Forest Resource Assessment-National Coordinating Office
<b>FRA-SC</b>	Forest Resource Assessment -Steering Committee
<b>GEZ</b>	Geographical Ecological Zone
<b>GIS</b>	Geographical Information System
<b>GPS</b>	Global Positioning System
<b>IEC</b>	Information Education & Communication
<b>IFMA</b>	Integrated Forest Management Agreement
<b>ITTA</b>	International Tropical Timber Agreement
<b>IW</b>	Inland Water
<b>LGU</b>	Local Government Unit
<b>LOA</b>	Letter of Agreement
<b>LUS</b>	Land Use Section
<b>NAMRIA</b>	National Mapping and Resources Information Authority
<b>NFA</b>	National Forest Assessment
<b>NFI</b>	National Forest Inventory
<b>NP</b>	Nested Plot
<b>NSCB</b>	National Statistics Coordination Board
<b>NWFP</b>	Non-wood Forest Product
<b>OL</b>	Other Land
<b>OWL</b>	Other Wooded Land
<b>PAWB</b>	Protected Areas and Wildlife Bureau
<b>PENRO</b>	Provincial Environment and Natural Resources Office
<b>RED</b>	Regional Executive Director
<b>RFIT</b>	Regional Field Inventory Team
<b>SIFMA</b>	Socialized Integrated Forest Management Agreement
<b>TAR</b>	Tropical Rain Forest
<b>TM</b>	Tropical Mountain Systems
<b>TOF</b>	Trees Outside Forest
<b>UNCED</b>	United Nation Conference on Environment and Development
<b>UNFCC</b>	United Nation Framework Convention on Climate Change
<b>WFP</b>	Work and Financial Plan

## DEFINITION OF LAND USE CLASSES

**1. FOREST** - Land with an area of more than 0.5 hectare and tree crown cover (or equivalent stocking level) of more than 10 percent. The trees should be able to reach minimum height of 5 meters at maturity *in situ*. It consists either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10 percent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of more than 10 percent or tree height of 5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest.

It includes forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, cleared tracks, firebreaks and other small open areas; forest within protected areas; windbreaks and shelter belts of trees with an area of more than 0.5 hectare and width of more than 20 meters; plantations primarily used for forestry purposes, including rubber wood plantations. It also includes bamboo, palm, and fern formations (except coconut and oil palm).

**1.1 Closed Broadleaved Forest (FBC)** - Formations where trees in the various storeys and the undergrowth cover a high proportion (>40 percent) of the ground and do not have a continuous dense grass layer. They are either managed or unmanaged forests in advanced state of succession and may have been logged-over one or more times, having kept their characteristics of forest stands, possibly with modified structure and composition.

**1.2 Open Broadleaved Forest (FBO)** - Formations with discontinuous tree layer but with a coverage of at least 10 percent and less than 40 percent. Generally there is a continuous grass layer allowing grazing and spreading of fires.

**1.3 Closed Coniferous Forest (FCC)** - Forest with predominance (more than 75 percent of tree crown cover) of trees of coniferous species where trees in the various storeys and the undergrowth cover a high proportion (>40 percent) of the ground and do not have a continuous dense grass layer. They are either managed or unmanaged forests in advance state of succession and may have been logged-over one or more times, having kept their characteristics of forest stands, possibly with modified structure and composition.

**1.4 Open Coniferous Forest (FCO)** - Formations with discontinuous tree layer with a coverage of at least 10 percent and less than 40 percent. Generally there is a continuous grass layer allowing grazing and spreading of fires.

**1.5 Closed Mixed Forest (FMC)** - Forest in which neither coniferous nor broadleaved species nor palms nor bamboos account for more than 75 percent of the tree crown cover where trees in the various storeys and the undergrowth cover a high proportion (>40 percent) of the ground and do not have a continuous dense grass layer. They are either managed or unmanaged forests in advance state of succession and may have been logged-over one or more times, having kept their characteristics of forest stands, possibly with modified structure and composition.

1.6 **Open Mixed Forest (FMO)** - Formations with discontinuous tree layer with a coverage of at least 10 percent and less than 40 percent. Generally there is a continuous grass layer allowing grazing and spreading of fires.

1.7 **Closed Broadleaved Plantation (PBC)** - Forest stands of broadleaved species established by planting and/or seeding in the process of afforestation or reforestation which has more than 40 percent crown cover.

1.8 **Open Broadleaved Plantation (.PBO)** - Forest stands of broadleaved species established by planting and/or seeding in process of afforestation or reforestation which has less than 40 percent crown cover.

1.9 **Closed Coniferous Plantation (PCC)** - Forest stands of coniferous species established by planting and/or seeding in the process of afforestation or reforestation which has more than 40 percent crown cover.

1.10 **Open Coniferous Plantation (PCO)** - Forest stands of coniferous species established by planting and/or seeding in the process of afforestation or reforestation which has less than 40 percent crown cover.

1.11 **Closed Bamboo/Boho Formation (BBC)** - Forest on which more than 75% of the crown cover consists of tree species other than coniferous or broad-leaved species (e.g. tree-form species of the bamboo & boho) which has more than 40 percent crown cover.

1.12 **Open Bamboo/Boho Formation (BBO)** - Forest on which more than 75% of the crowncover consists of tree species other than coniferous or broad-leaved species (e.g. tree-form species of the bamboo & boho) which has less than 40 percent crown cover.

1.13 **Closed Mangrove Forest (MgC)** - Forested wetland growing along tidal mudflats and along shallow water coastal areas extending inland along rivers, streams and their tributaries where the water is generally brackish and composed mainly of *Rhizophora*, *Bruguiera*, *Ceriops*, *Avicenia*, *Aegiceras*, and *Nipa* species having more than 40 percent crown cover.

1.14 **Open Mangrove Forest (MgO)** - Forested wetland growing along tidal mudflats and along shallow water coastal areas extending inland along rivers, streams and their tributaries where the water is generally brackish and composed mainly of *Rhizophora*, *Bruguiera*, *Ceriops*, *Avicenia*, *Aegiceras*, and *Nipa* species having less than 40 percent crown cover.

2. **Other Wooded Land (OWL)** - Land that has either a crown cover (or equivalent stocking level) of 5-10 percent of trees able to reach a height of 5 meters at maturity *in situ*, or a crown cover (or equivalent stocking level) of more than 10 percent of trees not able to reach a height of 5 meters at maturity *in situ* (e.g. dwarf or stunted trees); or with shrub or bush cover of more than 10 percent.

2.1 **Shrubs (Sh)** - Refer to vegetation types where the dominant woody elements are shrubs i.e. woody perennial plants, generally of more than 0.5 meter and less

than 5 meters in height on maturity and without a definite crown. The growth habit can be erect, spreading or prostrate. The height limits for trees and shrubs should be interpreted with flexibility, particularly the minimum tree and maximum shrub height, which may vary between 5 and 7 meters approximately.

**2.2 Forest fallow system (Fa)** - Refers to all complexes of woody vegetation resulting from the clearing of natural forest for shifting agriculture. It is an intermediate class between forest and non-forest land uses. Part of the area, may have the appearance of a secondary forest.

**2.3 Wooded Grassland (WGL)** - Area predominantly vegetated with grasses, such as Imperata, Themeda, Saccharum; and where the trees cover 5 to 10 percent of the area and their height may reach 5 meters at maturity.

**3. Other Lands (OL)** - Land not classified as forest or other wooded land as defined above. It includes agricultural land, pastures, built-up areas, bare areas, grassland etc.

**3.1 Barren land (BI)** - Land not covered by (semi) natural or artificial cover. This includes among others, sand dunes, riverwash and rocky or stony areas.

**3.2 Lahar (Lahar)** - Land covered with volcanic mudflows or debris flows.

**3.3 Grassland (Gl)** – Land predominantly vegetated with grasses such as Imperata, Themeda, Saccharum spp., among others.

**3.4 Marshland (ML)** - Natural land area usually dominated by grass-like plants such as cat tails and sedges which are rooted in bottom sediments but emerge above the surface of the water. It contains emergence vegetation and usually develop in zones progressing from terrestrial habitat to open water.

**3.5 Annual Crop (AC)** - Land cultivated with crops with a growing cycle under one year, which must be newly sown or planted for further production after harvesting.

**3.6 Perennial Crop (PCr)** - Land cultivated with long term crops that do not have to be replanted for several years after each harvest; harvesting components are not timber but fruits, latex and other products that do not significantly harm the growth of the planted trees or shrubs; orchards, vineyards and palm plantations, coffee, tea, sisal, banana, abaca, etc. are included in this category.

**3.7 Pastureland (Pa)** - Land managed for raising livestock.

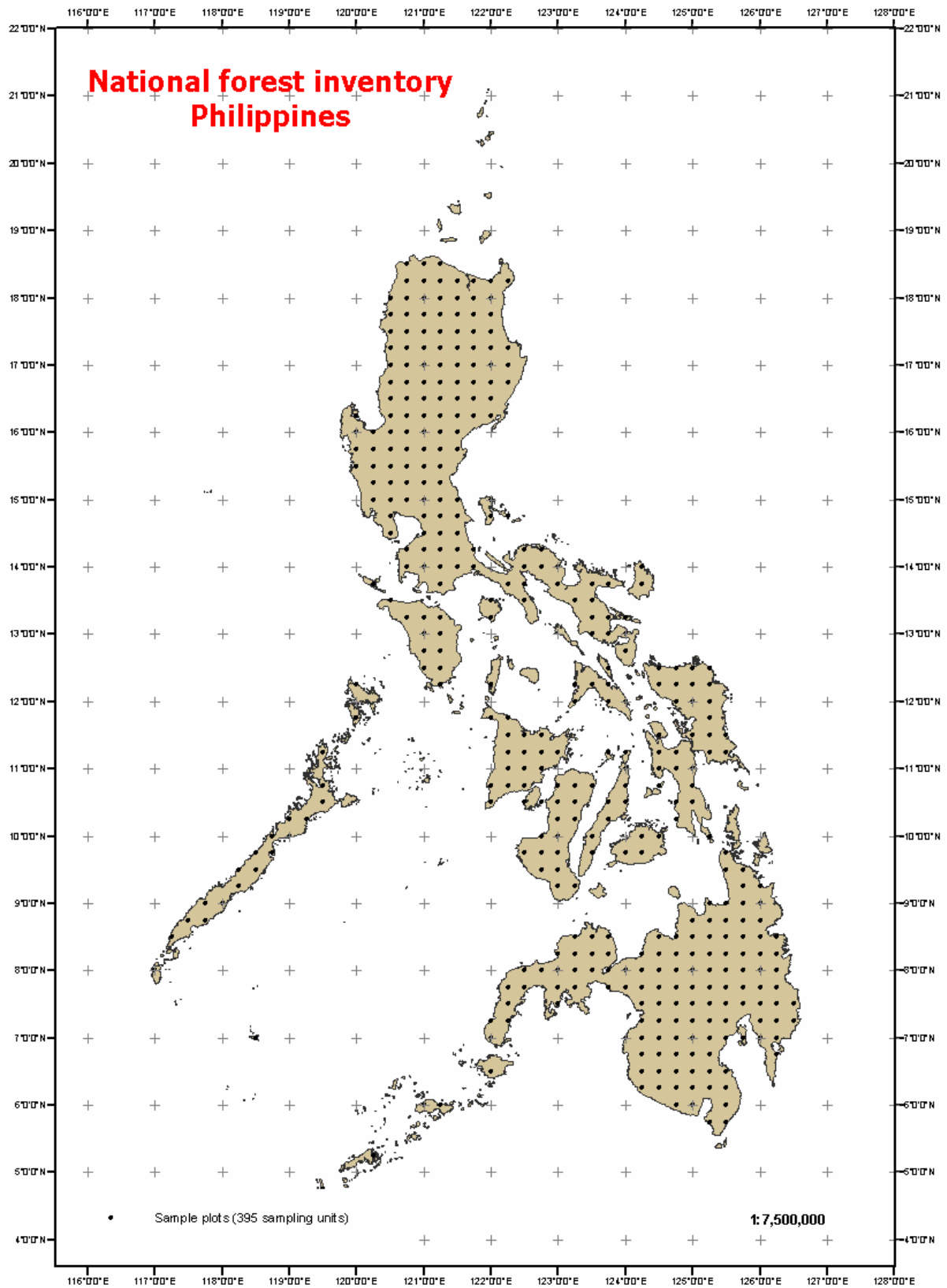
**3.8 Built-up Area (BUA)** - Compose of areas of intensive use with much of the land covered by structures. It includes cities, towns, villages, strip developments along highways, transportation, power, and communication facilities, and areas occupied by mills, shopping centers, industrial and commercial complexes, and institutions that may, in some instances, be isolated from urban areas.

**4. Inland Water (IW)** – Area occupied by major rivers, lakes and reservoirs.

4.1 **Inland Water pond (Iwp)** - Body of water surrounded by land which is usually stagnant and is not intended for commercial raising of fish.

4.2 **Fishpond (FpW)** - Body of water surrounded by land mainly intended for commercial raising of fish.

### Location Map (Tracts Distribution)



## **Executive Summary**

The *Forest Resources Assessment* (FRA) Project in the Philippines was initiated in August 2002 for the assessment of Philippine forest and tree resources as part of the framework of the *Forest Resources Assessment Programme* of the *Food and Agriculture Organization of the United Nations* (FAO) to support *national forest assessments* (NFA).

The project aims to provide, among others, information on the distribution of forest and other wooded lands according to tree species composition, ownership and management status, size of holdings, designation/protection status, commercial volume and growing stock, and felling and/or removals.

The project was spearheaded by the *Forest Management Bureau* (FMB) and implemented in the field by the *Department of Environment and Natural Resources* (DENR) operating units (DENR regional offices), in collaboration with the Forestry Department of FAO.

The major emphasis of this report is to provide comprehensive information on the status of forest and trees outside forest in the country and analysis of the level of precision and reliability of generated data/information from forest inventory that is based on relatively low-intensity and systematic multi-stage sampling design.

### Inventory Design

The inventory component of the project was based on relatively low intensity, systematic sampling method. Tracts measuring 1 km x 1 km were established in a national grid at 15' longitude and 15' latitude. Each tract consists of a cluster of 4 rectangular sample plots measuring 20 m x 250 m. Field measurements and data collection were carried out in these sample plots.

### Field Survey

The forest inventory included both legally classified forestland and trees resources in alienable and disposable land and/or private land. Data collection focused on the measurement of the biophysical characteristics of the trees as well as in the documentation of the stock and flow of wood and non-wood forest products and services, through interviews with local forest users and external key informants.

Data collection commenced in November 2002 and terminated in July 2004. The field crews submitted to FMB field reports covering 367 tracts. Of this, 6 tracts totally fell in the sea (non-inland water), 4 tracts partially fell in the sea, and 5 tracts fell in inland water.

### Data Entry and Data Processing

Data entry and data processing were centralized. The field data collected by the field crews were submitted to- and aggregated at FMB. Submitted field data were then electronically stored using both the NFI-Philippines database application software and the NFI-data database developed by FAO and FMB.

All data were entered into forms developed specifically for data entry by FAO-Forest Resource Development Service (FORM). The form was structured to look like the original data registration forms (Field Forms).

The data were then assembled from the various tables by linking those tables by fields containing related data. By making queries, various information was generated from the data contained in the tables.

In the calculation of land use area, the project also included those land use sections where physical measurement of trees was not carried out (e.g. ravine, steep slopes). In the calculation of volume, however, the project included only those land use sections where physical measurement of trees was carried out in order to avoid underestimation of volume.

The data in the NFI-Philippines database was then exported to MS Excel for statistical analysis.

The FAO-FORM backstopping forestry officer travelled to the Philippines in February 2004 and October 2004 to introduce the statistical functions for the data processing and also to demonstrate to the staff of FRA-NCO the basic application of the NFI-Philippines database processing system.

### Data Analysis and Data Interpretation

After the field data were collected, electronically stored and processed, data analysis and data interpretation was carried out.

Data analysis provided the following estimates:

#### Land Use Area

The Philippines has a total area of about 30 million hectares. Table 1.a shows the distribution by land use.

Tale 1a: Area distribution by land use

Land use	Area (ha)	Percent
Forest	7,162,560	23.9
Other Wooded Land (OWL)	3,611,204	12.0
Other Land (OL)	18,423,641	61.4
Inland Water (IW)	802,595	2.7
Total	30,000,000	100%

## Forest Area

The total forest in the country is estimated at 7,162,560 ha. Of this, about 6,857,803 ha is broad-leaved forest; 221,971 ha is coniferous forest; and 82,786 ha is mixed forest. Broad-leaved forest includes bamboo/boho formation and mangrove forest.

Table 1b: Forest area by category

Forest by category	Area (ha)	Percent
Broad-leaved Forest	6,857,803	95.7
Coniferous Forest	221,971	3.1
Mixed Forest	82,786	1.2
Total	7,162,560	100%

- Of the broad-leaved forest, about 616,671 ha or 9% is plantation; and of the coniferous forest, about 10,521 ha or 4.7% is plantation.

Table 1c: Area by main forest type

	Broad-leaved Forest		Coniferous Forest	
	Natural	Plantation	Natural	Plantation
Area	6,241,132	616,671	211,450	10,521
Percent	87.1%	8.6%	2.9%	0.1%

- Of the forest area, about 4,826,007 ha or 67.4% is closed canopy forest and 2,336,553 ha or 32.6 % is open canopy forest.

Table 1d: Area by major forest type

Major Forest Type	Area (ha)	Percent
Closed Canopy Forest	4,826,007	67.4
Open Canopy Forest	2,336,553	32.6
Total	7,162,560	100%

- Of the forest area, about 6,087,029 ha or 85% is owned by the state, 1,044,486 ha or 14.6% is privately owned, 9,486 ha or 0.1% is municipality owned and about 21,559 ha or 0.3% is owned by the community.

Table 1e: Forest area by ownership

Land Tenure	Area (ha)	Percent
State owned	6,087,029	85.0%
Privately owned	1,044,486	14.6%
Municipality owned	9,846	0.1%
Community owned	21,559	0.3%
Total	7,162,560	100%

- Of the forest area, about 2,102,942 or 29.4% is under formal management and 5,059,618 ha or 70.6% is without formal management.

Table 1f: Forest area by management system

Management System	Area (ha)	Percent
With Management Plan	2,101,942	29.4%
Without Management Plan	5,059,618	70.6%
Total	7,162,560	100%

Volume (Gross Volume: DBH  $\geq$  10 cm; Commercial Volume: DBH  $\geq$  50 cm )

- In forest, the estimated gross volume of all trees with dbh  $\geq$  10 cm is 1,247,858,946 m<sup>3</sup> or an average volume per ha of 174.22 m<sup>3</sup>. Of this, about 1,217,435,273 m<sup>3</sup> is in broad-leaved forest; 29,147,047.49 m<sup>3</sup> is in coniferous forest, and 1,276,625.85 m<sup>3</sup> is in mixed forest.

Table 1g: Gross volume by forest category

Forest Category	Gross Vol. (m <sup>3</sup> )	Percent
Broad-leaved forest	1,217,435,273.00	97.6%
Coniferous forest	29,147,047.49	2.3%
Mixed forest	1,276,625.85	0.1%
Total	1,247,858,946.00	100%

The estimated commercial volume of all trees with dbh  $\geq$  50 cm is 386,956,668.6 m<sup>3</sup> or an average volume per hectare of 54.02 m<sup>3</sup>. Of this, about 371,612,834 m<sup>3</sup> is in broad-leaved forest, 15,291,282.78 m<sup>3</sup> is in coniferous forest, and about 52,551.83 m<sup>3</sup> is in mixed forest.

Table 1h: Commercial volume by forest category

Forest Category	Comm. Vol. (m <sup>3</sup> )	Percent
Broad-leaved forest	371,612,834	96.0%
Coniferous forest	15,291,282.78	4.0%
Mixed forest	52,551.83	0.1%
Total	386,956,668.6	100.1%

- In trees outside forest, the estimated gross volume of all trees with dbh  $\geq$  10 cm is 444,666,003.5 m<sup>3</sup> or an average volume per ha of 19.47 m<sup>3</sup>. Of this, about 76,059,664.46 m<sup>3</sup> is in OWL; 365,030,730.4 m<sup>3</sup> is in OL; and 3,575,608.63 m<sup>3</sup> is in IW.

Table 1i: Gross volume of trees outside forest

	Gross Vol. (m <sup>3</sup> )	Percent
Other wooded land	76,059,664.46	17.1%
Other land	365,030,730.40	82.1%
Inland water	3,575,608.63	0.8%
Total	444,666,003.50	100%

The estimated commercial volume of trees outside forest with dbh  $\geq$  50 cm is 38,104,529.82 m<sup>3</sup> or an average volume per ha of 1.67 m<sup>3</sup>. Of this, about 13,351,271.42 m<sup>3</sup> is in OWL; 24,080,987.47 m<sup>3</sup> is in OL; and 672,270.93 m<sup>3</sup> is in IW.

Table 1l: Commercial volume of trees outside forest

	Comm. Vol. (m <sup>3</sup> )	Percent
Other wooded land	13,351,271.42	35.0%
Other land	24,080,987.47	63.2%
Inland water	672,270.93	1.8%
Total	38,104,529.82	100%

## **Forest Resources Assessment (Main Report)**

### **1. Introduction**

Forest resources assessment is essential in the sustainable management of forest resources. One of the most important objectives of forest resources assessment is to provide forest resources information to support for the development of forestry policies and programs for the management, sustainable development and conservation of forest resources.

The periodic conduct of forest resources assessment is consistent with the principles of the *United Nations Conference on Environment and Development* (UNCED) held in Rio de Janeiro, Brazil in 1992 which provides: “*The provision of timely, reliable and accurate information on forests and forest ecosystems is essential for public understanding and informed decision-making and should be ensured.*”

Practically, since FAO was created in 1948, it has been reporting on the worldwide status and trends of forest resources, their management and uses. All countries are involved in the process. They are the key players in data generation. Global assessment reports have been published at approximately 10 years interval. The latest of these reports (FRA 2000) concluded, however, that the level of availability and reliability of information is still low in developing countries.

In view of this, the FRA Programme of FAO conceived an approach to support national forest inventories through helping countries in developing or strengthening their capacities for continued national inventories. The FRA approach is founded on collaborative partnership between concerned governments and donors, with FAO facilitating the cooperation.

In March 2001, the *FRA Programme* of FAO informed the *Committee on Forestry* (COFO), the primary statutory body of the FAO Council that deals with forestry matters, of the FRA approach to support national forest assessment for country capacity building. The long-term objective of the approach will be “*to contribute to the sustainable management of forests and trees outside forest by providing decision makers and stakeholders with the best possible, most relevant and cost-effective information for their purposes at local, national and international levels*”. COFO supported in principle the idea.

Consequently, FAO embarked on a pilot program for the implementation of the FAO approach, as part of the framework of the *FAO-FRA Programme* to support national forest assessments.

The Philippines is one of the countries within that pilot program.

## 2. Background

The presently available information on the extent, location, volume and condition of the Philippine forest resources was obtained in the second national forest inventory that was carried out in 1979 to 1988. As a consequence, the data and information used to prepare plans and programmes on the management, development, protection and utilisation of forest resources are not up-to-date and do not reflect the current situation on the ground. In addition, the information from the latest national forest inventory refers only to designated "forestland", and only to the biophysical resources of the forest. Current information requirements intend to cover forest and tree resources on all types of land, and to include information on management and uses of the resources, including changes over time.

The second NFI was carried out with the assistance of donor funding institutions. It was designed as a conventional national forest inventory, based on a large number of sample plots, backed up with full-cover aerial photo interpretation. The inventory covered the legally designated "forestland", i.e. about 19.4% of the land area (FRA 2000). The inventory was designed mainly to support decisions related to the production of wood. The 2<sup>nd</sup> NFI was an ambitious project, following the state-of-the-art of the discipline at the time. In the present situation, however, some modifications to the approach must be considered. Information from all land is requested, related to all products and services obtained from the forest. Also, the information is required urgently, which means that national level results should be made available in much shorter time than the nine years used for the second NFI.

Two donor-assisted attempts have been made to update some of the national level information, using satellite remote sensing to map the land cover/land use for the entire country. In 1987/88, *SPOT* images were interpreted to map the vegetation in the entire country, and to provide a new set of land cover statistics, 5 years after the average inventory year of the preceding NFI. Unfortunately, the information was not compatible with the NFI and could not be used to establish trends. Since 1997, a project using recent *Landsat* images from recent years has produced another land cover map, presently covering about 80% of the country, mainly in the scale 1:100,000. Also this information showed to be incompatible with previous surveys, and reliable calculations of land use area changes can still not be made. Also, the precision and accuracy of area classifications are unknown in the two map sets. These two projects illustrate difficulties when relying on satellite remote sensing alone for area statistics generation. They also cover only the area aspect, and no new information on the attributes or use of forest resources has been obtained.

Necessarily, an updated national forest assessment was very much needed for the Philippines.

## 3. Objectives of the Study

The project aims at attaining the following development objective: Enhance the social, economic and environmental functions of forest and trees resources through their sustainable management on the basis of better knowledge of their qualitative and quantitative importance. The project also aims at improving contribution of these resources in the national economy.

The project would contribute in achieving the development objective through implementation of the activities of the following specific objectives:

- a) to develop and reinforce capacities of the national forestry institutions in the Philippines to design, plan, implement forest inventory projects and manage information;
- b) to design and carry out a forest inventory project that satisfies national needs in information and reliability and set up a monitoring system for future surveys. The inventory will cover a large array of biophysical and economic variables with emphasis on management and use of resources; and
- c) to design and set up a forestry information system to process field data and manage the generated information.

#### **4. Resources for the Implementation of the NFA**

##### **4.1 Institutions**

The *Forest Management Bureau* (FMB) led the NFA project and was implemented in the field by the DENR operating units (DENR regional offices) in collaboration with the Forestry Department of FAO. FMB had the overall co-ordinating role, including design and planning of the assessment. It had the *Letter of Agreement* (LOA) with FAO. FMB organized the field teams, making use of the staff of the DENR regional offices. FMB also provided staff and training for locating and establishing field plots using GPS receiver and other measurement techniques. The DENR Regional Offices provided staff for locating and establishing sample plots and collecting field data. DENR field teams conducted biophysical measurements/observations and field interviews at all sites.

The *National Mapping and Resource Information Authority* (NAMRIA), through its Remote Sensing and Resource Data Analysis Department, provided spatial information required for the design and implementation of the assessment.

The DENR Regional Offices provided staff for locating and establishing sample plots and collecting field data.

The *FRA-Steering Committee* (FRA-SC) was created and had the overall supervision over the project activities. The FRA-SC is composed of representatives from: the Office of the DENR Secretary for ENR Operations; the Office of the DENR Undersecretary for Planning and Policy; *Foreign-Assisted and Special Projects Office* (FASPO) of the DENR; *National Mapping and Resource Information Authority* (NAMRIA); the *National Statistics Coordination Board* (NSCB) and/or the *National Statistics Office* (NSO); the *Protected Areas and Wildlife Bureau* (PAWB); and the *Forest Management Bureau* (FMB). The Director of FMB is the Chairman of the Steering Committee.

FAO provided financial contribution in support of the project as well as expert technical assistance to all phases of the assessment, including ensuring compatibility with international information standards.

## 4.2 Staff

The *FRA National Coordinating Office* (FRA-NCO) was created in FMB to coordinate the project activities. The mandates of FRA-NCO are to: i) plan the project activities, ii) co-ordinate interventions of the involved national institutions and individuals, iii) train field crew members, iv) organise and supervise fieldwork and provide necessary logistical support to the field teams, v) assist in designing and developing the forest information system, and vi) process the field data and report project findings.

FRA-NCO is composed of the national coordinator who is assisted by 7 professional foresters (FMB: 5; NAMRIA: 2) and 1 database expert hired on contractual basis. The Director of FMB is the national coordinator. FRA-NCO is based at the FMB building.

## 4.3 Equipment, supplies and materials used

The instruments, supplies and materials used to carry out the inventory are:

- Box Compass (Suunto)
- GPS receiver (Garmin)
- Measurement tape (50 meters)
- Diameter tape
- Haga altimeter
- Galvanized steel bars for permanent plot marking (50 cm length)
- Topographic maps
- Regional and provincial maps
- Clipboards
- Field Forms (data registration forms)
- Philippines National Forest Inventory Field Manual
- A Dictionary of Philippine Plant Names (Volumes I & II)
- Backpacks
- Tents
- Sleeping bags
- First-Aid kits

## 5. **Preparations**

In order to attain the objectives of the project, careful planning and thorough preparation was undertaken. The planning focused on the type of data to be gathered, the method and strategy to be adopted in collecting field data, the task that each member of the field crews should performed, the equipment and supplies needed, and the timetable.

### 5.1 NFI-Philippines Field Manual

The Philippine's National Forest Inventory (NFI) Field Manual was prepared by FMB in collaboration with FAO. The field manual was prepared following the NFI Field Manual used in the pilot study conducted in Costa Rica and Cameroon. These NFI Field Manuals were refined to conform to the Philippine situation, taking into account the national as well as international information requirements.

The NFI Field Manual contains the definitions, land use and forest type classification, and procedures used to carry out the national forest inventory. The first part of the manual describes the sampling design adopted. The second part deals with the land use classification adopted to carry out the inventory. The third part shows the recommendations to undertake data collection in the field.

## 5.2 Field Forms

The Field Forms (Data Registration Forms) were prepared by FAO in collaboration with FMB.

FMB printed and distributed a set of Field Forms to each RFIT. A set of Field Forms consists of 8 Forms (F1, F2, F3a, F3b, F4a, F4b, F5 & F6). The crew leaders then reproduced the field forms according to the needs in each tract.

Description of Field Forms:

- Form F1: Tract

This form contains data related to the tract identification and location, reference points in accessing the tract, list of people involved in the inventory or related to the area, population size within the tract, and proximity to structures.

- Form F2: Plot

This form contains data related to the plot identification, plot start point description, time record of work in the plot, plot plan, and other general observations in the plot.

- Form F3a: Plot

This form consists of a table where data related to all trees and stumps with 10 cm dbh and larger found in the plot are entered.

- Form F3b: Rectangular subplot (Nested Plot Level 1)

This form consists of a table where data of relevant non-wood forest products (NWFP) like bamboo, erect palms, and rattan are recorded.

- Form F4a: Circular subplot (Nested Plot Level 2)

This form contains a table where data related to tree regeneration (sapling  $\geq 1.3$  m height and trees with dbh  $< 10$  cm) as well as edaphic variables are entered.

- Form F4b: Circular subplot (Nested Plot Level 2)

This form contains a table where data related to other NWFP, excluding bamboo, erect palms & rattan, gathered in the circular subplot are recorded.

- Form F5: Land Use Section

This form contains data related to land use section, designation/protection status, land tenure, disturbances, fire, and forest management and structure (i.e. stand origin, stand structure, canopy coverage, management system, disturbances, timber exploitation, silvicultural treatment & harvesting technology).

- Form F6: Land Use Section

This form consists of a table where data related to the use of forest resources (i.e. products and services, users, user rights, supply and demand trend, harvesting activity, & species) gathered in each land use section are recorded.



1. NFI Philippines

2. **Tract No** ..... 3. **Plot No**

**- F2 -  
PLOT**

**A. Plot start point description**

Plot starting point (calculated):

39a. Latitude \_\_\_ , \_\_\_ °

39b. Longitude \_\_\_ , \_\_\_ °

Marker position (GPS reading):

40a. Latitude \_\_\_ , \_\_\_ °

40b. Longitude \_\_\_ , \_\_\_ °

41. Distance from Marker to Plot start point  m

42. Bearing from Marker to Plot start point  °

Central line bearing:

Plot # 1 = 0°

Plot # 2 = 90°

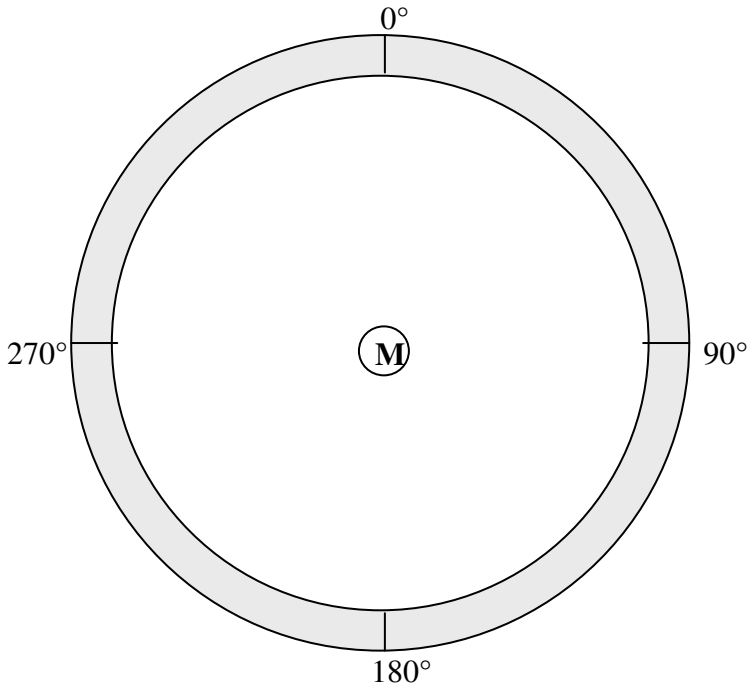
Plot # 3 = 180°

Plot # 4 = 270°

M = Marker position

P = Plot starting point, if P ≠ M for any reason

43. Plot starting point plan



*Reference points surrounding Marker position*

44. W	45. Description	46. Bearing* (°)	47. Distance* (m)

\* From Marker position

**B. Time record of work within**

Starting:

48. Date \_\_\_ / \_\_\_ / \_\_\_

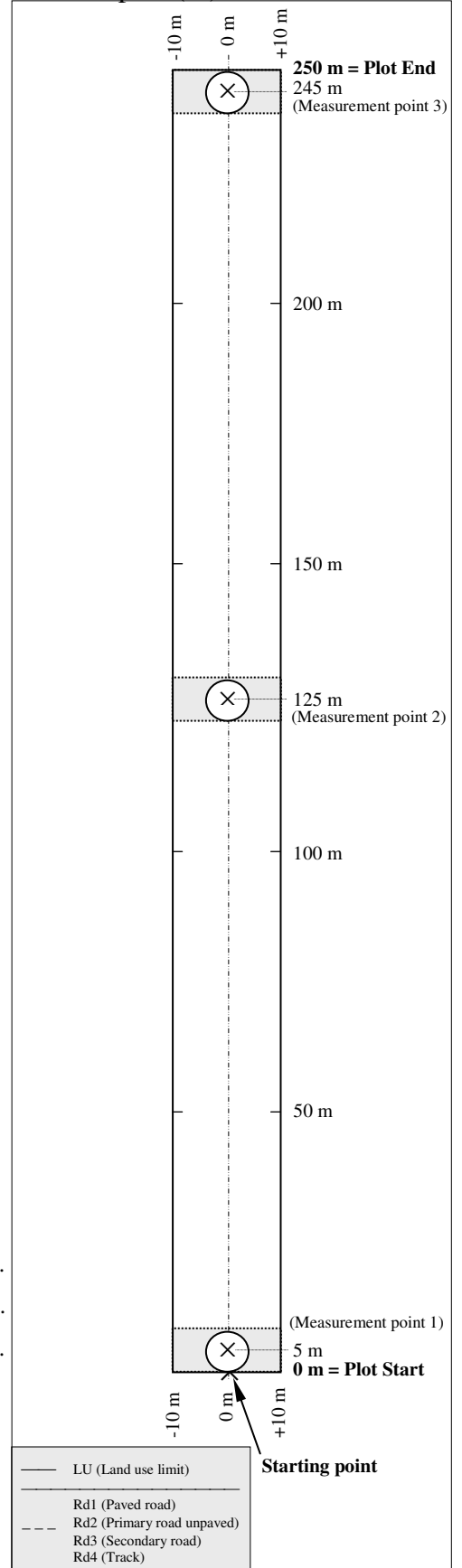
Ending:

50. Date: \_\_\_ / \_\_\_ / \_\_\_

49. Time: \_\_\_ : \_\_\_

51. Time: \_\_\_ : \_\_\_

**C. Plot plan (52.)**



53. Notes:

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 .....  
 .....





1. NFI Philippines  
 2. Tract No ..... 3. Plot No

- F4a -  
**NESTED PLOTS**

A. Topography and soil

<p><b>Measurement point No 1</b>                  4a. Sub-Plot No <input style="width: 40px;" type="text"/></p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr><td>70a. Aspect</td><td><input style="width: 20px;" type="text"/></td><td>°</td></tr> <tr><td>71a. Slope</td><td><input style="width: 20px;" type="text"/></td><td>%</td></tr> <tr><td>72a. Relief</td><td><input style="width: 20px;" type="text"/></td><td>C</td></tr> <tr><td>73a. Soil texture</td><td><input style="width: 20px;" type="text"/></td><td>C</td></tr> <tr><td>74a. Soil drainage</td><td><input style="width: 20px;" type="text"/></td><td>C</td></tr> </table>	70a. Aspect	<input style="width: 20px;" type="text"/>	°	71a. Slope	<input style="width: 20px;" type="text"/>	%	72a. Relief	<input style="width: 20px;" type="text"/>	C	73a. Soil texture	<input style="width: 20px;" type="text"/>	C	74a. Soil drainage	<input style="width: 20px;" type="text"/>	C	<p><b>Measurement point No2</b>                  4b. Sub-Plot No <input style="width: 40px;" type="text"/></p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr><td>70b. Aspect</td><td><input style="width: 20px;" type="text"/></td><td>°</td></tr> <tr><td>71b. Slope</td><td><input style="width: 20px;" type="text"/></td><td>%</td></tr> <tr><td>72b. Relief</td><td><input style="width: 20px;" type="text"/></td><td>C</td></tr> <tr><td>73b. Soil texture</td><td><input style="width: 20px;" type="text"/></td><td>C</td></tr> <tr><td>74b. Soil drainage</td><td><input style="width: 20px;" type="text"/></td><td>C</td></tr> </table>	70b. Aspect	<input style="width: 20px;" type="text"/>	°	71b. Slope	<input style="width: 20px;" type="text"/>	%	72b. Relief	<input style="width: 20px;" type="text"/>	C	73b. Soil texture	<input style="width: 20px;" type="text"/>	C	74b. Soil drainage	<input style="width: 20px;" type="text"/>	C	<p><b>Measurement point No3</b>                  4c. Sub-Plot No <input style="width: 40px;" type="text"/></p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr><td>70c. Aspect</td><td><input style="width: 20px;" type="text"/></td><td>°</td></tr> <tr><td>71c. Slope</td><td><input style="width: 20px;" type="text"/></td><td>%</td></tr> <tr><td>72c. Relief</td><td><input style="width: 20px;" type="text"/></td><td>C</td></tr> <tr><td>73c. Soil texture</td><td><input style="width: 20px;" type="text"/></td><td>C</td></tr> <tr><td>74c. Soil drainage</td><td><input style="width: 20px;" type="text"/></td><td>C</td></tr> </table>	70c. Aspect	<input style="width: 20px;" type="text"/>	°	71c. Slope	<input style="width: 20px;" type="text"/>	%	72c. Relief	<input style="width: 20px;" type="text"/>	C	73c. Soil texture	<input style="width: 20px;" type="text"/>	C	74c. Soil drainage	<input style="width: 20px;" type="text"/>	C
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B. NESTED PLOTS LEVEL 2 – Tree measurements (0cm < Dbh < 10cm)

6. L2 No (1-3)	4. Sup-plot N	76. Area (≤50m <sup>2</sup> ) (m <sup>2</sup> )	77. Species		78a. Counts	78b. Total number
			77a. Common name	77b. Scientific name		

79. Notes:

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- F5 -  
SUB-PLOT

1. NFI Philippines  
 2. Tract No ..... 3. Plot No   
 4. Sub-plot No

A. General

80. Land use <input type="checkbox"/> C	<table border="1"> <thead> <tr> <th colspan="2">84. Environmental problems</th> </tr> </thead> <tbody> <tr><td>0</td><td>Not Applicable (urban areas...)</td></tr> <tr><td>1</td><td>Not existing</td></tr> <tr><td>2</td><td>Loss of water levels in rivers and other sources</td></tr> <tr><td>3</td><td>Drought</td></tr> <tr><td>4</td><td>Inundation</td></tr> <tr><td>5</td><td>Poor water quality</td></tr> <tr><td>6</td><td>Pests</td></tr> <tr><td>7</td><td>Erosion</td></tr> <tr><td>10</td><td>Landslide</td></tr> <tr><td>11</td><td>Windthrow</td></tr> <tr><td>90</td><td>Not known</td></tr> <tr><td>99</td><td>Other .....</td></tr> </tbody> </table>	84. Environmental problems		0	Not Applicable (urban areas...)	1	Not existing	2	Loss of water levels in rivers and other sources	3	Drought	4	Inundation	5	Poor water quality	6	Pests	7	Erosion	10	Landslide	11	Windthrow	90	Not known	99	Other .....	85. Fire occurrence <input type="checkbox"/> C	<table border="1"> <tr> <td>88. Lianas <input type="checkbox"/></td> </tr> <tr> <td>89. Epiphytes <input type="checkbox"/></td> </tr> </table>	88. Lianas <input type="checkbox"/>	89. Epiphytes <input type="checkbox"/>
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\* N=Natural regeneration; P=Plantation; C=Coppice; nk= not known

98. Notes:.....

4. Sub-plot No

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5	Sanitary cutting																																																
97. Technology used																																																	
0	Not Applicable																																																
1	Manual																																																
2	Chainsaw																																																
3	Mechanised (tractors etc.)																																																
90	Not known																																																
99	Other (oxen etc.)																																																
91. Stand structure <input type="checkbox"/> C																																																	
92. Canopy coverage <input type="checkbox"/> C																																																	
93. Management plan <input type="checkbox"/> C																																																	

\* N=Natural regeneration; P=Plantation; C=Coppice; nk= not known

1. NFI Philippines

2. Tract No .....

3. Plot No

4. Sup-plot No

- F6 -  
SUB-PLOT

D. Products / Services

99. Product/Service	100. Rank	102. Harvester**							103. User right	104. User conflicts	105. Demand Trend	106. Supply Trend	Harvesting/ Activity				111. Species**
		101. End use*	Children	Women	Men	Local organisations & comp.	National companies	International companies					Other	107. Season activity	108. Last activity	109. Trend	
C								C	C	C	C	C	C	C	C	C	
		d															
		c															
		nk															
		d															
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		nk															
		d															
		c															
		nk															
		d															
		c															
		nk															

\* Multiple choice: d = domestic use; c = commercial use; nk = destination not known

\*\* Multiple choice

112. Notes:

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 .....  
 .....

### 5.3 Tract/plots Coordinates

FAO-FORM provided FMB with the list of tract/plots coordinates. The list of coordinates was reproduced by the staffs of FRA-NCO and distributed to the crew leaders. Further, FRA-NCO prepared the list of tracts by region to determine the number of tracts to be established in each region. Said list specified the location of the respective tracts by province and municipality. A copy of the list was provided to the crew leaders, for reference purposes.

### 5.4 Equipment

In collaboration with the FAO-FORM backstopping forestry officer, the staffs of FRA-NCO identified the surveying/measurement instruments, supplies and materials needed by the field crews in collecting field data. The staffs of FRA-NCO then contacted identified dealers who submitted the lowest price quotations and made arrangement for the order and purchase of said instruments, supplies and materials. The instruments, supplies and materials were later issued to the respective crew leaders. (Please see the list of equipment in the preceding paragraph).

FAO-FORM donated to FMB 6 sets of surveying instruments. A set consists of a GPS receiver (Garmin), box compass (Suunto), Haga altimeter, calliper, meter tape, diameter tape, flagging tapes, and back-pack. These were issued to the staffs of FRA-NCO.

### 5.5 Maps

Map provides data on the spatial attributes of the area. The topographic map charts the physical features on the ground (e.g. roads, rivers, etc) and the elevation of the area. A topographic map is usually available at a scale of 1:50,000.

The project purchased from NAMRIA sets of topographic maps (1:50,000) as well as regional and provincial maps and distributed these to the crew leaders for reference purposes. The crew leaders prepared their respective regional map showing the location of the tracts by province and municipality, based on the list of tract/plots coordinates. Some crew leaders generated their respective regional map with the help of the GIS unit in the regional office.

Further, the crew leaders delineated the tract and plots borders on the appropriate topographic map sheet to help them identify possible routes that could expedite their access to the tract/first plot.

### 5.6 Regional Field Inventory Teams (RFIT)

Seventeen (17) *regional field inventory teams* (RFIT) were created nationwide to carry out data collection in the field. Each regional office has one RFIT, composed of 2 professional foresters (1 team leader and 1 assistant team leader) and 3 locally hired laborers.

In May 2002, FMB requested all DENR regional offices to submit to FMB the names of 2 professional foresters, preferably with background in forest inventory, who shall act as team leader and assistant team leader of the field crew. In June 2002, FMB drafted the DENR Special Order creating the crew leaders of the RFIT. In August 2002, the DENR Secretary approved said Order.

In October 2002, FMB organized and conducted a one-week training course to familiarize the crew leaders with the technique and methodology of the NFA approach and improve their individual skills.

## **6. Project Management**

The activities of the project were implemented through the *Letter of Agreement* (LOA) signed between the representatives of FAO and FMB. The LOA stipulated, among others, the financial contribution of FAO to FMB, the activities for which the funds were to be used, general conditions of the Agreement, reporting system, terms of payment, and settlement of disputes.

Two LOAs were signed for the project; each LOA had a duration of 6 months. The 1<sup>st</sup> LOA entered into force in August 2002; in this agreement FAO made a financial contribution in the amount of US\$96,000. The 2<sup>nd</sup> LOA entered into force in May 2003; in this agreement FAO made a financial contribution in the amount of US\$98,000.

The project was implemented in the field by the DENR operating units. To support the budgetary requirements of the regional teams in the conduct of field survey, FMB had to transfer funds to the RFIT. In this connection, the crew leaders had to open a bank account in the name of the project to facilitate fund transfer. The team leader and the assistant team leader were the signatories. FMB periodically transferred the budget of the field crews to said bank account.

FMB and in collaboration with the crew leaders had periodically prepared the Regional Work and Financial Plan (WFP) which were then approved by the concerned REDs. The approved WFP served as basis for FRA-NCO in facilitating funds to the bank account of the regional teams. The approved WFP also provided FRA-NCO with a tool to monitor the teams' progress towards achieving the specified work goals.

During project implementation, FMB periodically visited the RFIT to assist and supervise them in data collection, and ensure that field data were collected in accordance with the prescribed procedures in the NFI Field Manual. The field visits also allowed the crew leaders to clarify uncertainties associated with data gathering. Inasmuch as the FRA approach is new, it was not expected that every team could carry out the work right from the start.

To ensure that the field crews' concerns regarding project implementation are appropriately addressed, the 17 regions were divided into 3 groups, based on geographic location. A desk officer was assigned and/or designated for each group. The desk officer, aside from his inherent responsibilities in FRA-NCO, was directly

responsible for the review and correction of submitted field reports and editing of electronically stored data for his regions.

The crew leaders prepared and submitted field report to FMB on a monthly basis. The concerned *Regional Executive Director* (RED) or *Regional Technical Director* (RTD) for Forestry endorsed said report. The desk officers reviewed the submitted field report and corrected identified deficiencies prior to data entry.

Data entry and data processing was undertaken at FMB (FRA-NCO). The project contracted the services of a database expert to handle the project's database concerns. Data entry progressed as field reports were submitted to FMB. To fast-track data encoding, the project hired the services of a data encoder and a GIS expert to assist the database expert in data entry. The staffs of FRA-NCO and in consultation with the FAO-FORM backstopping forestry officer were responsible for data processing and analysis as well as in reporting the results to FAO-FORM.

### IEC Campaign

In order to create awareness to the people about the operations of the FRA Project, the project contracted the services of a Communications Consultant for the production of posters and leaflets promoting the project. The information materials were prepared in English and translated into the major vernaculars used as medium of communication in the country. Said leaflets and posters were distributed to the crew leaders for further distribution to concerned government offices and communities involved during the field survey.

## **7. Methodology**

### **7.1 Sampling Design**

The sampling design adopted was systematic and without stratification. The design was developed by FAO-FORM and adopted by the FMB. The selection of the sample sites population has been done on the basis of the latitude/longitude grid. A grid of tracts measuring 1 km x 1 km was established at each 15 minutes latitude and 15' longitude. The coordinates of the Southwest corner of the tracts correspond to the intersection of the lat/long lines.

The inventory component of the project was based on relatively low intensity sampling (sampling intensity is 0.0026%). Three hundred and ninety five (395) tracts were initially selected in the national grid. Each tract composed of a cluster of 4 rectangular sample plots where data collection was carried out. The sample plots measuring 20 m x 250 m were in perpendicular orientation following the 4 cardinal directions and were 250 m apart from each other. (Please see item 5 under Form F2).

The sample plot would be further subdivided into land use sections (LUS), with variable sizes and shapes, representing homogenous land use and forest type units along the plot. Most of the data related to forest characteristics, management and resource uses were collected in the LUS. In LUS that was classified as forest, only trees with dbh  $\geq 20$  cm were measured and recorded. However, in LUS that was not

classified as forest (OWL, OL, and IW), all trees with dbh  $\geq 10$  cm were measured and recorded.

Each sample plot included “nested plots” (NP) when the land use was forest. There could be up to 3 locations of NP in the sample plot. The 1<sup>st</sup> location was centered at 5 m, the 2<sup>nd</sup> at 125 m, and the 3<sup>rd</sup> at 245 m from the plot starting point, respectively. The NPs consisted of two levels. The 1<sup>st</sup> level NP comprised a sample area of 200 m<sup>2</sup> (20 m x 10 m) for measurement of trees with dbh  $\geq 10$  cm but  $< 20$  cm dbh. The 2<sup>nd</sup> level comprised a sample area of 50 m<sup>2</sup> for recording tree regenerations, soil information and topography.

If the land use at the location of the NP was not classified as forest, the nested plot was not established.

## 7.2 Land Use/Land Cover Classification

The FAO global land use classes were used as a standard for developing the country’s national classification system. The FAO global land use classes were applied as the first level of the national land use classification system.

The FAO global land use classes are the following:

- Forest
- Other Wooded Land
- Other Lands
- Inland water

A second level classification subdivided the FAO global land use classes into more detailed classes to fulfil country specific needs. The national land uses classes were the following:

- Forest
  - Closed broad-leaved forest (FBC)
  - Open broad-leaved forest (FBO)
  - Closed coniferous forest (FCC)
  - Open coniferous forest (FCO)
  - Closed mixed forest (FMC)
  - Open mixed forest (FMO)
  - Closed broad-leaved plantation (PBC)
  - Open broad-leaved plantation (PBO)
  - Closed coniferous plantation (PCC)
  - Open coniferous plantation (PCO)
  - Closed bamboo/boho formation (BBC)
  - Open bamboo/boho formation (BBO)
  - Closed mangrove forest (MgC)
  - Open mangrove forest (MgO)
- Other Wooded Lands
  - Shrubs (Sh)
  - Fallow (Fa)
  - Wooded grassland (WGL)

- Other Lands
  - Barren land (Bl)
  - Lahar (Lahar)
  - Grassland (Gl)
  - Marshland (Ml)
  - Annual crop (AC)
  - Perennial crop (PCr)
  - Pastures (Pa)
  - Built-up area (BUA)
  - Primary paved road (Rd1)
  - Primary unpaved road (Rd2)
- Inland Water
  - Inland water pond (lwp)
  - Fishpond (FpW)

### 7.3 Variables

Three groups of variables were defined to cover the social, economic as well as environmental aspects. These provided description of the forest and trees outside forest resources in the country. The extent of variables was defined taking into account the need to produce different outputs in the predefined forest and tree attributes such as land use/land cover area, volume, biomass and carbon, resources management and protection status, biodiversity, and uses of resources. The variables were chosen to provide the necessary information for decision making at national level as well as for international reporting. The set of variables consisted of a core of internationally harmonised variables and a group of country specific variables that together permitted monitoring and reporting to satisfy both the national and international information requirements.

Attributes	Variables
Land use/ land cover	Land use class, area, land tenure/ownership status, designation/protection status, management system, ecological zone*
Volume	Land use class, area, tree species, diameter at breast height/above buttress, total tree height, commercial height, timber quality, management system, land tenure/ownership status, designation/protection status, ecological zone*
Biomass & Carbon Stock	Land use class, area, tree species, diameter at breast height/above buttress, total tree height, management system, land tenure/ownership status, designation/protection status, ecological zone*
Management	Land use class, area, management system, land tenure/ownership status, designation/protection status, stand origin, timber exploitation, silvicultural treatments, technology used, disturbances, ecological zone*
Forest health	Land use, area, management system, land tenure/ownership status, health state, causing elements, fire occurrence
Biodiversity	Land use, area, tree species
Uses of resources	Products and services, users, user rights, supply and demand trend, harvesting activity, season and frequency of extraction, tree species, accessibility to sample sites, distance to infrastructures

\* Ecological Zone – large ecological areas characterized by similar vegetation and climate and all the living organisms in it (e.g. Tropical rain forest and Tropical Mountain Systems).

## 7.4 Training of Field Crews

In preparation for the NFA Training, the staff of FRA-NCO developed a design for the NFA Training program. The list of official participants, budget estimate and course content were prepared. Potential resource persons who are experienced in the specified field of discipline and with good academic background were identified and considered. Further, the necessary letters-of-invitation to concerned DENR executives and selected resource persons were prepared. Likewise, the instructional materials were prepared. Moreover, the training venue was identified.

After the training program was designed, the staffs of FRA-NCO drafted in July 2002 the DENR Special Order requiring the field crew leaders and selected FMB technical personnel to attend and participate in the NFA training scheduled from October 1-8, 2002. In August 2002, the DENR Secretary approved said Order.

In September 2002, a week prior to the NFA training, the FAO-FORM backstopping forestry officer and the staffs of FRA-NCO conducted 2 days field-testing of the inventory sampling design and data collection methodology of the NFA approach. The group also selected 2 sites to be used in the field practicum. The sites contained a mixture of forests, shrubs, perennial crops and annual crops that are typical in the country to familiarize the participants with the different land use classifications prescribed in the NFI Field Manual.

The NFA training was organized and conducted by the staffs of FRA-NCO, in collaboration with DENR-HRDS personnel, FAO-FORM backstopping forestry officer, and local experts. The training was held in Los Baños, Laguna.

The NFA training involved lectures and field practicum. The training included, but was not limited to, the following:

- Forest inventory design and data collection methodology
- Dendrology/tree identification
- Tree measurement standards
- Soil analysis
- Training to operate the GPS receiver

The ultimate aim of the training was to develop the skills and improve the participants' performance. To ensure that the participants' had a higher level of acquisition and application of the skills discussed in the lectures, field practicum was conducted.

## 7.5 Measurement of Biophysical Variables

### 7.5.1 Diameter

Tree diameter was measured over bark. It was expressed as diameter at breast height (dbh) or diameter above buttress (dab). The dbh was measured at 1.3 m above the ground, while dab was at 0.3 m above the highest flange or buttress. If the tree was located on a slope, the dbh/dab measurement was made on the uphill side of the tree.

When abnormalities occurred at dbh/dab, such as bulge or depression, the dbh/dab was measured at the point just above the abnormality. A forked tree was considered as one tree when the fork occurred above the 1.3 m, and two trees when the fork was situated below the 1.3 m. The dbh of the latter was measured above the fork.

The dbh/dab was recorded to the nearest centimeter. In order to avoid overestimation of volume and to compensate for measurement errors, dbh/dab was measured in cm and rounded off to the immediate lower whole centimeter. DBH/dab was measured with the aid of diameter tape.

#### 7.5.2 Tree Height

The total height of a tree is the linear distance along the axis of the bole from the base of the tree to the tip of the crown. The total height of a tree was measured with the aid of the Haga altimeter and recorded to the nearest meter.

#### 7.5.3 Commercial Height

The commercial height of a tree is the linear distance along the axis of the bole from the stump height (50 cm above the ground or end of buttress) to the first main branch; however, it could be extended beyond the first main branch if there is a clear length of 3 meters up to the succeeding branch or at top end diameter of 30 cm.

The commercial height of a tree was measured with the use of the Haga altimeter and recorded to the nearest meter.

#### 7.5.4 Distance

Ground distance was measured with the use of the meter tape. It was recorded in the horizontal. In sloping terrain, the horizontal distance was determined by break-chaining.

#### 7.5.5 Elevation

The elevation was determined from the topographic map.

#### 7.5.6 Slope

Slope was determined with the use of the Haga altimeter or clinometer. In the absence of these instruments, the slope is computed using the Rise/Run formula.

## 7.6 Interviews

Field interviews were an essential element of the NFA approach. It was conducted to collect reliable and valid information by asking questions from local forest users and external key informants face-to-face. The interview produced observations in the form of narrations or responses stated in the respondent's own words which are then interpreted. The interview provided information on the social aspects of the use of the forests and tree resources and also provided very valuable additional information to the direct observations and measurements.

The RFIT normally conducted the interview after measurement of the biophysical variables in the plot. Most of the data on forest products and services were collected from the interviews. Majority of the respondents were the local folks that accompanied the team. The team leader usually did the interview. The interview was semi-structured. The questions answered by the respondents were not formulated prior to interview.

It was observed that some respondents did not have the necessary information needed to answer some of the questions. There were also matters that the respondents were reluctant to disclose, particularly when it related to timber poaching. At times, the field crews found difficulties in locating respondents from whom to elicit the required information.

The first requisite for successful interview was to create a congenial atmosphere and to put the respondent at his ease so that he will talk freely and fully. The interviewer casually and briefly introduced the project with a pleasant and confident approach. His manner was friendly, courteous, and conversational. He had to create a situation wherein the respondent's answers will be reliable and valid.

The interview began by asking questions that started off easily. From then on, the interview proceeded by asking questions that were able to collect valid and useful data that are responsive to the interview's objectives. When the reply was inadequate, the question was simply repeated, with proper emphasis, to get a response in satisfactory terms. The interviewer took all opinions in stride and never showed surprise or disapproval of a respondent's answer. The interviewer also answered any legitimate questions the respondent asked. Throughout, the interviewer was extremely careful not to suggest a possible reply.

## 7.7 Reporting

The crew leaders submitted field reports to FMB on a monthly basis. Said reports were collated and compiled at FRA-NCO. Likewise, the staffs of FRA-NCO prepared and submitted to FAO-FORM the project's Accomplishment Reports, pursuant to the provisions of the Letter of Agreement. The reports included physical accomplishment and Statement of Expenditures covering specific periods.

## 8. Fieldwork and Coordination

### 8.1 Coordination

When conducting fieldwork, it is an office protocol to pay courtesy call to the concerned heads of different government agencies with administrative jurisdiction over the area to be visited. This is to inform the concerned authorities of the presence of the team in the area as well as the nature of the activity to be undertaken. This enabled the team to be apprised of the situation in the area.

In August 2002, prior to the start of the project implementation, the staffs of FRA-NCO drafted a letter for the Secretary of *Interior and Local Government* (DILG) requesting that heads of local government units (province, municipality, and barangay) be informed of the implementation of the FRA Project - taking into consideration that some tracts fell in alienable and disposable lands/private lands - to help facilitate field coordination with concerned local government officials. A copy of the letter-response from DILG, informing that DENR shall directly coordinate with the concerned LGUs, was provided to the crew leaders as documentary evidence that shows proper coordination has been carried out at the national level.

Before proceeding to the tract, the crew leaders paid courtesy call to the concerned Provincial Environment and Natural Resources Officer (PENRO) and Community Environment and Natural Resources Officer (CENRO) and subsequently to the head of local government unit (LGU) to ask information about the situation in the area and about local people who can be hired as guides and laborers. In areas with peace and order problem, the crew leaders coordinated with the commanding officer of the concerned military unit and sought for his clearance before visiting the area.

### 8.2 Fieldwork

Primary data gathering was done during the fieldwork. Fieldwork was physically demanding, particularly in forestland. It usually required walking several kilometers over varied terrain.

#### 8.2.1 Access to the First Plot

With the aid of the topographic map and through the help of the local guides/laborers, the field crew first located the best route that could expedite the team's access to the nearest plot. Then the field crew proceeded to the nearest plot, with the aid of the GPS receiver and box compass. When leaving the nearest road, the crew leader identified the coordinates and time, and recorded these in Form F1. The field crew also identified and recorded the coordinates of natural features on the ground used as reference points in accessing the nearest plot. The coordinates were determined with the GPS receiver.

#### 8.2.2 Plot Marking

Permanent sample plots were established on the ground generally at the exact location specified for each plot. The plot starting point was located on

the ground with the aid of the GPS receiver. A tolerance of 5 m radius, which is the maximum estimated position error (EPE) of the GPS, was allowed.

When arriving at the starting point of the 1<sup>st</sup> plot, a marker (galvanized iron pipe measuring 0.5 m in length x 5 cm in diameter) was inserted on the ground. The marker was placed exactly on the starting point of the plot. However, if an obstacle hampered the operation, the marker was placed as close as possible to the plot starting point. The distance and direction of the plot starting point from the marker were measured and recorded. Further, at least three reference points surrounding the marker were also identified and recorded. Said data were recorded in Form F2.

### 8.2.3 Data Collection

During data collection, the team leader acted as the operator of the GPS receiver, compass man, and recorder. The assistant team leader led the laborers in the measurement of biophysical variables. The laborers also acted as brushers and tapemen/chainmen. They also helped in the identification of local tree species.

Data collection started from the plot starting point and progressed towards the plot end following the appropriate direction of the plot axis. The date and time when the operation started and ended were recorded in Form F2.

Measurement was carried out on each side of the plot axis, on a 10 m wide extension. Different variables were collected according to data unit level.

- The Plot

Measurement of large diameter trees was carried out in the plot. In LUS classified as forest, trees with dbh  $\geq$  20 cm were measured, whereas trees with dbh  $\geq$  10 cm were measured in land use section outside the forest. The data collected included tree species, dbh/dab, total height, commercial height, health, and stem quality. Said data were recorded in Form F3.

All details observed in the plot such as boundaries of the LUS, rivers, roads, and other features inherent to the plot were reflected in the Plot Plan (Form F2). Natural features adjacent to the plot that can help in locating the plot during revisits were also sketched in the Plot Plan.

- Rectangular Subplot (Nested Plot Level 1)

Trees with dbh  $\geq$ 10 cm but  $<$ 20 cm were measured in the rectangular subplot. Likewise, non-wood forest products such as bamboo, rattan, and erect palms were measured. Trees with dbh  $\geq$ 10 cm but  $<$ 20 cm were recorded in Form

F3a and NWFP were recorded in Form F3b. The rectangular subplot shall be established only when the land use is forest.

- Circular Subplot (Nested Plot Level 2)

Data on regeneration and small diameter trees (saplings  $\geq 1.3$  m height and trees  $< 10$  cm dbh) were collected in the circular subplot. These were counted by species. Edaphic variables such as aspect, slope, relief, soil texture, soil drainage, and thickness of organic matter were also measured. Said data were recorded in Form F4a. Further, data on other non-wood forest products (other than bamboo, rattan and erect palms) were also measured. Said data were recorded in Form F4b. The circular subplot shall be established only when the land use is forest.

- Land Use Section (LUS)

A land use section is an area that has homogenous land use class. Different LUS varied in size and shape. The whole plot was considered as one LUS when it has a homogeneous land use; however, it was subdivided into different LUS when some portions of the plot have varying land uses.

Most of the data related to forest characteristics, management and resource uses were collected in the LUS. In order to facilitate the area calculation for each LUS, the width of the LUS was fixed at 20 meters.

In forest, trees with dbh  $\geq 20$  cm were measured and recorded whereas in TOF, trees with dbh  $\geq 10$  cm were measured and recorded.

In the field survey, the field crews recorded tree species either in their official common name or local name in the region. As a consequence a tree species may have been assigned at least one local name.

Table 1m shows the status of physical accomplishment by region.

Table 1m: Status of accomplishment by Region

Region	Goal	Accomplished	Accomplishment (%)
NCR	2	2	100
CAR	24	22	92
1	17	17	100
2	36	36	100
3	25	25	100
4A	24	20	83
4B	35	33	94
5	24	23	96
6	28	28	100
7	21	21	100
8	27	27	100
9	19	18	95
10	22	18	82
11	22	19	86
12	26	26	100
13	26	24	92
ARMM	17	8	47
Total	395	367	93

Of the 367 tracts visited, 6 tracts fell in sea water (non-inland water), 4 tracts partially fell in the sea, 5 tracts fell in inland water, and 1 tract fell in a ravine.

## **9. Database Design, Data Entry and Data Processing, Data Analysis and Data Interpretation**

### **9.1 Database Design**

The purpose of the database system is to store the data in a manner that allows the extraction of information through queries. Data is a collection of facts while information is that data organized or presented in such a way as to be useful for decision making.

The NFI-Philippines database application was developed by FAO-FORM and FMB.

### **9.2 Data Entry and Data Processing**

Data entry and data processing was centralized. The field data collected by the field crews were submitted to- and aggregated at FMB (FRA-NCO). Submitted field data were then electronically stored using both the NFI-Philippines database application (MS Access 2000) developed by FAO together with FMB. The data were then organized and transformed into information so that it can be viewed in a useful form.

#### **9.2.1 Data Entry**

Data were entered into form. FAO-FORM developed tailor-made forms for the data entry. The forms were structured to look like the original data registration forms (Field Forms).

Before data entry, the staffs of FRA-NCO reviewed the field data to screen incorrect or missing values. However, considering that said staffs at first were not quite familiar with the NFA approach, not all errors were corrected in many of the early reports. As such, some field data have missing or incorrect values.

Data entry started in the 1<sup>st</sup> quarter of CY 2003 when field reports started to come in at FMB (FRA-NCO) and ended in August 2004. Out of the 367 tract reports submitted to FMB, the reports in 10 tracts were not encoded for the following reasons: 8 tract reports (Region 12) were submitted during data processing, 1 tract report (ARMM) was collected about 2 km away from its supposed location because the field crew was denied entry by the landowner, and 1 tract report (ARMM) was neglected by the data encoder.

The electronically encoded data were later reviewed and edited by the staffs of FRA-NCO to correct any observed disparities.

In January 2005, the FAO-FORM backstopping forestry officer further recommended some refinements to the Data Registration Forms to address

observed data gaps. As a consequence, re-editing of the encoded field data was conducted. Re-editing of encoded data was completed in April 2005.

The project employed a database expert to help the staffs of FRA-NCO in managing the data generated by the project. To expedite data entry, the project also contracted the services of a data encoder to assist the database expert in the data entry.

### 9.2.2 Data Processing

The FAO-FORM backstopping forestry officer travelled to the Philippines in February and October 2004 to introduce the statistical functions for the data processing and also to demonstrate to the staffs of FRA-NCO the basic applications of the NFI-Philippines database processing system.

In the NFI-Philippines database application, all data was stored in tables or two-dimensional grids. The columns of the grid are called fields and the rows are called records. The rows contain the data corresponding to the fields. Fields or columns define the type of data, while rows or records give specific values to fields. Each record in the table has a primary key to positively identify it. The *primary key value* for a record is unique to that record in each table.

The data within the database was broken into small, but logically consistent, parts. Each of these parts had its own table. Each table has logically consistent contents.

The data were then assembled from the various tables by linking those tables by fields containing identical data. By making a query with the tables, information was extracted from the data contained in the tables. A query using the tables in the dataset was designed; the query then assembled the linked data. The database manager associated and put together the data from the said tables.

The data in the NFI-Philippines database was then exported to Microsoft Excel for statistical calculations. Worksheet macros were built to automate the calculations.

### 9.3 Data Analysis and Data Interpretation

After the field data were collected, electronically stored and processed, the staff of FRA-NCO and in collaboration with the FAO-FORM backstopping forestry officer conducted data analysis and interpretation. The purpose of data analysis is to summarize the completed observations in such a manner that they yield answers to any question at hand; while the purpose of data interpretation is to search for the broader meaning of these answers by linking them to other available knowledge.

## 10. Results

Based on the numerical descriptions extracted from the processed data, the following results are drawn:

### 10.1 Area

In the calculation of area, those land use sections where physical measurement of trees was not carried out, but the field crews were able to visually identify the land use classification, were included. An example is a plot with a land use of forest that fell in a ravine.

In the calculation of land use area distribution in the country, a total of 351 sample units (tracts) with an aggregate area of 695.768 ha were statistically analyzed. This excludes the tracts and/or land use sections that fell in the sea (non-inland water). A tract could have one or more land use classes. Table 2.a shows the distribution of the sample units per land use class.

Table 2a: Sample units distribution by land use

Land Use Class	No. of sample units (tract)	Area (ha)
Forest	169	166.116
Other Wooded Land	136	83.752
Other Land	299	427.286
Inland Water	110	18.614
Total		695.768

Likewise, in the calculation of area by forest type in the country, even those LUS where tree measurement was not carried out were included. A total of 169 sample units (tracts) with an aggregate area of 166.116 ha contain land use sections classified as forest. A sample unit (tract) could have one or more forest types. Table 2.b shows the sample unit distribution by forest type.

Table 2b: Sample units distribution by forest type

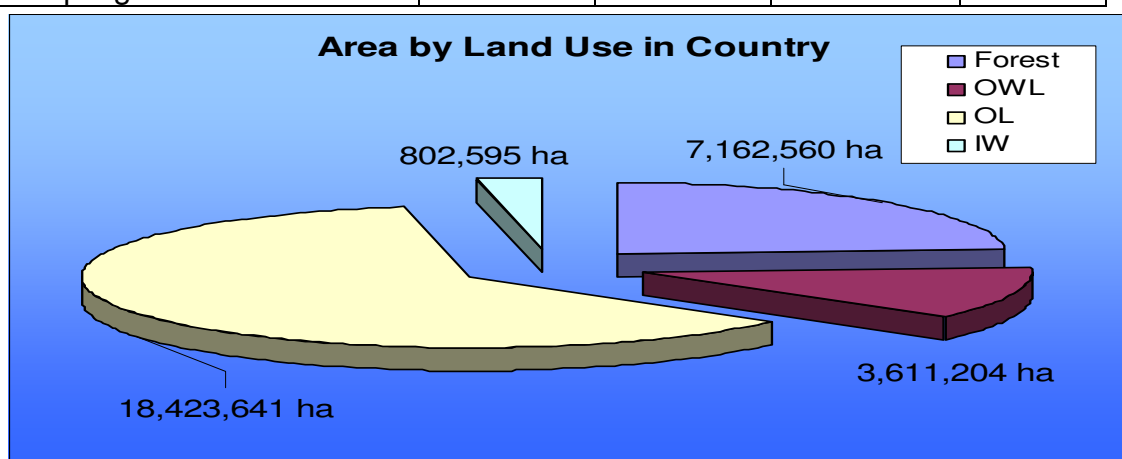
Forest Type	No. of sample units (tract)	Area (ha)
Closed broad-leaved forest (FBC)	90	99.418
Open broad-leaved forest (FBO)	66	40.4
Closed coniferous forest (FCC)	2	1.03
Open coniferous forest (FCO)	4	3.874
Closed mixed forest (FMC)	1	1.5
Open mixed forest (FMO)	1	0.42
Closed broad-leaved plantation (PBC)	17	6.456
Open broad-leaved plantation (PBO)	28	7.846
Closed coniferous plantation (PCC)	1	0.2
Open coniferous plantation (PCO)	1	0.044
Closed bamboo/boho formation (BBC)	8	2.602
Open bamboo/boho formation (BBO)	7	1.384
Closed mangrove forest (MgC)	1	0.72
Open mangrove forest (MgO)	2	0.222
Total		166.116

### 10.1.1 Area by Land Use Class

Statistical analysis shows that the area distribution in the Philippines based on global land use classes, in decreasing order of area coverage, is as follows: Other Land (OL): 18,423,641 ha; Forest: 7,162,560 ha; Other Wooded Land (OWL): 3,611,204 ha; and Inland Water (IW): 802,595 ha.

Table 2c: Area by land use class

	Forest	OWL	OL	IW
Land use area in country (ha)	7,162,560	3,611,204	18,423,641	802,595
Percent	23.9%	12.0%	61.4%	2.7%
Sampling Error %	7.92%	10.21%	3.38%	20.72%



### 10.1.2 Area by Forest Type

Statistical analysis shows that the country's forest cover is about 7,162,560 ha (about 23.9% of the total area of the country). Out of this, about 6,087,029 ha or 85% is in legally classified forestland or owned by the state; 4,826,007 ha or 67.4% is closed canopy forest; 6,535,368 ha or 91.2% is natural forest; 6,645,319 ha or 92.8% is broad-leaved forest; 5,462,510 ha or 76.3% is for production purposes; and about 5,059,618 ha or 70.6% is not covered by a formal management system.

The succeeding discussions will provide details on the status of the forest situation in the country.

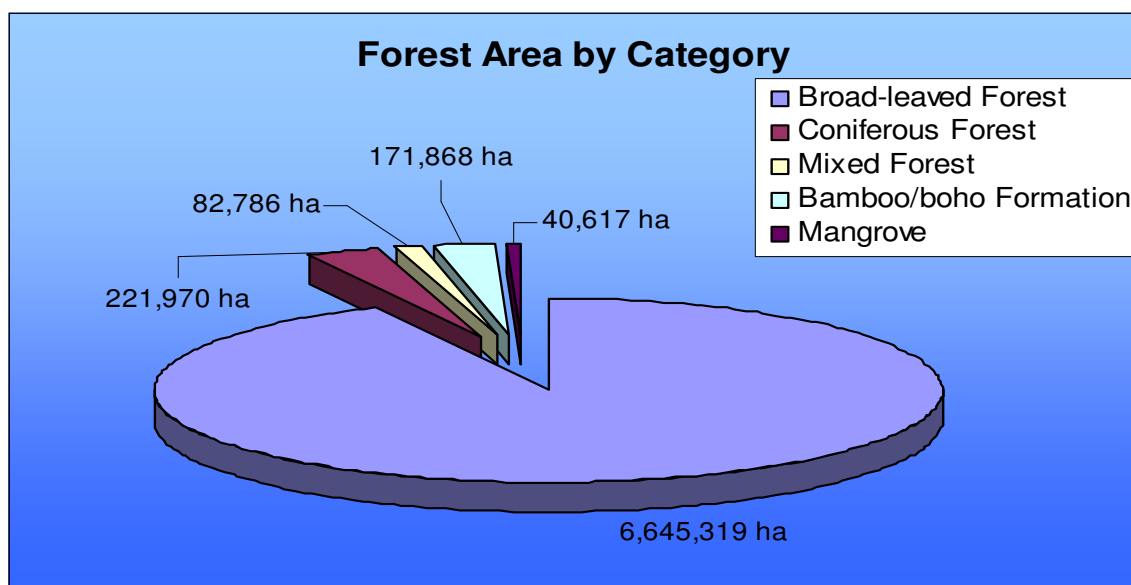
#### 10.1.2.1 Forest area by category

Based on forest category, about 6,645,319 ha or 92.8% is broad-leaved forest; 221,970 ha or 3.1% is coniferous forest; 82,876 ha or 1.2% is mixed forest, 171,868 ha or 2.4% is bamboo/boho formation, and 40,617 ha or 0.6% is mangrove forest.

In bamboo/boho formation, the dominant species is boho. The area is most often sparsely interspersed with small diameter naturally-growing trees. Bamboo is mostly found in alienable and disposable lands.

Table2d: Forest area by category

	Broad-leaved Forest	Coniferous Forest	Mixed Forest	Bamboo/boho Formation	Mangrove
Area (ha)	6,645,319	221,970	82,786	171,868	40,617
Percent	92.8%	3.1%	1.2%	2.4%	0.6%

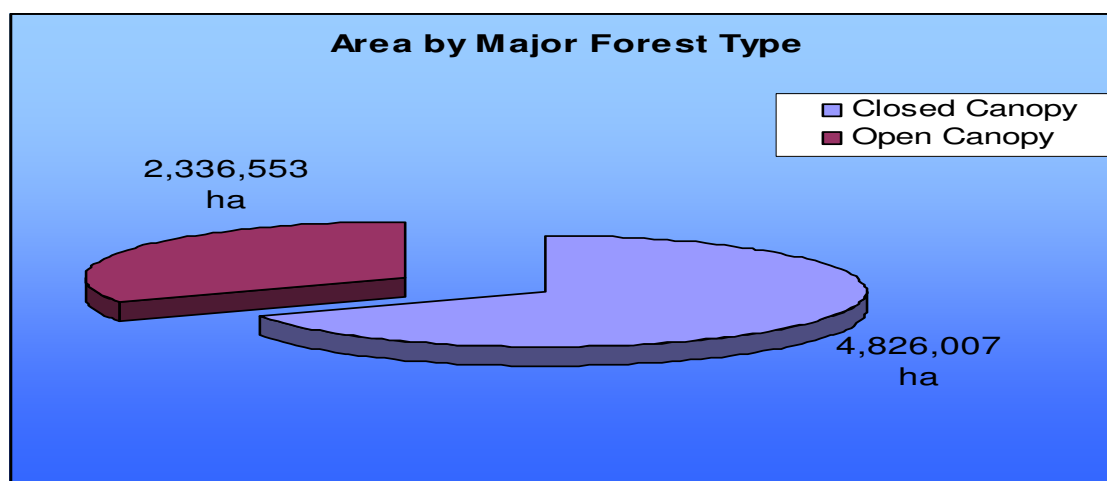


10.1.2.2 Area by major forest type

Based on canopy coverage, forest is classified into closed canopy forest and open canopy forest. Out of the forest area, about 4,826,007 ha or 67.4% is closed canopy forest and 2,336,553 ha or 32.6% is open canopy forest.

Table 2e: Area by major forest type

	Forest	Closed Canopy	Open Canopy
Area (ha)	7,162,560	4,826,007	2,336,553
Percent	100%	67.4%	32.6%

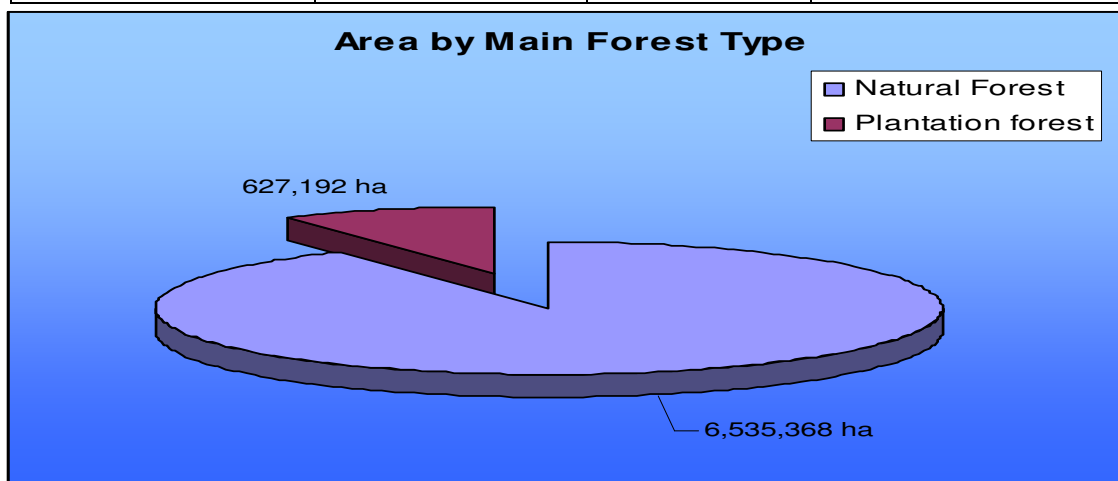


### 10.1.2.3 Area by main forest type

Forest is further sub-classified into natural forest and plantation forest. Natural forest covers about 6,535,368 ha or 91.2% and plantation forest covers 627,192 ha or 8.8%.

Table 2f: Area by main forest type

	Total	Natural Forest	Plantation forest
Area (ha)	7,162,560	6,535,368	627,192
Percent	100%	91.2%	8.8%

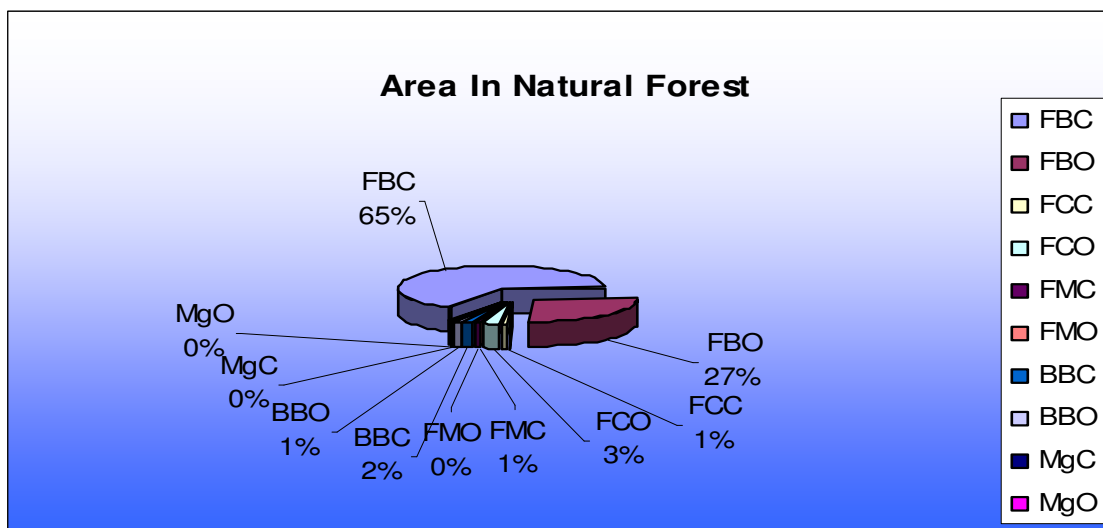


#### 10.1.2.3.1 Natural forest area

In the natural forest, about 4,286,688 ha is closed broad-leaved forest (FBC); 1,741,960 ha is open broad-leaved forest (FBO); 44,411 ha is closed coniferous forest (FCC); 167,038 ha is open coniferous forest (FCO); 64,677 ha is closed mixed forest (FMC); 18,109 ha is open mixed forest (FMO); 112,193 ha is closed bamboo/boho formation (BBC); 59,675 ha is open bamboo/boho formation (BBO); 31,045 ha is closed mangrove forest (MgC); and 9,572 ha is open mangrove forest (MgO).

Table 2g: Natural forest area

Main Forest Type	Area (ha)	Percent
Closed broad-leaved forest	4,286,688	65.6%
Open broad-leaved forest	1,741,960	26.6%
Closed coniferous forest	44,411	0.7%
Open coniferous forest	167,038	2.6%
Closed mixed forest	64,677	1.0%
Open mixed forest	18,109	0.3%
Closed bamboo/boho formation	112,193	1.7%
Open bamboo/boho formation	59,675	0.9%
Closed mangrove forest	31,045	0.5%
Open mangrove forest	9,572	0.1%
Total	6,535,368	100.0%

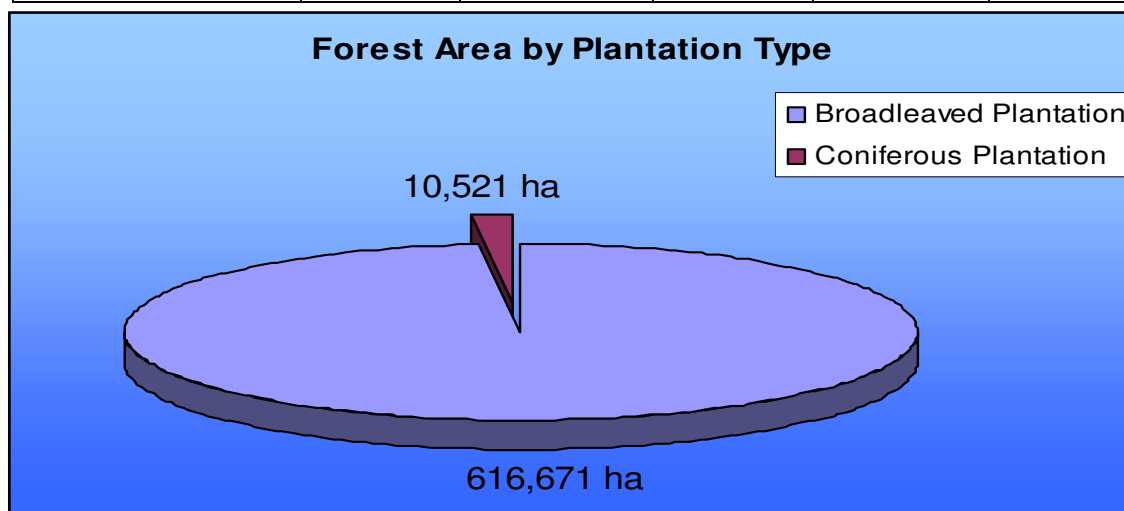


### 10.1.2.3.2 Plantation forest

In the plantation forest, about 616,671 ha or 98.3% is broad-leaved plantation and 10,521 ha or 1.7% is coniferous plantation. Broad-leaved plantation is broken down as follows: about 278,369 ha is closed broad-leaved plantation (PBC); and 338,302 ha is open broad-leaved plantation (PBO). On the other hand, coniferous plantation is broken down as follows: 8,624 ha is closed coniferous plantation (PCC); and 1,897 ha is open coniferous plantation (PCO).

Table 2h: Area by forest plantation type

	Total	Broadleaved Plantation		Coniferous Plantation	
Area (ha)	627,192	616,671		10,521	
Percent	100.0%	98.3%		1.7%	
		Closed	Open	Closed	Open
Area (ha)	627,192	278,369	338,302	8,624	1,897
Percent	100.0%	44.4%	53.9%	1.4%	0.3%

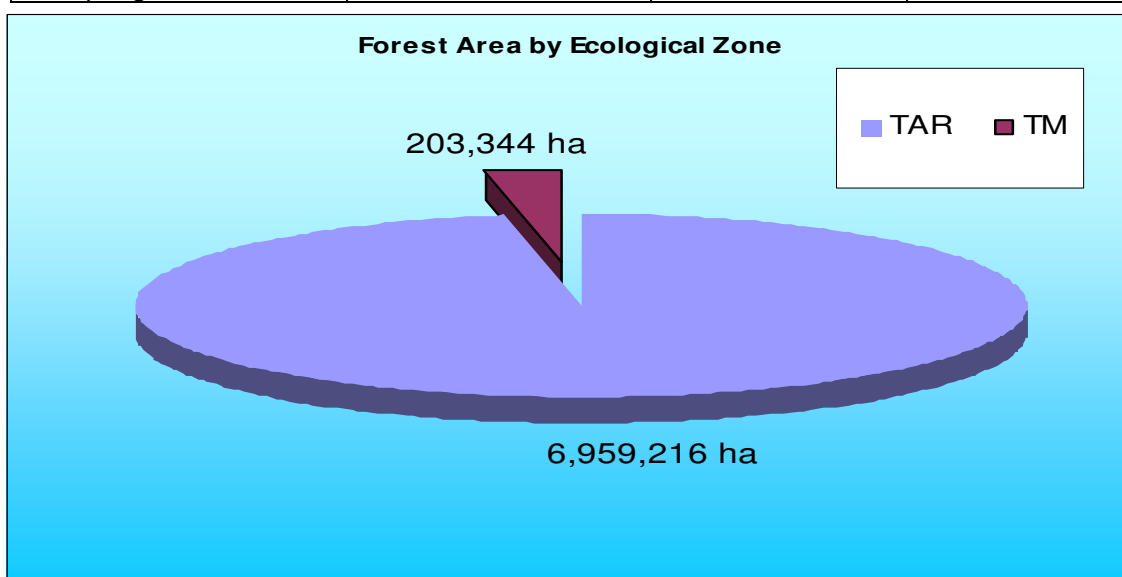


### 10.1.3 Forest Area by Ecological Zone

Based on the global ecological zone classification, the country lies under the Tropical Rain Forest (TAR) and Tropical Mountain Systems (TM). Data shows that out of the 7,162,560 ha of forest, about 6,959,216 ha or 97.1% falls in TAR while 203,344 ha or 2.9% falls in TM.

Table 2i: Forest area by ecological zone

	Total	TAR	TM
Area (ha)	7,162,560	6,959,216	203,344
Percent	100%	97.1%	2.9%
Sampling error %		1.7%	59.4%

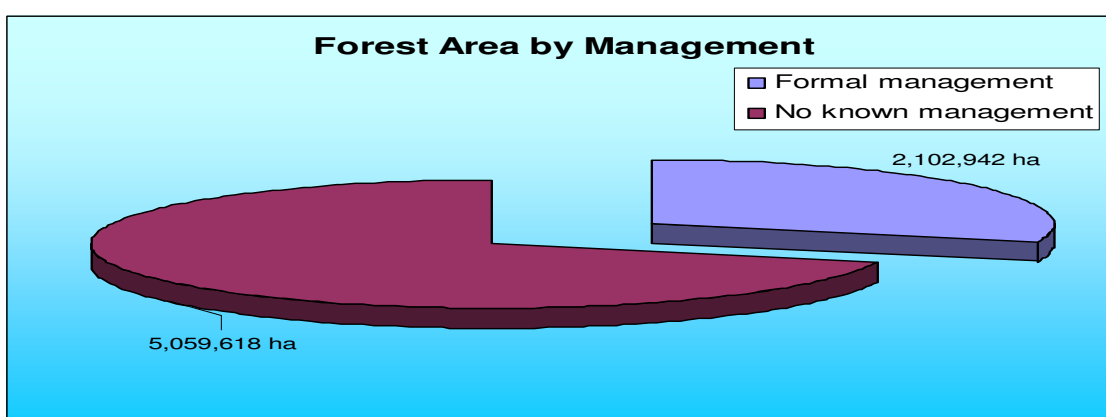


### 10.1.4 Forest Area by Management System

Data shows that about 2,102,942 ha or 29.4% is under formal management system (with Forest Management Plan) and 5,059,618 ha or 70.6% is not covered by any management system.

Table 2j: Forest area by management system

	Total	Formal management	No known management
Area (ha)	7,162,560	2,102,942	5,059,618
Percent	100%	29.4%	70.6%
Sampling error %		15.5%	6.4%

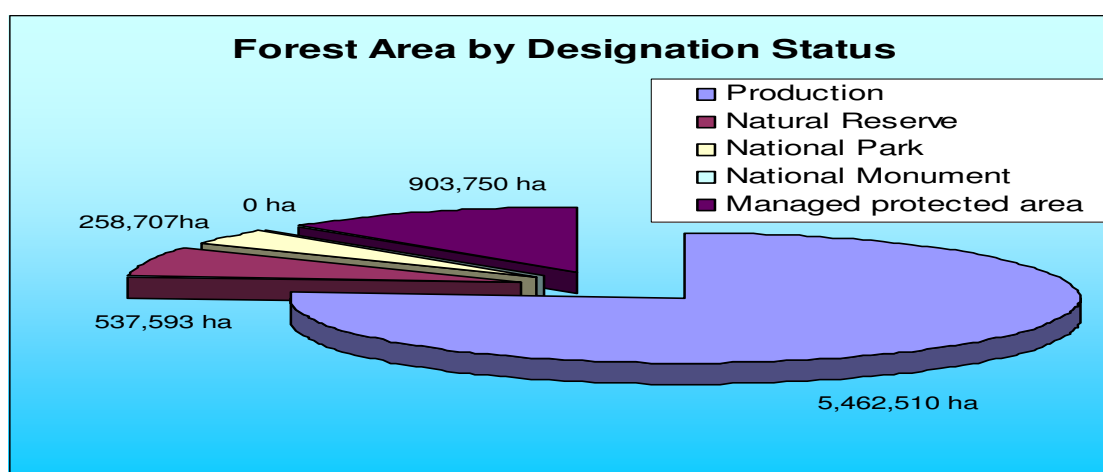


### 10.1.5 Forest Area by Designation/Protection Status

Data shows that about 5,462,510 ha or 76% of the country's forest is designated for production purposes and the remaining 24% is for protection purposes. Protection forest is broken down as follows: natural reserve: 537,593 ha; national park: 258,707; and managed protected area: 903,750 ha.

Table 2k: Forest area by designation/protection status

	Total	Production	Natural Reserve	National Park	National Monument	Managed protected area
Area (ha)	7,162,560	5,462,510	537,593	258,707	0	903,750
Percent	100%	76.3%	7.5%	3.6%	0%	12.6%
Sampling error %		5.8%	123.7%	511.7%	0%	77.3%



### 10.1.6 Forest Area by Ownership

As of 2002, about 15.86 million hectares or 53% of total area of the Philippines is legally classified as forestlands while 14.14 million hectares or 47% is alienable and disposable lands.

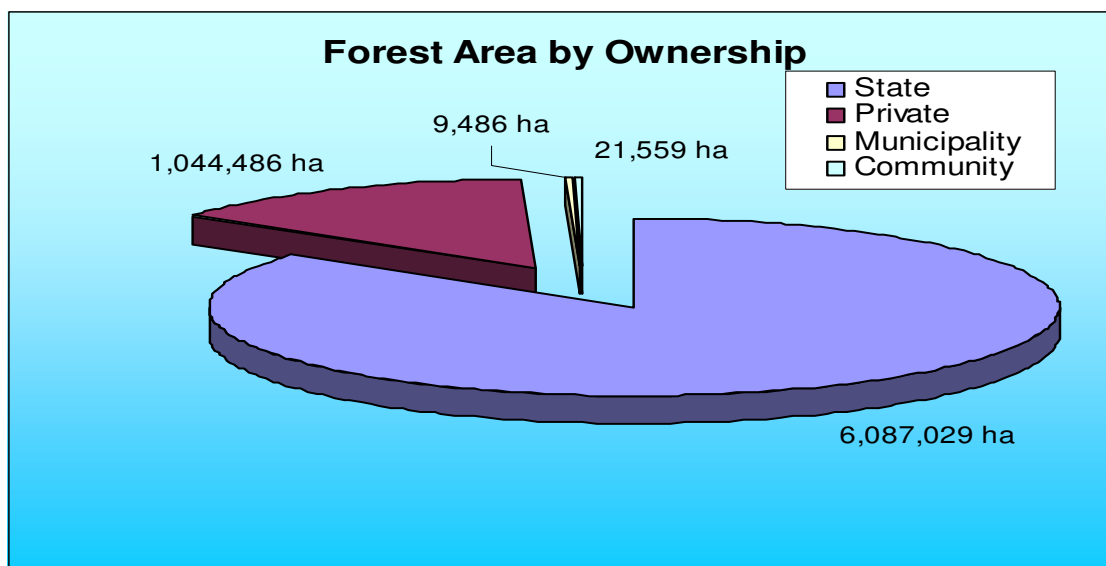
Legally classified forestlands are those lands that belong to the public domain and are classified for forestry purposes regardless of the present state of the forest cover. Forestlands include the public forest, the permanent forest or forest reserves, and forest reservations.

Alienable and disposable lands refer to those lands of the public domain which have been the subject of the present system of classification and declared as not needed for forest purposes. No land of the public domain 18% in slope or over shall be classified as alienable and disposable land.

Out of the 7,162,560 ha of forest in the country, about 6,087,029 ha or 85% is owned by the state; 1,044,486 ha or 14.6% is privately owned; 9,486 ha or 0.1% is municipality owned and 21,559 ha or 0.3% is owned by the community. Those areas owned by the communities are covered by Certificate of Ancestral Domain Title (CADT).

Table 2l: Forest area by ownership

	Total	State	Private	Municipality	Community
Area (ha)	7,162,560	6,087,029	1,044,486	9,486	21,559
Percent	100%	85%	14.6%	0.1%	0.3%
Sampling error		3%	17.7%	100.5%	99.5%



### 10.1.7 Precision of Area Estimates

Precision is measured through the sampling error of an estimate – the smaller the sampling error, the more precise is the estimate.

#### 10.1.7.1 Precision of Area Estimates by Land Use

Based on 351 sample units, Other Land has a sampling error of  $\pm 3.38\%$ . At the same time, Forest has a sampling error of  $\pm 7.92\%$ .

Table 2m: Precision of area estimates by land use

Land Use	Sampling Unit	Area (ha)	Sampling Error
Forest	169	166.116	7.92%
Other Wooded Land	136	83.752	10.21%
Other Land	299	427.286	3.38%
Inland Water	110	18.614	20.72%

#### 10.1.7.2 Precision of Area Estimates by Forest Type

When Forest was subdivided into different forest types, the sampling error is high. Based on 169 sample units, closed broad-leaved forest, with the largest number of sample plots, has a sampling error of  $\pm 6.81\%$ . At the same time, closed mixed forest, open mixed forest, closed coniferous plantation, open coniferous plantation, and closed mangrove forest, with the lowest no. of sample units, have more  $>100\%$  sampling error.

10.1.8 Table 2n: Precision of area estimates by forest type

Forest Type	Sampling Unit	Area (ha)	Sampling Error
Closed broadleaved forest	90	99.418	6.81
Open broadleaved forest	66	40.4	14.12
Closed coniferous forest	2	1.03	70.41
Open coniferous forest	4	3.874	63.0
Closed mixed forest	1	0.42	100.5
Open mixed forest	1	1.5	99.54
Closed broadleaved plantation	17	6.456	33.81
Open broadleaved plantation	28	7.846	31.98
Closed coniferous plantation	1	0.2	100.29
Open coniferous plantation	1	0.044	99.6
Closed bamboo/boho formation	8	2.602	46.26
Open bamboo/boho formation	7	1.384	47.18
Closed mangrove forest	1	0.72	100.28
Open mangrove forest	2	0.222	75.419

Table 2m shows that precision for area estimates in Forest is very high in the aggregated results. However, when it is subdivided into forest types (Table 2n) the sampling error increased. It can be deduced from the above information that the number of sample units is critical in ensuring the precision of the results; that the larger the number of sample plots the lesser the sampling error.

## 10.2 Volume

In this report, two types of volume were calculated: the gross volume and the commercial volume.

The gross volume is calculated using the following formula:  $\text{Gross Volume} = (\text{dbh})^2 \times \text{form factor} \times \text{total height of the tree}$ . The form factor differs between dipterocarp species and non-dipterocarp species. Likewise, the form factor differs in each climatic region. (Please see the attached Regional Volume Equations). In the calculation of gross volume, all trees with  $\text{dbh} \geq 10$  cm that have healthy and slightly damaged health state are included. Those trees whose health state are strongly affected, lying and/or standing dead were excluded.

At the same time, the commercial volume is calculated using the following formula:  $\text{Commercial Volume} = (\text{dbh})^2 \times \text{form factor} \times \text{commercial height of the tree}$ . The form factor differs between dipterocarp species and non-dipterocarp species as well as in each climatic region. In the calculation of the commercial volume, only trees with  $\text{dbh} \geq 50$  cm that have healthy and slightly damaged health state are included.

The above-mentioned formulae were applied to all types of land use, including mangrove forest.

In the calculation of volume, only those land use sections where physical measurement of trees was carried out were included to avoid underestimation of volume. In this connection, the number of sample units used in the calculation of volume is lesser than the number of sample units used in the calculation of area.

A total of 164 sample units (tracts) with an aggregate area of 141.856 ha contain LUS classified as Forest. A sample unit (tract) could have one or more forest types. Table 3.a shows the distribution of sample units (tracts) by forest type.

Table 3a: Sample unit distribution by Forest Type

Forest Type	No. of sample unit	Area of sample unit (ha)
Closed broad-leaved forest (FBC)	86	85.792
Open broad-leaved forest (FBO)	64	33.89
Closed coniferous forest (FCC)	2	0.91
Open coniferous forest (FCO)	3	1.37
Closed mixed forest (FMC)	0	0.0
Open mixed forest (FMO)	1	0.42
Closed broad-leaved plantation (PBC)	17	6.456
Open broad-leaved plantation (PBO)	26	7.846
Closed coniferous plantation (PCC)	1	0.2
Open coniferous plantation (PCO)	1	0.044
Closed bamboo/boho formation (BBC)	8	2.602
Open bamboo/boho formation (BBO)	7	1.384
Closed mangrove forest (MgC)	1	0.72
Open mangrove forest (MgO)	2	0.222
Total		141.856

Table 3.a shows that closed canopy broad-leaved forest has the largest number of sampling units (86 tracts), and followed by open canopy broad-leaved forest (64 tracts).

### 10. 2.1: Volume in Forest

In Forest, the gross volume of all trees with dbh  $\geq 10$  cm is about 1,247,858,946 m<sup>3</sup> or an average gross volume per ha of 174.22 m<sup>3</sup>. At the same time, the commercial volume of all trees with dbh  $\geq 50$  cm is 386,956,668.6 m<sup>3</sup> or an average commercial volume per ha of 54.02 m<sup>3</sup>.

#### 10.2.1.1: Gross Volume in Forest

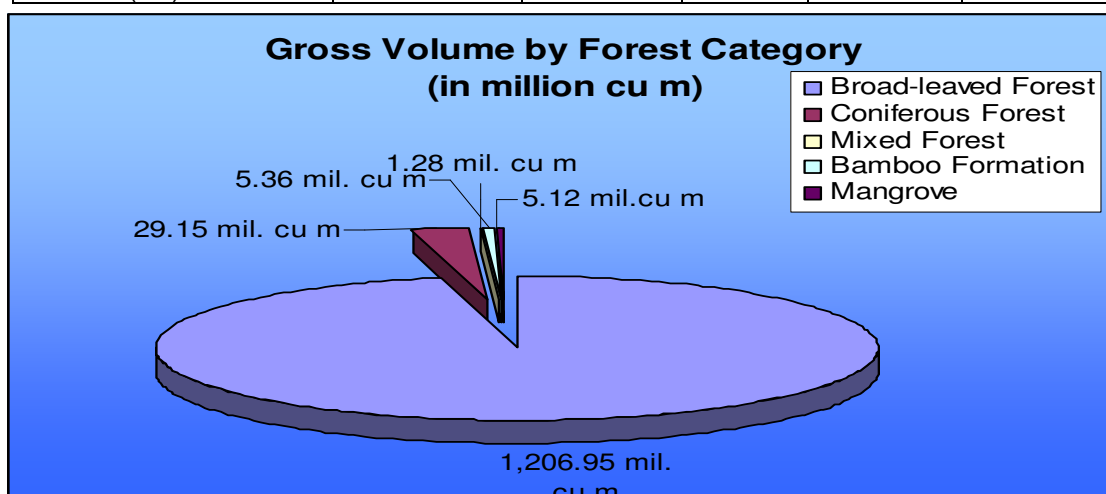
In the calculation of gross volume, the volume of all trees with dbh  $\geq 20$  cm was computed first. Then a separate calculation was carried out for the volume of trees with dbh  $\geq 10$  cm but  $< 20$  cm (trees recorded in the rectangular subplots). The calculated volume of trees with dbh  $\geq 10$  cm but  $< 20$  cm was later added to the volume of trees with dbh  $\geq 20$  cm to come up with the gross volume of all trees with dbh  $\geq 10$  cm.

##### 10.2.1.1.1: Gross volume by forest category

Forest is categorized into broad-leaved forest, coniferous forest, mixed forest, bamboo/boho formation, and mangrove forest. These have aggregate gross volume of 1,247,858,946 m<sup>3</sup>. Out of this, about 1,206.95 million m<sup>3</sup> or 96.7% is in broad-leaved forest; 29.15 million m<sup>3</sup> or 2.3% is in coniferous forest; 1.28 million m<sup>3</sup> or 0.1% is in mixed forest; 5.36 million m<sup>3</sup> or 0.4% is in bamboo/boho formation; and 5.12 million m<sup>3</sup> or 0.4% is in mangrove forest.

Table 3b: Gross volume by forest category

	Broad-leaved Forest	Coniferous Forest	Mixed Forest	Bamboo Formation	Mangrove
Gross Vol. (million m <sup>3</sup> )	1,206.95	29.15	1.28	5.36	5.12
Percent	96.7%	2.3%	0.1%	0.4%	0.4%
Vol./ha (m <sup>3</sup> )	178.41	228.71	15.42	31.21	126.08

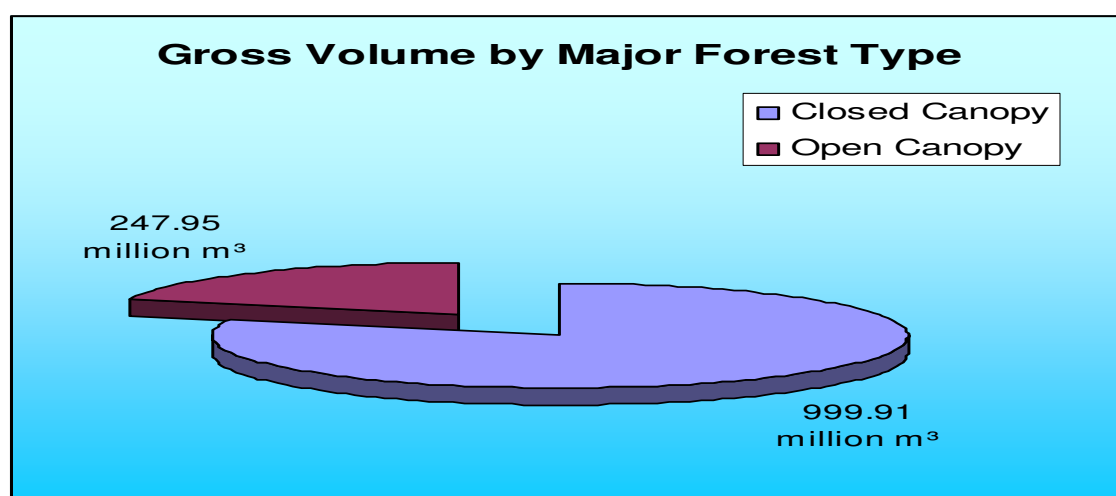


10.2.1.1.2: Gross volume by major forest type

Forest is further classified into closed canopy forest and open canopy forest. Out of the gross volume of 1,247.86 million m<sup>3</sup>, about 999.91 million m<sup>3</sup> or 80.1% is in closed canopy forest and 247.95 million m<sup>3</sup> or 19.9% is in open canopy forest.

Table 3c: Gross volume by major forest type

	Total	Major Forest Type	
		Closed Canopy	Open Canopy
Gross Volume (million m <sup>3</sup> )	1,247.86	999.91	247.95
Percent	100.0%	80.1%	19.9%
Vol./ha (m <sup>3</sup> )	174.22	204.83	99.94

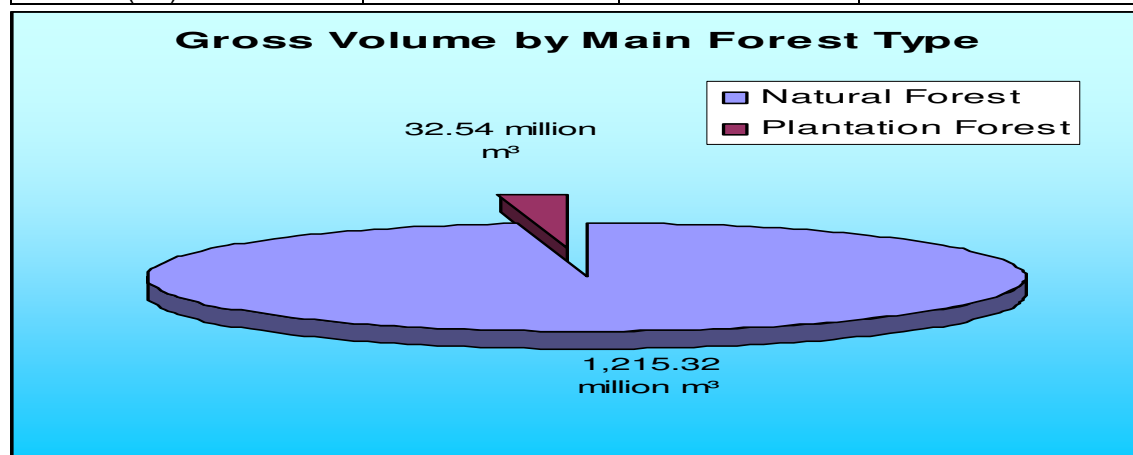


10.2.1.1.3: Gross volume by main forest type

Forest is further sub-classified into natural forest and plantation forest. Out of the gross volume of 1,247.86 million m<sup>3</sup>, about 1,215.32 million m<sup>3</sup> or 97.4% is in natural forest and 32.54 million m<sup>3</sup> or 2.6% is in plantation forest.

Table 3d: Gross volume by main forest type

	Total	Natural Forest	Plantation Forest
Volume (in million m <sup>3</sup> )	1,247.86	1,215.32	32.54
Percent	100.0%	97.4%	2.6%
Vol./ha (m <sup>3</sup> )	174.22	186.0	52.0

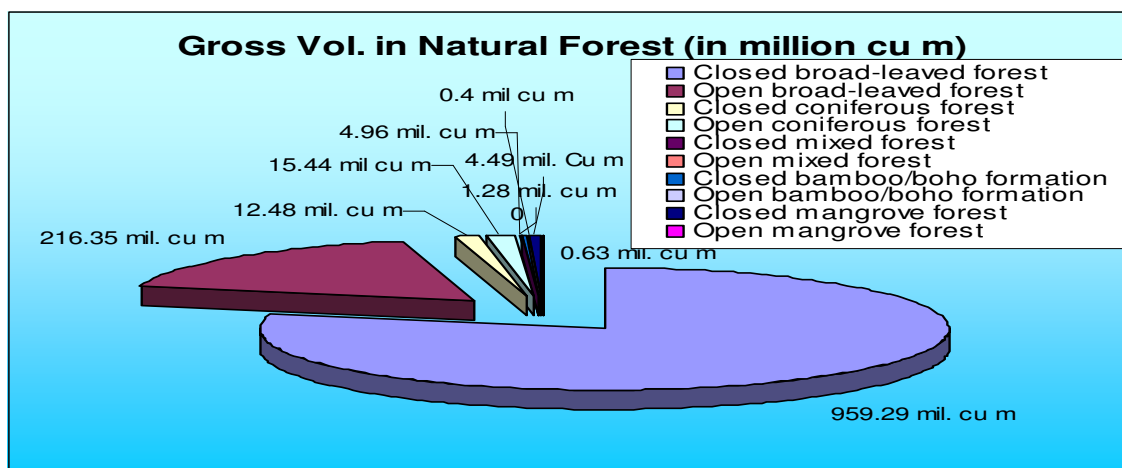
10.2.1.1.3.1: Gross volume in natural forest

The gross volume distribution in natural forest is as follows: closed broad-leaved forest (FBC): 959.29 million m<sup>3</sup>; open broad-leaved forest (FBO): 216.35 million m<sup>3</sup>; closed coniferous forest (FCC): 12.48 million m<sup>3</sup>; open coniferous forest (FCO): 15.44 million m<sup>3</sup>; closed mixed forest (FMC) 0 m<sup>3</sup>; open mixed forest (FMO): 1.28 million m<sup>3</sup>; closed bamboo/boho formation (BBC): 4.96 million m<sup>3</sup>; open bamboo/boho formation (BBO): 0.40 million m<sup>3</sup>; closed mangrove (MgC): 4.49 million m<sup>3</sup>; and open mangrove (MgO): 0.63 million m<sup>3</sup>.

Note: The gross volume indicated under bamboo/boho formation is the **gross volume of trees within the area** and not the volume of bamboo or boho.

Table 3e: Gross volume in natural forest

Main Forest Type	Gross Volume (in million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )
Closed broad-leaved forest	959.29	221.45
Open broad-leaved forest	216.35	126.44
Closed coniferous forest	12.48	271.59
Open coniferous forest	15.44	223.20
Closed mixed forest	0.0	0.0
Open mixed forest	1.28	60.20
Closed bamboo/boho formation	4.96	37.77
Open bamboo/boho formation	0.4	5.74
Closed mangrove forest	4.49	123.60
Open mangrove forest	0.63	55.98



In Table 3e, natural coniferous forest has a higher gross volume/ha than natural broad-leaved forest. This may be attributed to the smallness of sample unit as well as the relatively higher total height of the trees in the coniferous forest, as observed in the tract reports.

#### 10.2.1.1.3.1.1 Gross volume of most abundant tree species in natural forest

Table 3f shows the top 20 most abundant tree species in the natural forest. The most dominant species are *Shorea contorta* and *Shorea polysperma* with average volume/ha of 19.78 m<sup>3</sup> and 19.33 m<sup>3</sup>, respectively.

In the calculation of average gross volume/ha per tree species, the land use area in mangrove forest was included. In case the area of mangrove forest be excluded, the average gross volume/ha per tree species would be higher.

Table 3f: Gross volume/ha of most abundant tree species in natural forest

Scientific Name	Species	Gross Vol./ha (m <sup>3</sup> )
<i>Shorea contorta</i>	white lauan	19.78
<i>Shorea polysperma</i>	Tangile	19.33
<i>Shorea negrosensis</i>	red lauan	16.28
<i>Shorea squamata</i>	Mayapis	14.76
<i>Dipterocarpus grandiflorus</i>	Apitong	10.76
<i>Parashorea plicata</i>	Bagtikan	7.59
<i>Shorea astylosa</i>	Yakal	4.97
<i>Shorea almon</i>	Almon	3.69
<i>Lithocarpus llanosii</i>	Ulayan	3.40
<i>Shorea guiso</i>	Guijo	3.01
<i>Pterocarpus indicus</i>	Narra	2.83
<i>Palaquium luzoniense</i>	Nato	2.11
<i>Combretodendron quadrialatum</i>	Toog	1.82
<i>Tristania decorticata</i>	Malabayabas	1.35
<i>Terminalia foetidissima</i>	talisai-gubat	1.26
<i>Koordersiodendron pinnatum</i>	Amugis	1.16
<i>Anisoptera thurifera</i>	Palosapis	1.10
<i>Hopea foxwothyi</i>	Dalingdingan	1.11
<i>Mangifera altissima</i>	Pahutan	1.07
<i>Euphoria didyma</i>	Alupag	0.95

10.2.1.1.3.2: Gross volume in plantation forest

The gross volume distribution in plantation forest is as follows: Broad-leaved plantation is 31.31 million m<sup>3</sup> and coniferous plantation is 1.23 million m<sup>3</sup>. This is broken down as follows: closed broad-leaved plantation (PBC): 17.45 million m<sup>3</sup>, open broad-leaved plantation (PBO) 13.86 million m<sup>3</sup>, and closed coniferous plantation (PCC): 1.23 million m<sup>3</sup>.

Table 3g: Gross volume in plantation forest

	Broad-leaved Plantation		Coniferous Plantation	
Gross Vol. (m <sup>3</sup> )	31,308,464.76		1,228,301.06	
Percent	96.2%		3.8%	
	Closed Canopy	Open Canopy	Closed Canopy	Open Canopy
Gross Vol. (m <sup>3</sup> )	17,452,442.43	13,856,022.32	1,228,301.06	0
Vol./ha (m <sup>3</sup> )	53.54	23.24	121.64	0.0

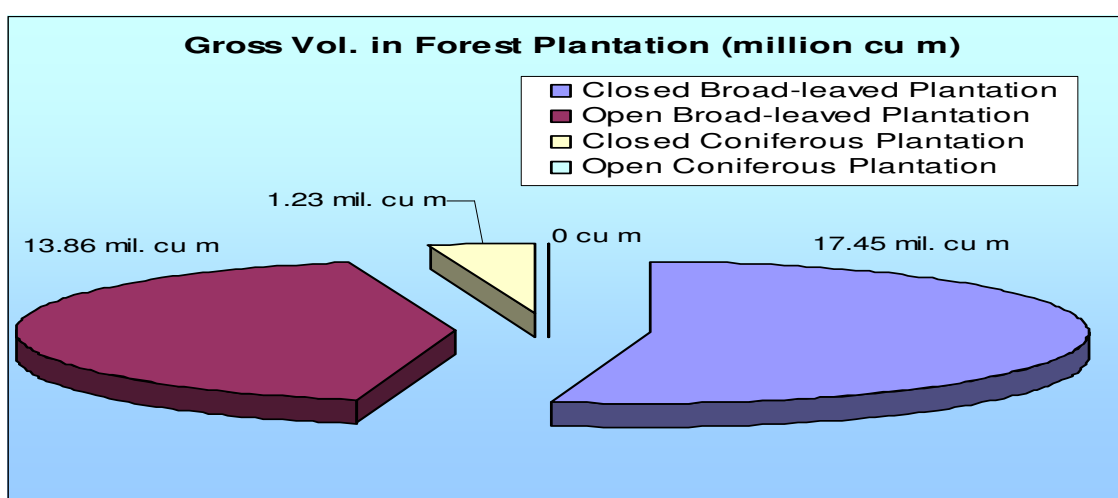
10.2.1.1.3.2.1 Gross volume per ha of the top 20 most abundant tree species in plantation forest

Table 3h shows the top 20 most abundant tree species in plantation forests. Some tree species that were not used as planting materials are among the dominant species like *Ficus elastica*, *Araucaria bidwilli*, *Musanga cecropioides*, *Syzygium gigantifolium*, *Mallotus philippinenses*, *Hevea brasiliensis*, *Albizia procera*, *Ceiba pentandra*, and *Macaranga tanarius*. This may infer that natural succession is taking place in the area.

Table 3h: Gross volume of most abundant tree species in plantation forest

Scientific Name	Species	Gross Volume/ha
<i>Gmelina arborea</i>	Yemane	15.56
<i>Ficus elastica</i>	India rubber	4.55
<i>Leucaena leucocephala</i>	ipil-ipil	6.34
<i>Paraserianthes falcataria</i>	Moluccan sau	3.61
<i>Cocos nucifera</i>	Coconut	1.99
<i>Acacia mangium</i>	mangium	1.52
<i>Araucaria bidwilli</i>	bunya pine	1.45
<i>Mangifera indica</i>	mangga	0.87
<i>Samanea saman</i>	raintree	0.80
<i>Pterocarpus indicus</i>	narra	0.72
<i>Swietenia macrophylla</i>	broad-leaved mahogany	2.83
<i>Musanga cecropioides</i>	umbrella tree	0.78
<i>Syzygium gigantifolium</i>	malatalisai	0.44
<i>Mallotus philippinenses</i>	banato	0.39
<i>Hevea brasiliensis</i>	para rubber	1.39
<i>Albizia procera</i>	akleng-parang	0.37
<i>Ceiba pentandra</i>	kapok	0.29
<i>Artocarpus blancoi</i>	antipolo	0.53
<i>Shorea contorta</i>	white lauan	0.21
<i>Macaranga tanarius</i>	binunga	0.18
<i>Vitex parviflora</i>	molave	0.87

#### 10.2.1.2: Commercial Volume in Forest

In the calculation of commercial volume, only the volume of trees with dbh  $\geq$  50 cm is included. At the same time, only the land use sections where tree measurement was carried out were taken into consideration.

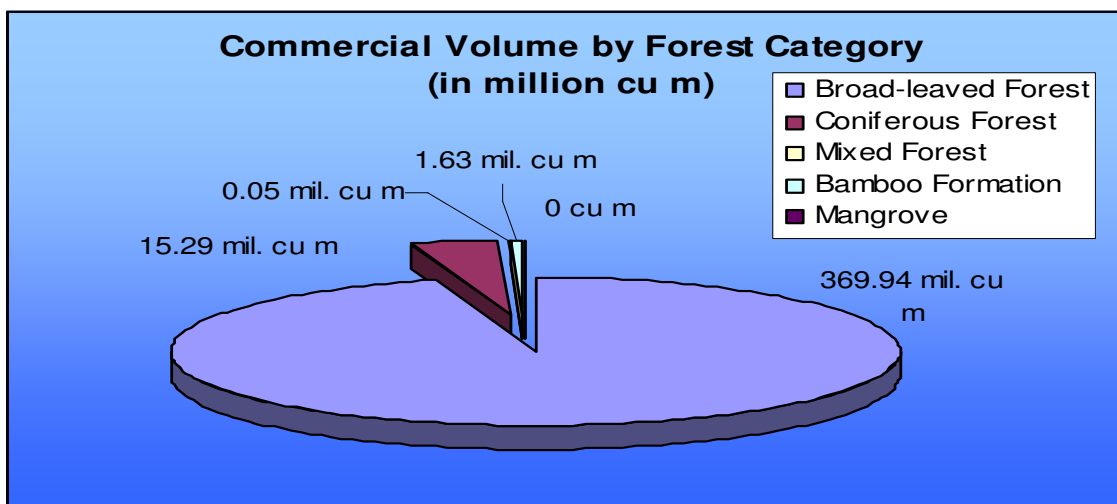
##### 10.2.1.2.1 Commercial volume by forest category

Forest is categorized into broad-leaved forest, coniferous forest, mixed forest, bamboo/boho formation, and mangrove forest. The afore-mentioned forest categories have aggregate commercial volume of 386,956,668.6 m<sup>3</sup>. Out of this, about 369.98 million m<sup>3</sup> or 95.6% is in broad-leaved forest; 15.29 million m<sup>3</sup> or 4% is in coniferous forest; 0.05 million m<sup>3</sup> or 0.01% is in mixed forest; 1.63 million m<sup>3</sup> or 0.4% is in bamboo/boho formation; and 0 m<sup>3</sup> is in mangrove forest.

Mangrove forest has a 0 m<sup>3</sup> commercial volume because no mangrove species with dbh of  $\geq$  50 cm was recorded during the field survey. At the same time, this may be attributed to the smallness of the sample unit (0.942 ha). In the calculation of commercial volume, probably the diameter limit for mangrove species may be lower than the prescribed diameter limit for other tree species. Consequently, the NFA result on the commercial volume for mangrove forest may change.

Table 3i: Commercial volume by forest category

	Broad-leaved Forest	Coniferous Forest	Mixed Forest	Bamboo Formation	Mangrove Forest
Comm. Vol. (million m <sup>3</sup> )	369.94	15.29	0.05	1.63	0.0
Percent	95.6%	4.0%	0.01%	0.4%	0.0%
Vol./ha (m <sup>3</sup> )	54.69	119.99	2.47	8.09	0.0



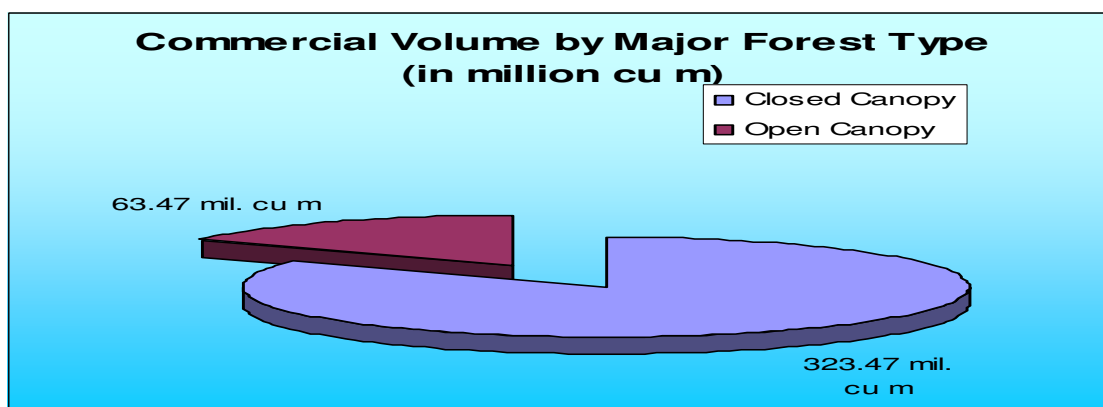
It can be observed in Table 3.i that coniferous forest has a higher commercial volume per ha (119.99 m<sup>3</sup>) than broad-leaved forest (54.59 m<sup>3</sup>). This may be attributed to the small number of sample size in coniferous forest (0.244 ha) as compared to broad-leaved forest (119.682 ha).

10.2.1.2.2 Commercial volume by major forest type

Out of the commercial volume of 386.96 million m<sup>3</sup>, about 323.49 million m<sup>3</sup> or 83.6% is in closed canopy forest and 63.47 million m<sup>3</sup> or 16.4% is in open canopy forest. Closed canopy forest has a higher average commercial volume per ha (66.27 m<sup>3</sup>) than open canopy forest (25.58 m<sup>3</sup>).

Table 3j: Commercial volume by major forest type

	Total	Closed Canopy	Open Canopy
Comm. Vol. (in million m <sup>3</sup> )	386.96	323.47	63.47
Percent	100.0%	83.6%	16.4%
Vol./ha (m <sup>3</sup> )	54.02	66.27	25.58

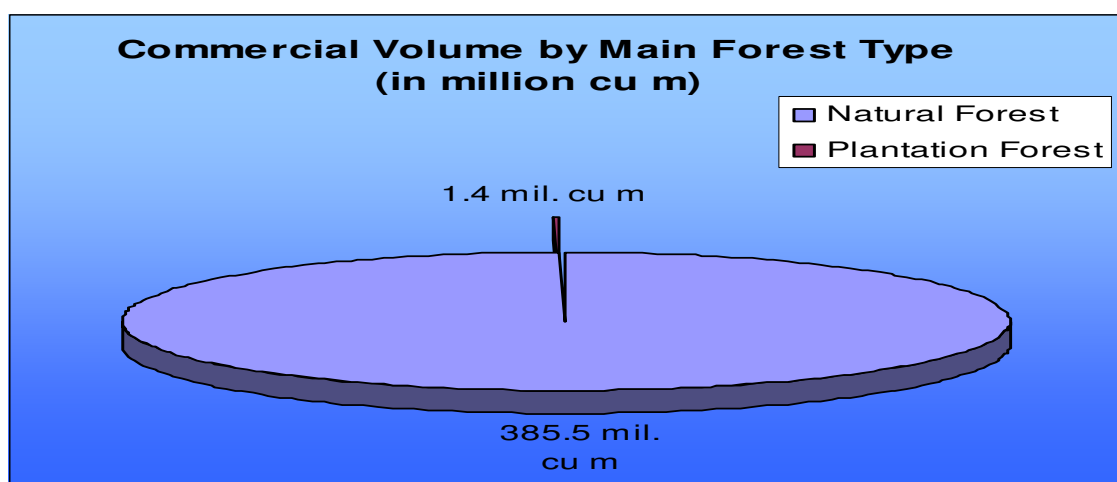


### 10.2.1.2.3 Commercial volume by main forest type

Forest is further sub-classified into natural forest and plantation forest. Out of the commercial volume of 386.96 million m<sup>3</sup>, about 385.5 million m<sup>3</sup> or 99.6% is in natural forest and 1.4 million m<sup>3</sup> or 0.4% is in plantation forest.

Table 3k: Commercial volume by main forest type

	Total	Natural Forest	Plantation Forest
Comm. Volume (in million m <sup>3</sup> )	386.96	385.5	1.4
Percent	100.0%	99.6%	0.4%
Vol./ha (m <sup>3</sup> )	54.02	59.0	2.0



#### 10.2.1.2.3.1 Commercial volume in natural forest

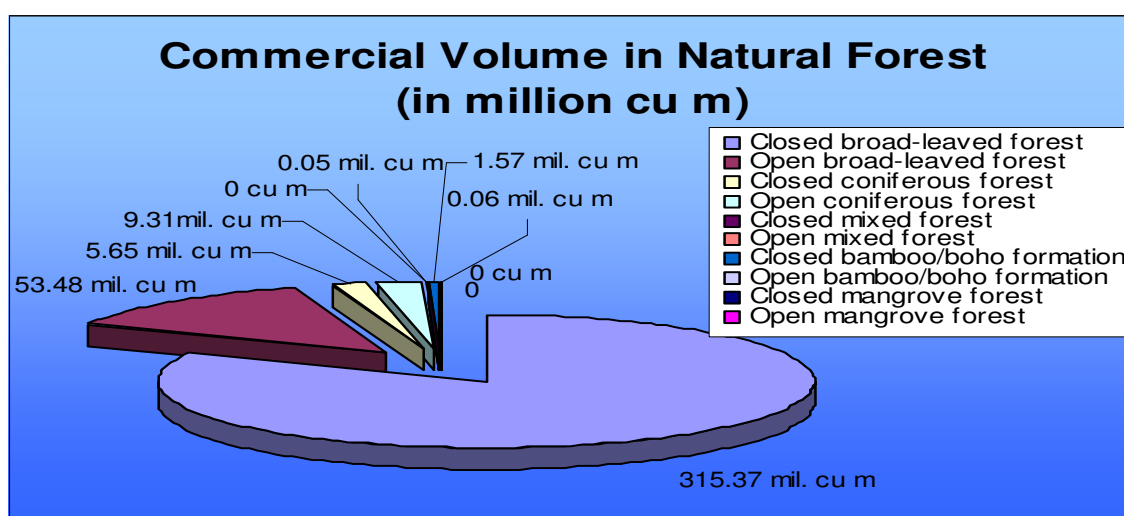
Table 3.i shows the commercial volume in natural forest. This is distributed as follows: closed broad-leaved forest (FBC): 315.37 million m<sup>3</sup>, open broad-leaved forest (FBO): 53.48 million m<sup>3</sup>, closed coniferous forest (FCC): 5.65 million m<sup>3</sup>, open coniferous forest (FCO): 9.31 million m<sup>3</sup>, closed mixed forest (FMC): 0 m<sup>3</sup>, open mixed forest (FMO): 0.05 million m<sup>3</sup>, closed bamboo/boho formation (BBC): 1.57 million m<sup>3</sup>, open bamboo/boho formation (BBO): 0.06 million m<sup>3</sup>, and open mangrove forest (MgO): 0 m<sup>3</sup>.

It can be observed that natural coniferous forest has a higher commercial volume/ha than natural broad-leaved forest. Further, open canopy natural coniferous forest has a higher average commercial volume/ha (134.65 m<sup>3</sup>) than closed canopy natural coniferous forest (123 m<sup>3</sup>). These abnormalities may be attributed, among others, to the size of the sample units. In closed canopy coniferous forest, there were only 2 sample units with a total area of 0.91 ha as compared to open canopy forest with 3 sample units with aggregate area of 1.37 ha.

Note: The commercial volume indicated under bamboo/boho formation is the **commercial volume of trees within the area** and not the volume of bamboo or boho.

Table 3l: Commercial volume in natural forest

Main Forest Type	Comm. Vol. (million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )
Closed broad-leaved forest	315.37	72.80
Open broad-leaved forest	53.48	31.25
Closed coniferous forest	5.65	123.00
Open coniferous forest	9.31	134.65
Closed mixed forest	0.0	0.0
Open mixed forest	0.05	2.48
Closed bamboo/boho formation	1.57	11.94
Open bamboo/boho formation	0.06	0.86
Closed mangrove forest	0.0	0.0
Open mangrove forest	0.0	0.0



#### 10.2.1.2.3.2 Commercial volume in plantation forest

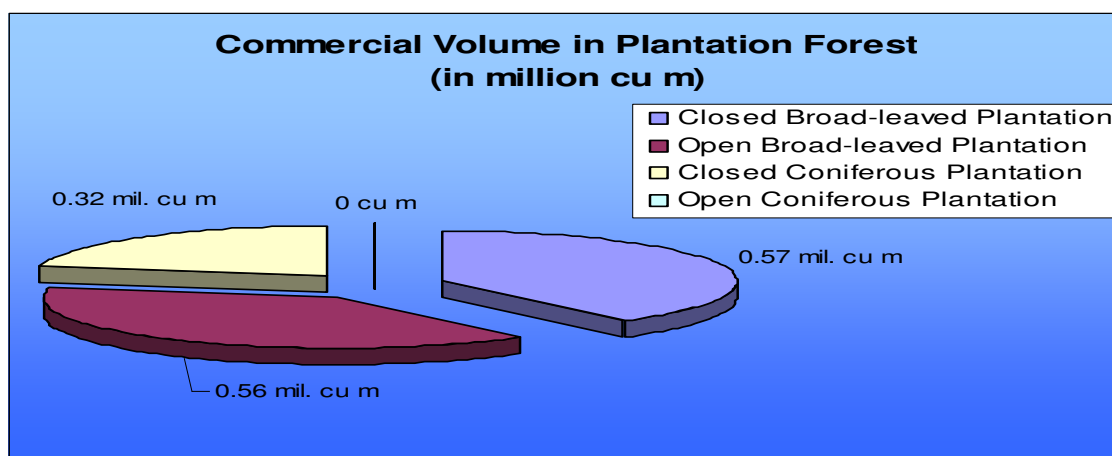
Plantation forest complements the natural forest as source of a sustained supply of wood raw materials for the various forest-based industries.

Plantation forest has a total commercial volume of 1,453,694 m<sup>3</sup>. Out of this, broad-leaved plantation has a commercial volume of about 1,128,558.43 m<sup>3</sup> or 77.6% and coniferous plantation has 325,135.57 m<sup>3</sup> or 22.4%. Commercial volume in broad-leaved plantation is broken down as follows: closed broad-leaved plantation (PBC): 0.57 million m<sup>3</sup>; open broad-leaved plantation (PBO): 0.56 million m<sup>3</sup>. At the same time, the commercial volume in closed coniferous plantation (PCC) is estimated at 0.32 million m<sup>3</sup>. Open coniferous plantation has no commercial volume.

Table 3m shows that coniferous plantation has a higher average commercial volume per ha than broad-leaved plantation. This may be attributed, among others, to the size of the sample units. In coniferous plantation, there were only 2 sample units (0.244 ha) whereas broad-leaved plantation has 43 sample units (14.302 ha).

Table 3m: Commercial volume in plantation forest

	Broad-leaved Plantation		Coniferous Plantation	
Comm. Vol. (m <sup>3</sup> )	1,128,558.43		325,135.57	
Percent	77.6%		22.4%	
Vol./ha (m <sup>3</sup> )	1.56		26.39	
	Closed	Open	Closed	Open
Comm. Vol.( in million m <sup>3</sup> )	0.57	0.56	0.32	0.0
Percent	39.0%	38.6%	22.4%	0.0%
Vol./ha (m <sup>3</sup> )	1.74	1.42	32.20	0.0



### 10.2.1.3 Commercial volume of most abundant tree species in natural forest

In forest, there are about 541 tree species recorded. The most abundant tree species belong to the Family Dipterocarpaceae. Out of the top 20 dominant tree species that register the highest commercial volume per ha, 11 tree species belong to the Family Dipterocarpaceae. Table 3n shows the average commercial volume per ha for the top 20 most abundant tree species in forest.

Table 3n: Commercial volume of most abundant tree species in natural forest

Scientific Name	Common Name	Comm. Vol. /ha (m <sup>3</sup> )
<i>Shorea polysperma</i>	tangile	8.36
<i>Shorea contorta</i>	white lauan	7.85
<i>Shorea squamata</i>	mayapis	6.89
<i>Shorea negrosensis</i>	red lauan	6.29
<i>Parashorea plicata</i>	bagtikan	3.33
<i>Dipterocarpus grandiflorus</i>	apitong	3.24
<i>Shorea almon</i>	almon	1.44
<i>Combretodendron quadrialatum</i>	toog	1.17
<i>Shorea astylosa</i>	yakal	1.14
<i>Shorea guiso</i>	guijo	1.06
<i>Palaquium luzoniense</i>	nato	0.79

Scientific Name	Common Name	Comm. Vol. /ha (m <sup>3</sup> )
<i>Pterocarpus indicus</i>	narra	0.65
<i>Lithocarpus llanosii</i>	ulayan	0.61
<i>Koordersiodendron pinnatum</i>	amugis	0.49
<i>Hopea foxwothii</i>	dalingdingan	0.45
<i>Terminalia foetidissima</i>	talisai-gubat	0.43
<i>Mangifera altissima</i>	pahunan	0.38
<i>Tristania decorticata</i>	malabayabas	0.33
<i>Anisoptera thurifera</i>	palosapis	0.30
<i>Euphoria didyma</i>	alupag	0.23

#### 10.2.2.4 Commercial volume of most abundant tree species in plantation forest

Table 3o shows the commercial volume of most abundant tree species in plantation forest. The results show that the most common species is *Gmelina arborea* followed by *Araucaria bidwilli* and *Paraserianthes falcataria*.

Table 3o: Commercial volume of most abundant tree species in plantation forest

Scientific Name	Species Name	Comm. Vol./ha (m <sup>3</sup> )
<i>Gmelina arborea</i>	yemane	0.54
<i>Araucaria bidwilli</i>	bunya pine	0.44
<i>Paraserianthes falcataria</i>	Moluccan sau	0.29
<i>Mangifera indica</i>	mangga	0.23
<i>Pterocarpus indicus</i>	narra	0.14
<i>Samanea saman</i>	raintree	0.10
<i>Swietenia macrophylla</i>	broad-leaved mahogany	0.07
<i>Ceiba pentandra</i>	kapok	0.07
<i>Tamarindus indica</i>	sampalok	0.04
<i>Mallotus philippinenses</i>	banato	0.03
<i>Leucaena leucocephala</i>	ipil-ipil	0.03

#### 10.2.2: Volume in Trees Outside Forests (TOF)

Trees outside forest (TOF) are defined by default, as all trees excluded from the definition of forest and other wooded lands. However, in order to provide information on the volume of trees in OWL and IW, data on OWL and IW are included under TOF.

In the calculation of volume, only LUS where physical measurement of trees was carried out were included to avoid underestimation of volume. In this connection, the number of sample units used in the calculation of volume is lesser than the number of sample units used in the calculation of area.

A total of 317 sample units (tracts) with an aggregate area of 519.878 ha contain LUS classified as outside forest (TOF). A sample unit (tract) could have one or more land use types. Table 3.p shows the distribution of sample units (tracts) in TOF.

Table 3p: Sample units distribution in TOF

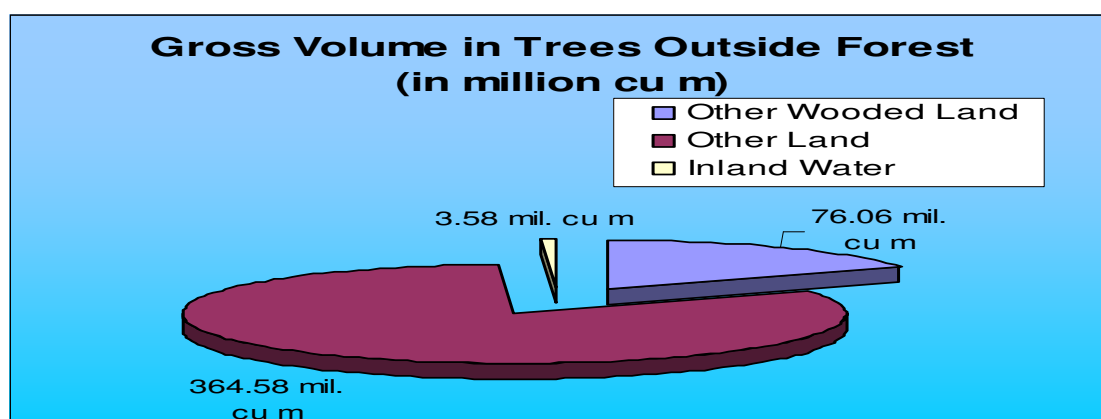
Land Use	No. of sample units (tract)	Area (ha)
Other Wooded Land (OWL)	136	82.202
Other Land (OL)	299	423.062
Inland Water (IW)	109	16.614

#### 10.2.2.1 Gross volume in TOF

In TOF, the gross volume of all trees with dbh  $\geq$  10 cm is estimated at 444,666,003.5 m<sup>3</sup>, broken down as follows: about 76,059,664.46 m<sup>3</sup> or 17.1% is in OWL; 365,030,730.4 m<sup>3</sup> or 82.1% is in OL; and 3,575,608.63 m<sup>3</sup> or 0.8% is in IW. IW has volume because trees found on the side-slope of rivers and creeks were recorded. Further, in some instances trees were also found on the riverbeds.

Table 3q: Gross Volume in TOF

Land Use	Gross Vol. (in million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )
Other Wooded Land (OWL)	76.06	21.99
Other Land (OL)	364.58	20.14
Inland Water (IW)	3.58	4.99

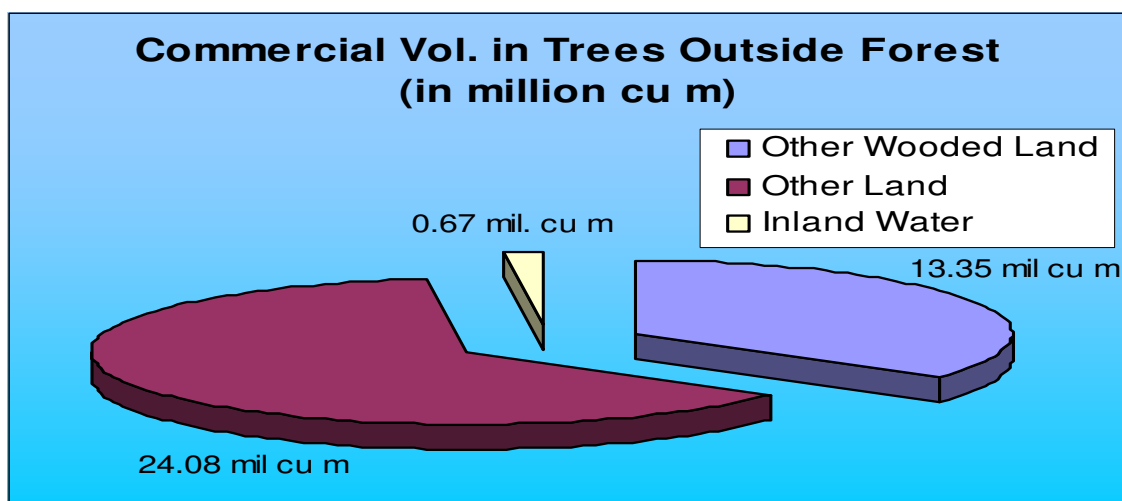


#### 10.2.2.2: Commercial volume in TOF

In TOF, the commercial volume of all trees with dbh  $\geq$  10 cm is 38,104,529.82 m<sup>3</sup>. Out of this, about 13,351,271.42 m<sup>3</sup> or 35.04% is in OWL; 24,080,987.47 m<sup>3</sup> or 63.2% is in OL; and 672,270.93 m<sup>3</sup> or 1.76% is in IW.

Table 3r: Commercial volume in TOF

Land Use	Comm. Vol. (in million m <sup>3</sup> )	Vol/ha (m <sup>3</sup> )
Other Wooded Land	13.35	3.86
Other Land	24.08	1.32
Inland Water	0.67	0.94



### 10.2.3: Gross and Commercial Volume per Ecological Zone

A total of 164 sample units (tracts) with an aggregate area of 141.856 ha contain LUS classified as forest. Out of this, 161 sample units fell in TAR and only 3 sample units fell in TM. Table 3s shows the distribution of sample units in forest by ecological zone.

Table 3s: Sample unit distribution in forest by ecological zone

GEZ	No. of sample units (tract)	Area (ha)
TAR	161	139.26
TM	3	2.596
Total		141.856

On the other hand, a total of 317 sample units (tracts) with an aggregate area of 519.878 ha contain LUS classified as outside forest (TOF). Out of this, 314 sample units fell in TAR and only 3 sample units fell in TM. The following table shows the distribution of sample units in TOF by ecological zone.

Table 3t: Sample unit distribution in TOF by ecological zone

Land Use	TAR		TM	
	No. of sample units	Area (ha)	No. of sample units	Area (ha)
OWL	136	80.202	0	0
OL	296	419.778	3	3.284
IW	109	16.614	0	0
Total		516.594		3.284

#### 10.2.3.1 Gross and commercial volume in Forest per ecological zone

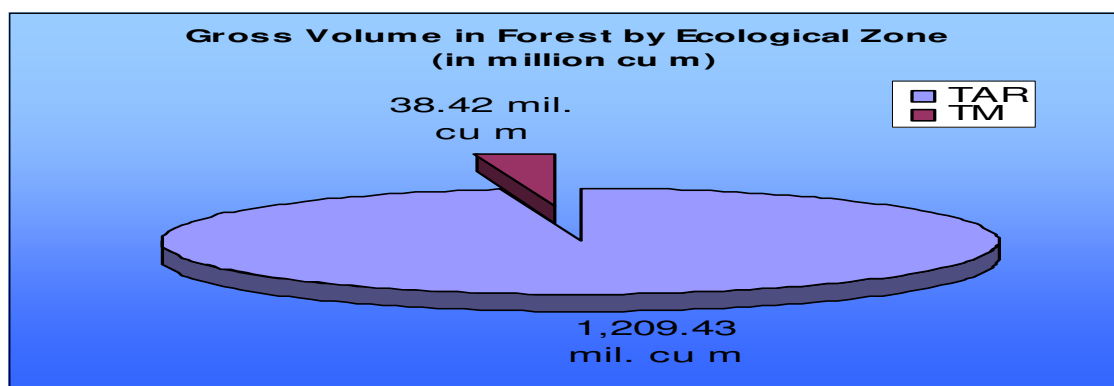
In terms of area, about 97% of the country's forests lies in the tropical rainforest (TAR) and only 3% lies in tropical mountain system (TM). In terms of gross volume, 97% is in TAR and 3% is in TM. At the same time, in terms of commercial volume, 98% is in TAR and 2% is in TM.

10.2.3.1.1 Gross volume in Forest per ecological zone

In TAR, forest has a gross volume of 1,209,433,265 m<sup>3</sup> or an average volume per ha of 172.00 m<sup>3</sup> while in TM the gross volume is 38,425,681.24 m<sup>3</sup> or an average volume per ha of 293.15 m<sup>3</sup>.

Table 3u: Gross volume in forest by ecological zone

GEZ	Gross Vol. (in million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )
TAR	1,209.43	172.00
TM	38.42	293.15

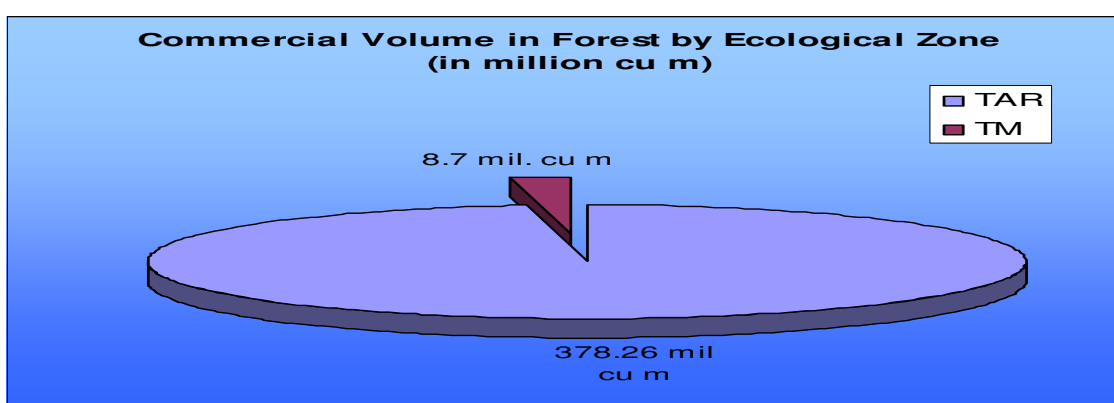


10.2.3.1.2 Commercial volume in forest per ecological zone

In TAR, forest has a commercial volume of 378,258,107.6 m<sup>3</sup> or an average commercial volume per ha of 53.79 m<sup>3</sup> while in TM the commercial volume is 8,698,560.95 m<sup>3</sup> or an average commercial volume per ha of 66.36 m<sup>3</sup>.

Table 3v: Commercial volume in forest by ecological zone

GEZ	Comm. Vol. (in million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )
TAR	378.26	53.79
TM	8.70	66.36



10.2.3.2 Gross and commercial volume in TOF per ecological zone

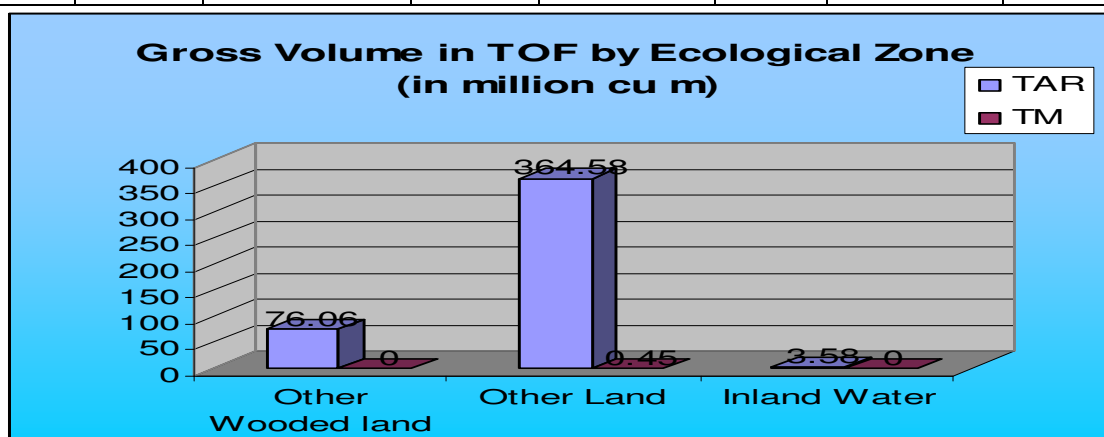
In terms of area, about 99% of all land use outside forest (TOF) lie in TAR and only 1% lies in TM. With regard to gross volume, about 99.9% is in TAR and only 0.1% is in TM. In terms of commercial volume, all is in TAR.

10.2.3.2.1 Gross volume in TOF per ecological zone

In TOF, the gross vol. of trees with dbh  $\geq 10$  cm is 444,666,003.5 m<sup>3</sup>. In TAR, the gross vol. is 444,219,085.7 m<sup>3</sup> or an average vol. per ha of 19.84 m<sup>3</sup> and in TM the gross vol. is 446,917.81 m<sup>3</sup> or an average vol. per ha of 3.16 m<sup>3</sup>.

Table 3w: Gross volume in TOF by ecological zone

GEZ	Total (million m <sup>3</sup> )	Other Wooded Land		Other Land		Inland Water	
		Gross Vol. (million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )	Gross Vol. (million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )	Gross Vol. (million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )
TAR	444.67	76.06	21.99	365.03	20.01	3.58	4.99
TM	0.45	0.0	0.0	0.45	3.16	0.0	0.0

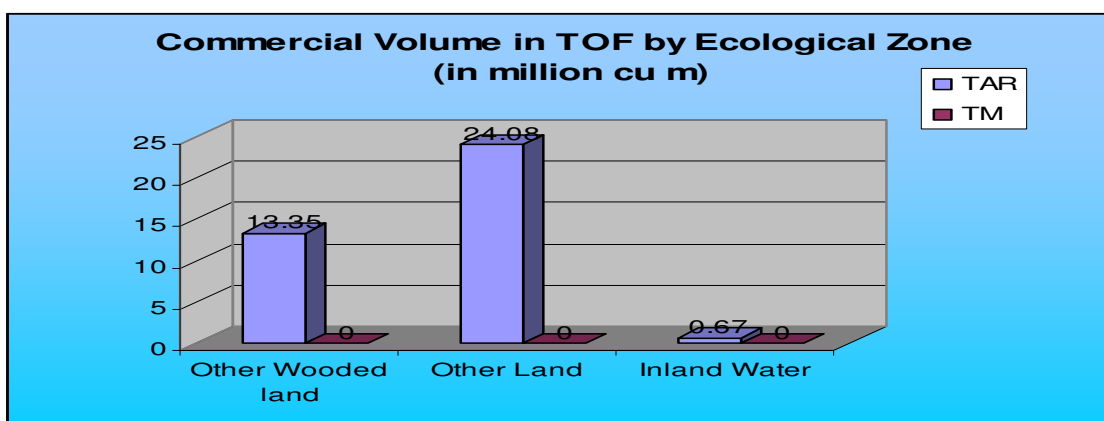


Commercial volume in TOF per ecological zone

In TOF, the commercial volume of trees with dbh  $\geq 50$  cm is 38,104,529.82 m<sup>3</sup> or an average volume per ha of 1.7 m<sup>3</sup>. Said volume is found only in TAR. No commercial volume was recorded in TM.

Table 3x: Commercial volume in TOF by ecological zone

GEZ	Total (million m <sup>3</sup> )	Other Wooded land		Other Land		Inland Water	
		Comm. Vol. (million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )	Comm. Vol. (million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )	Comm. Vol. (million m <sup>3</sup> )	Vol./ha (m <sup>3</sup> )
TAR	38.10	13.35	3.86	24.08	1.33	0.67	0.94
TM	0.0	0.0	0.0	0.0	0.0	0.0	0.0



### 10.2.7. Precision of Volume Estimates

#### 10.2.7.1 Precision of Volume Estimates by Land Use

Based on Table 3y, we can deduce that the precision of volume estimates is dependent on the quantity of trees found in the sample unit more than on the size of the sample unit (land use area), as observed between the volume in Forest and Other Land. Although Other Land has a larger sample size than Forest, the quantity of trees found in Other Land is lesser than in Forest. Corollary to this the sampling error in Other Land is higher than in Forest. This inference is also supported by the precision level between gross volume and commercial volume whereby gross volume has a higher precision level than commercial volume. In the calculation of gross volume, trees with dbh  $\geq 10$  cm were included; however, in the calculation of commercial volume, only those trees with dbh  $\geq 50$  cm were included. As such, more trees were involved in the calculation of gross volume than in the calculation of commercial volume.

Table 3y: Precision of Volume Estimates by Land Use

Land Use	Sampling Unit	Land Use Area (ha)	Gross Vol. (m <sup>3</sup> )	SeR (%)	Comm. Vol. (m <sup>3</sup> )	SeR (%)
Forest	164	141.856	24714.107	8.78	7663.757	17.80
Other Wooded Land	136	83.752	1763.996	12.05	309.646	21.89
Other Land	299	427.286	8465.89	9.04	558.492	15.84
Inland Water	110	18.614	82.926	40.72	15.591	60.61

#### 10.2.7.2 Precision of Volume Estimates by Forest Type

The precision of volume estimate in Forest is generally at acceptable level (8.78%) when taken collectively (by land use). However, when this is subdivided into forest types the sampling error increased to above 10% (Table 3z).

Table 3z: Precision of Volume Estimates by Forest Type

Forest Type	Sampling Unit	Area (ha)	Gross Vol. (m <sup>3</sup> )	SeR (%)	Comm. Vol. (m <sup>3</sup> )	SeR (%)
Closed broad-leaved forest	86	85.792	18998.959	9.69	6246.059	20.21
Open broad-leaved forest	64	33.89	4284.886	11.43	1059.196	21.09
Closed coniferous forest	2	0.91	247.148	13.80	111.931	20.67
Open coniferous forest	3	1.37	305.788	36.66	184.475	48.20
Closed mixed forest	-	-	-	-	-	-
Open mixed forest	1	0.42	25.283	-	1.04	-
Closed broad-leaved plantation	17	6.456	345.649	14.77	11.22	239.34
Open broad-leaved plantation	28	7.846	274.421	26.89	11.127	-
Closed coniferous plantation	1	0.2	24.326	-	6.439	-
Open coniferous plantation	1	0.044	-	-	.044	-
Closed bamboo/ boho formation	8	2.602	98.283	52.69	31.07	86.08
Open bamboo/boho formation	7	1.384	7.939	39.01	1.191	105.72
Closed mangrove forest	1	0.72	88.994	-	-	-
Open mangrove forest	2	0.222	12.426	42.84	-	-

### 10.3 Biomass

Given the volume over bark (VOB) data, the above-ground biomass density can be computed using the following allometric equations (Brown, 1997):

$$\text{Above-ground biomass density (Mg/ha)} = \text{VOB} \times \text{WD} \times \text{BEF}$$

Where:

WD = volume-weighted average wood density (t of oven dry biomass per m<sup>2</sup> green volume)

BEF = biomass expansion factor (ratio of aboveground oven-dry biomass of trees to oven-dry biomass of inventoried volume)

Ideally the wood density should be weighted based on all the species found in the stand. However, in the absence of species names and wood density values, the “default” value for tropical trees in Asia is 0.57 t/m<sup>3</sup> (range: 0.40-0.69).

The BEF for broadleaf forests can be computed using the following formula:

$$\text{BEF} = \text{Exp. } \{3.213 - 0.506 \text{ Ln (BV)}\} \text{ for } \text{BV} < 190$$

$$1.74 \text{ for } \text{BV} \geq 190 \text{ t/ha}$$

(sample size = 56, adjusted  $r^2 = 0.76$ )

where:

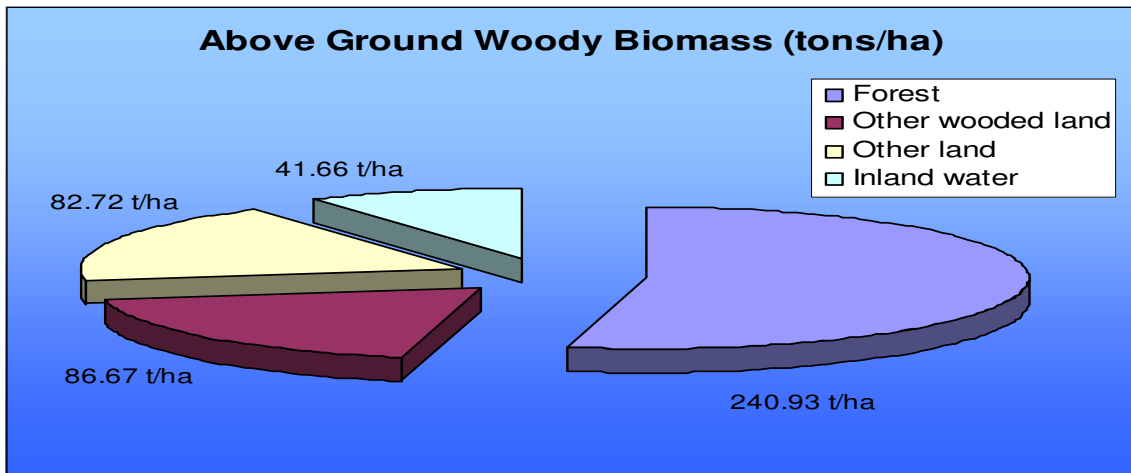
BV = biomass of inventoried volume in t/ha. Calculated as the product of VOB/ha (m<sup>3</sup> / ha) and wood density (t/ m<sup>3</sup>)

#### 10.3.1 Above-Ground Woody Biomass per Hectare

In forest, the average above-ground woody biomass is 240.93 tons/ha. In TOF the average above-ground woody biomass is 82.36 tons/ha. Out of this about 86.67 t/ha is in OWL; 82.72 t/ha is in OL; and 41.66 t/ha is in IW.

Table 4a: Above-ground woody biomass by Land Use (tons/ha)

Land Use	VOB/ha (m <sup>3</sup> )	AGB (t/ha)
Forest	174.22	240.93
Other Wooded Land	21.99	86.67
Other Land	20.01	82.72
Inland Water	4.99	41.66

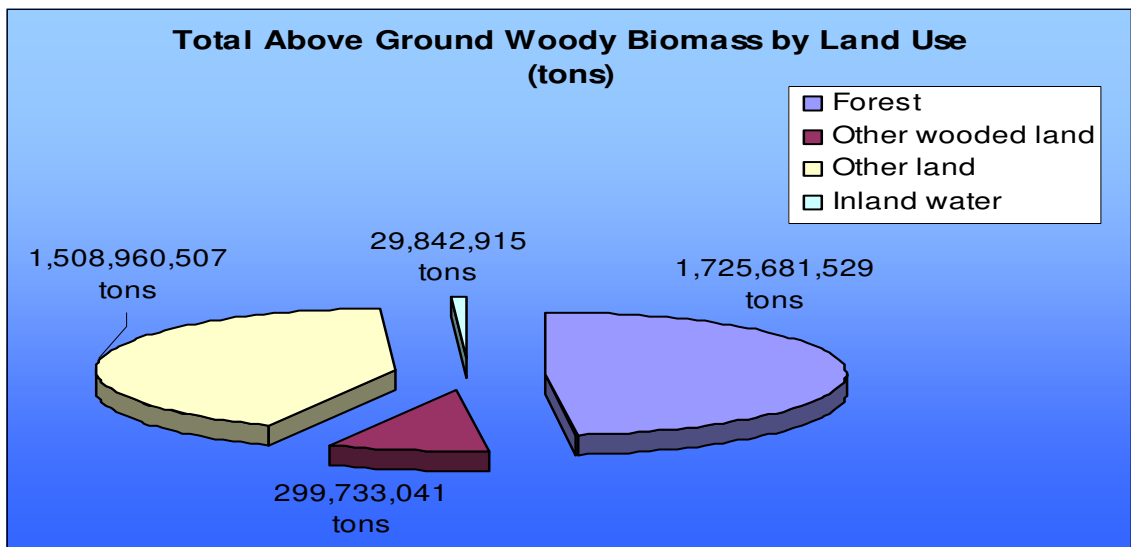


10.3.2. Total Above-Ground Woody Biomass

In forest the total above-ground woody biomass is 1,725,681,529 tons. In TOF the aggregate total above-ground woody biomass is 1,846,297,029 tons, distributed as follows: about OWL: 299,733,041 tons; OL: 1,508,960,507 tons; and IW: 29,842,915 tons.

Table 4b: Total above-ground woody biomass by land use

Land Use	AGB (t)
Forest	1,725,681,529
Other wooded land	299,733,041
Other land	1,508,960,507
Inland water	29,842,915



### 10.4 DBH distribution

The trees were grouped into diameter classes at interval of 10 cm (DBH Class 15, DBH Class 25, DBH Class 35, etc). DBH Class 15 ranges from 10 cm to 19.99 cm, DBH Class 25 ranges from 20 cm to 29.99 cm; DBH Class 35, ranges from 30 cm to 39.99 cm, and so on.

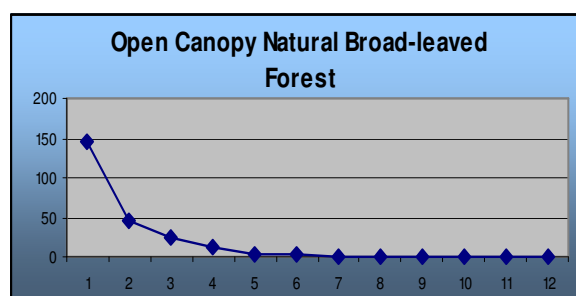
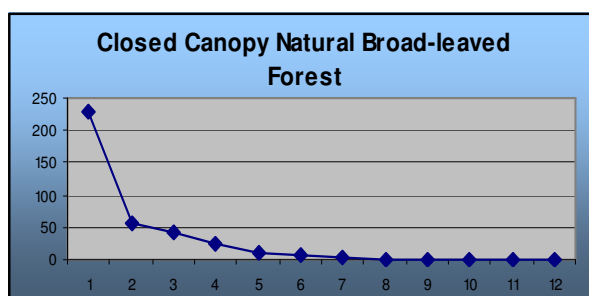
#### 10.4.1 DBH Distribution by Forest Type

In normal condition, tree distribution by DBH class follows the inverted “J” graph, whereby small diameter trees are always greater in number than big diameter trees.

Based on the NFA results, the DBH distribution in the different forest types is shown in Table 5.

Table 5: DBH Class distribution by forest type

Forest Type	DBH Class (trees/ha)											
	DBH 15	DBH 25	DBH 35	DBH 45	DBH 55	DBH 65	DBH 75	DBH 85	DBH 95	DBH 105	DBH 115	DBH ≥125
FBC	227.38	55.69	41.04	24.77	10.14	5.68	2.28	1.48	0.72	0.15	0.15	0.21
FBO	144.54	44.64	24.79	13.6	4.19	2.77	1.06	0.83	0.71	0.21	0.12	0.12
FCC	0	0	15.38	18.68	31.87	18.68	20.88	6.59	0	0	0	0
FCO	56.25	61.31	11.68	10.95	10.95	8.76	8.76	2.19	1.46	0.73	0	0
FMC	0	0	0	0	0	0	0	0	0	0	0	0
FMO	0	30.95	26.19	7.14	2.38	0	0	0	0	0	0	0
PBC	250.00	64.59	20.29	2.79	1.08	0.15	0	0.15	0	0	0	0
PBO	88.24	51.36	10.58	1.66	1.02	0.13	0	0.25	0	0	0	0
PCC	0	40.00	5.00	40.00	15.00	10.00	0	0	0	0	0	0
PCO	0	0	0	0	0	0	0	0	0	0	0	0
BBC	22.73	8.46	7.69	3.07	0.77	0	0	0.77	0	0	0	0.38
BBO	0	4.34	2.89	1.45	0.72	0	0	0	0	0	0	0
MgC	200.00	54.17	56.94	20.83	0	0	0	0	0	0	0	0
MgO	150.00	76.58	4.50	4.50	0	0	0	0	0	0	0	0



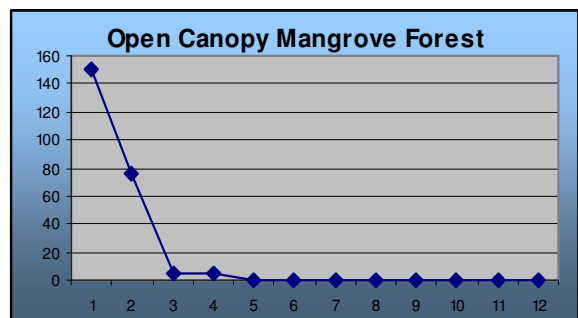
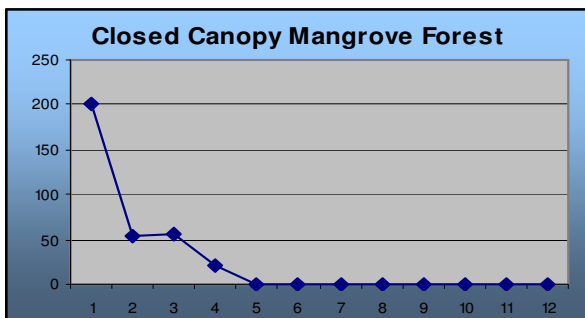
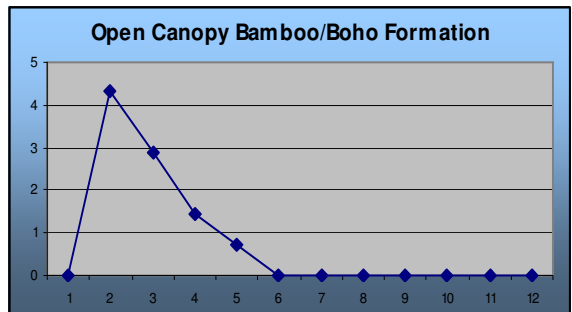
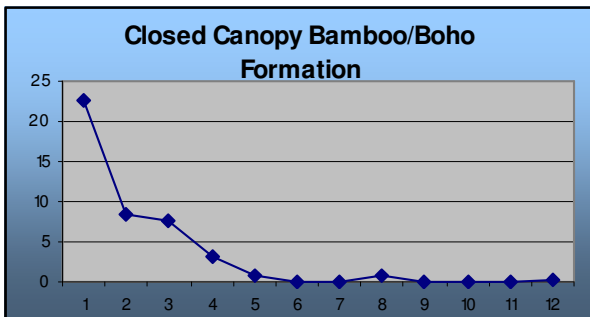
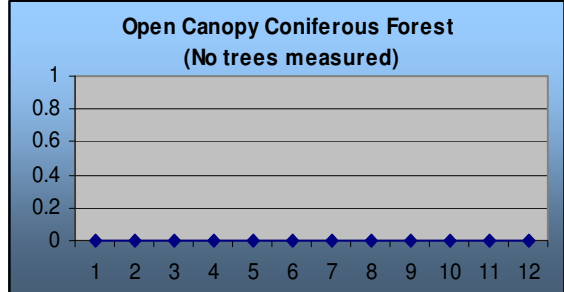
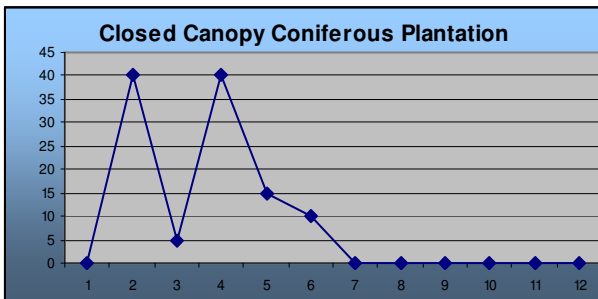
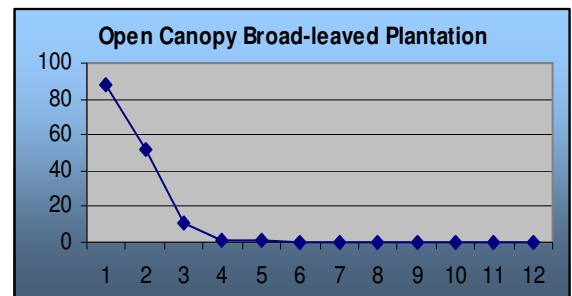
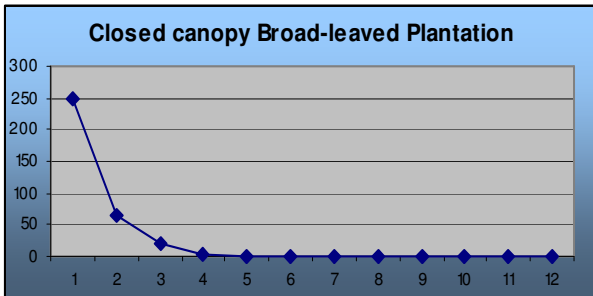
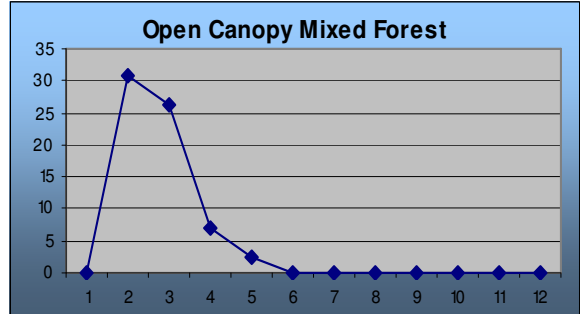
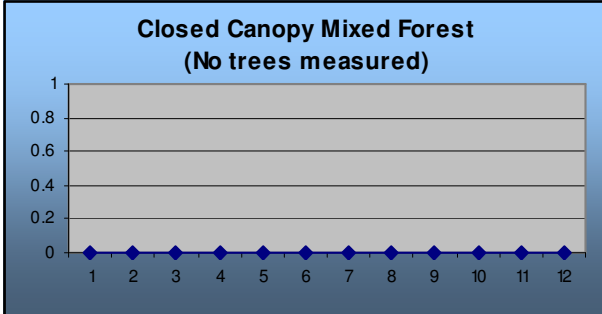
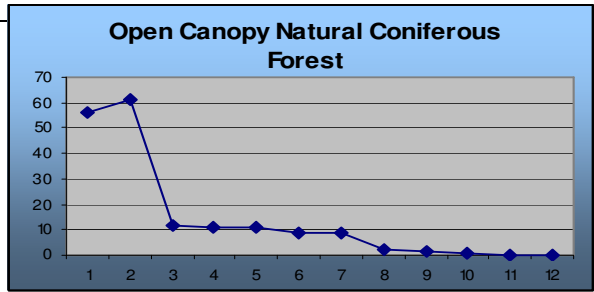
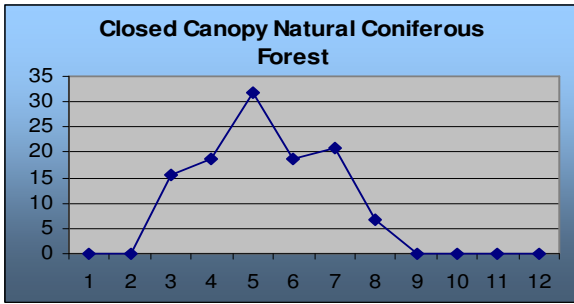


Table 5 shows that the distribution of trees by DBH Class in the different forest type is erratic, except in broad-leaved forest (both natural and plantation). This may be attributed to the size of the sample units. In forest type with large sample units, such as natural broad-leaved forest, the tree distribution by DBH Class follows the inverted “J” graph; however, in forest type with small sample units, such as natural coniferous forest, the tree distribution by DBH Class is erratic.

## 10.5 Biodiversity

Forest is the home of the majority of living species. In the Philippines, there are over three thousand species of trees that can reach dbh of 30 cm or more. However, forest biodiversity is being lost due to deforestation, fragmentation and degradation of all forest types. The most important factors associated with forest and biological diversity decline are human-induced causes that include: agricultural development, overgrazing, unmitigated shifting cultivation, unsustainable forest management, infrastructure development, mining, forest fires and pollution and climate change.

### 10.5.1 List and Frequency of Tree Species in Natural Forest

In the natural forest, there were about 541 tree species recorded. The most dominant tree species recorded are of the Family Dipterocarpaceae, such as: *Shorea contorta*, *Shorea polysperma*, *Shorea negrosensis*, *Shorea squamata*, *Dipterocarpus grandiflorus*, *Dipterocarpus grandiflorus*, *Shorea astylosa*, *Shorea almon*, and *Shorea guiso*.

Table 6a: Top 20 most abundant tree species in natural forest

Order	Scientific Name	Species	Trees/ha	%
1	<i>Shorea contorta</i>	white lauan	11.22	8.01%
2	<i>Shorea polysperma</i>	Tangile	8.83	6.31%
3		miscellaneous spp.	8.71	6.21%
4	<i>Shorea negrosensis</i>	red lauan	8.57	6.12%
5	<i>Shorea squamata</i>	Mayapis	7.22	5.15%
6	<i>Dipterocarpus grandiflorus</i>	Apitong	6.16	4.40%
7	<i>Parashorea plicata</i>	Bagtikan	3.79	2.71%
8	<i>Shorea astylosa</i>	Yakal	3.67	2.62%
9	<i>Lithocarpus llanosii</i>	Ulayan	3.49	2.49%
10	<i>Gmelina arborea</i>	Yemane	2.98	2.13%
11	<i>Shorea almon</i>	Almon	2.51	1.79%
12	<i>Pterocarpus indicus</i>	Narra	2.24	1.60%
13	<i>Syzygium brevistylum</i>	Sagimsim	1.74	1.24%
14	<i>Pinus kesiya</i>	Benguet pine	1.70	1.21%
15	<i>Shorea guiso</i>	Guijo	1.68	1.20%
16	<i>Ficus elastica</i>	India rubber	1.67	1.19%
17	<i>Ficus nota</i>	Tibig	1.64	1.17%
18	<i>Palaquium luzoniense</i>	Nato	1.39	0.99%
19	<i>Alangium javanicum var. jaheri</i>	Putian	1.36	0.97%
20	<i>Macaranga tanarius</i>	Binunga	1.28	0.92%

### 10.5.2 List and Frequency of Tree Species in TOF

In TOF, there were 426 tree species recorded. The most dominant tree species are *Cocos nucifera*, *Gmelina arborea*, *Mangifera indica*, *Leucaena leucocephala*, *Artocarpus blancoi*, *Macaranga tanarius*, *Sandoricum koetjape*, *Artocarpus heterophylla*, *Swietenia macrophylla*, *Ficus nota*, *Syzygium cumini*, *Pterocarpus indicus*, *Polyscias nodosa*, and *Trema orientalis*. About 77.1% of these tree species are found in Other Land while 68.3% are in Other Wooded Land (OWL).

Table 6b: Top 20 tree species in TOF

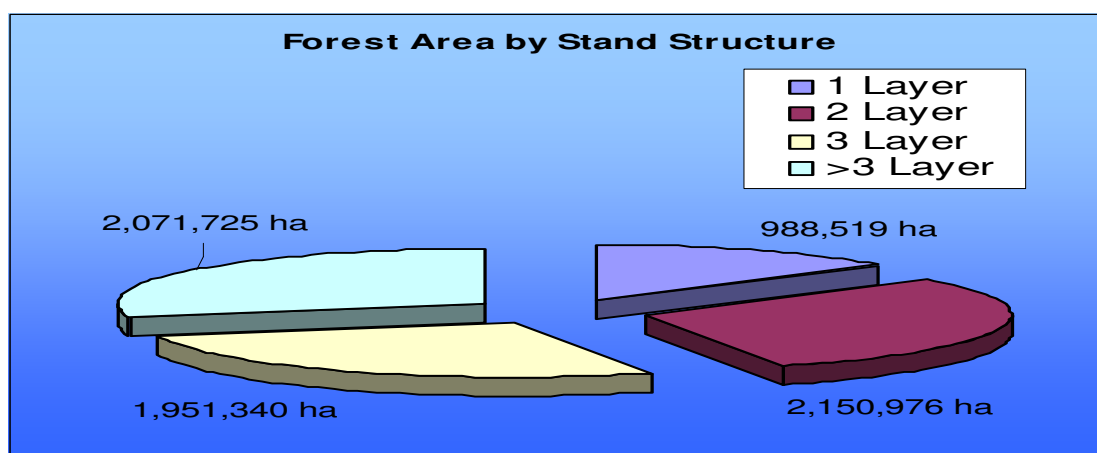
Scientific Name	Default Common name	TOF (trees/ha)	OWL (trees/ha)	OL (trees/ha)	IW (trees/ha)
<i>Cocos nucifera</i>	Coconut	17.88	2.10	21.66	2.04
<i>Gmelina arborea</i>	yemane	1.60	2.28	1.54	0.16
	Miscellaneous spp	1.44	5.42	0.71	0.32
<i>Mangifera indica</i>	mangga	1.01	0.20	1.20	0.21
<i>Leucaena leucocephala</i>	ipil-ipil	0.81	0.90	0.81	0.27
<i>Artocarpus blancoi</i>	antipolo	0.49	0.92	0.43	0.05
<i>Macaranga tanarius</i>	binunga	0.42	1.25	0.28	0.05
<i>Sandoricum koetjape</i>	santol	0.39	0.14	0.45	0.00
<i>Pterocarpus indicus</i>	narra	0.34	0.55	0.32	0.00
<i>Ficus nota</i>	tibig	0.33	0.78	0.23	0.64
<i>Polyscias nodosa</i>	malapapaya	0.32	0.97	0.21	0.00
<i>Artocarpus heterophylla</i>	nangka	0.32	0.23	0.35	0.11
<i>Syzygium cumini</i>	duhat	0.30	0.87	0.20	0.00
<i>Trema orientalis</i>	anabiong	0.29	0.80	0.21	0.00
<i>Swietenia macrophylla</i>	broad-leaved mahogany	0.29	0.57	0.24	0.11
<i>Alstonia macrophylla</i>	batino	0.26	0.20	0.26	0.59
<i>Gliricida sepium</i>	madre-cacao	0.25	0.74	0.17	0.00
<i>Samanea saman</i>	raintree	0.24	0.36	0.22	0.11
<i>Chrosphyllum cainito</i>	starapple	0.21	0.11	0.24	0.05
<i>Theobroma cacao</i>	cacao	0.21	0.00	0.26	0.00

### 10.5.3 Forest Area per Stand Structure

Out of the 7,162,560 ha of forest, about 2,150,976 ha or 30% has 2 layer canopy structure; 2,071,725 ha or 28.9% has more than 3 layer canopy structure; 1,951,340 ha or 27.2% has 3 layer canopy structure; and 988,519 ha or 13.8% has 1 layer canopy structure.

Table 7a: Forest area per stand structure

	1 Layer	2 Layer	3 Layer	>3 Layer
Area	988,519	2,150,976	1,951,340	2,071,725
Percent	13.8%	30%	27.2%	28.9%
Sampling error %	30.6%	18.6%	27.2%	32.8%

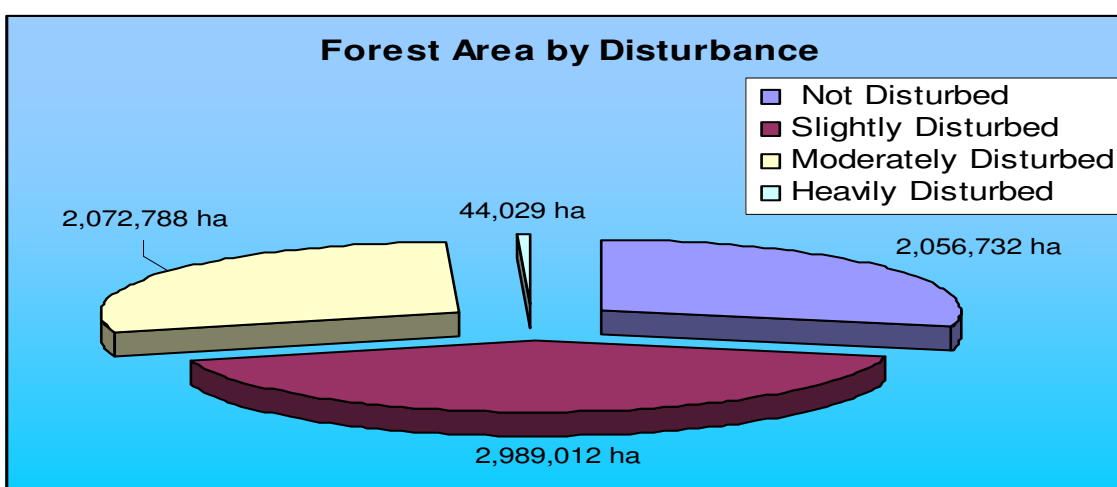


#### 10.5.4 Forest Area per Human Induced Disturbance Level

Forest disturbance is mostly anthropogenic in nature resulting from the increasing pressure of expanding population. NFA data shows that out of the total forest in the country, only about 44,029 ha or 0.6% is heavily disturbed. Table 7b shows the status of forest disturbance in the country.

Table 7b: Status of forest disturbance

Status of disturbance	Area (ha)	Percent
Not Disturbed	2,056,732	28.7%
Slightly Disturbed	2,989,012	41.7%
Moderately Disturbed	2,072,788	28.9%
Heavily Disturbed	44,029	0.6%
Total	7,162,560	99.99%



### 10.5.5 Forest Area Burned

The forest controls the rise of carbon dioxide concentration in the air. Frequent forest fires, therefore, reduce the carbon stored in vegetation and trees, increasing carbon dioxide emissions, and contributes to forest degradation.

Out of the 166 sample units with LUS classified as forest, 4 sample units have incidence of forest fire. Table 7c shows the statistics on the extent of forest fire in the country.

Table 7c: Forest area burned

	Forest Area	Area Burned		
		Total	Recent Fire	Old Fire
Area	7,162,560	28,427	5,352	23,075
Percent		0.4%	0.1%	0.3%

## 10.6 Use of Resources

Forest provides a wide array of goods and services, from timber and some non-timber forest resources to playing an important role in mitigating climate change as carbon sinks. At the same time, forest provides livelihood and jobs to millions of people.

In the calculation of area for the production of goods and services in Forest, only those land use sections where measurement was carried out were included.

### 10.6.1 Wood and Non-wood Products Provided by the Forest and Trees Outside Forest

#### 10.6.1.1 Wood and Non-wood Products Provided by the Forest

Based on the perception of the people interviewed, timber and fuel-wood remain the highest-value products provided by the forest.

Statistics shows that out of the total forest area of 7,162,560 ha, about 4,730,372 ha or 66.0% is the source of wood. The 2003 Philippine Forestry Statistics shows that about 505,703 m<sup>3</sup> round logs were produced, excluding data from the Autonomous Region in Muslim Mindanao (ARMM). Out of this about 177,566 m<sup>3</sup> were produced from the natural forest and 328,137 m<sup>3</sup> were produced from the plantation forest.

Table 8a shows the extent of the area covered in the extraction of the different wood and non-wood products. It can be observed that "Bush meat" has zero value. This is probably attributed to the opinion that "bush meat" is the end-product of hunting.

Table 8a: Wood and non-wood products provided by the Forest.

Product Type	Area (ha)	Percent
Wood	4,730,372	66.0%
Fuel wood	3,340,636	46.6%
Food	874,113	12.2%
Fodder	103,609	1.4%
Medicines	100,883	1.4%
Essential oils	30,295	0.4%
Tannins	39,989	0.6%
Spices, herbs	151,475	2.1%
Exudates	275,887	3.9%
Utensils, handicrafts	725,870	10.1%
Construction materials	483,206	6.7%
Ornamentals	100,984	1.4%
Seeds	13,128	0.2%
Bio fertilizers, insecticides etc.	0	0.0%
Other non wooded plant products	479,672	6.7%
Living animals	241,856	3.4%
Bush meat	0	0.0%
Honey, beeswax	353,947	4.9%

#### 10.6.1.2 Wood and Non-wood Products Provided by Trees Outside Forest

Table 8b shows that food, fuel-wood, and wood are the highest-value products derived from TOF. Food products are not limited to those provided by the trees but include agricultural products such as rice, vegetables, etc.

Table 8b: Wood and non-wood products provided by TOF

Product Type	Area (ha)	Percent
Wood	3273549	14.3%
Fuel wood	6012840	26.3%
Food	12609489	55.2%
Fodder	1128522	4.9%
Medicines	361619	1.6%
Essential oils	1253630	5.5%
Tannins	0	0.0%
Spices, herbs	0	0.0%
Exudates	69758	0.3%
Utensils, handicrafts	193022	0.8%
Construction materials	2482837	10.9%
Ornamentals	118958	0.5%
Seeds	0	0.0%
Bio fertilizers, insecticides etc.	56404	0.2%
Other non wooded plant products	706457	3.1%
Living animals	182655	0.8%
Bush meat	74678	0.3%
Honey, beeswax	13618	0.1%

## 10.6.2 Social, Economic and Environmental Services Provided by the Forest and Trees Outside Forest

### 10.6.2.1 Social, economic and environmental services provided by the Forest

Water and soil conservation is perceived to be the highest value services provided by the forest. Statistics shows that about 3,959,160 ha or 55.3% of the country's forest is intended for soil and water conservation. This is followed by hunting that covers about 1,307,939 ha or 18.3%.

Table 8c: Social, economic and environmental services provided by the Forest

Service Type	Area (ha)	Percent
Employment (salary)	453,315	6.3%
Hunting	1,307,939	18.3%
Grazing	32,719	0.5%
Exploration of natural resources	30,093	0.4%
Conservation	418,072	5.8%
Agricultural functions	174,197	2.4%
Water and soil conservation	3,959,160	55.3%
Recreation	353,442	4.9%
Religious/spiritual	0	0.0%

### 10.6.2.2 Social, economic and environmental services provided by the Trees Outside Forest

Based on the perception of the respondents, grazing is the highest value service provided by TOF at 12.6% (Table 8d). This is followed by water and soil conservation, agricultural functions, employment, and hunting.

Table 8d: Social, economic and environmental services provided by TOF

Service Type	Area (ha)	Percent
Employment (salary)	1,848,334	8.1%
Hunting	471,352	2.1%
Grazing	2,882,234	12.6%
Exploration of natural resources	82,761	0.4%
Conservation	13,618	0.1%
Agricultural functions	1,935,927	8.5%
Water and soil conservation	2,250,016	9.9%
Recreation	91,371	0.4%
Religious/spiritual	44,895	0.2%

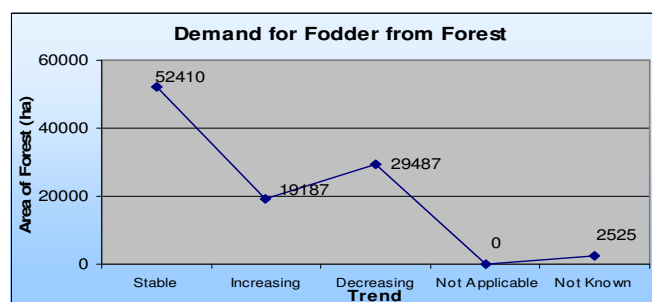
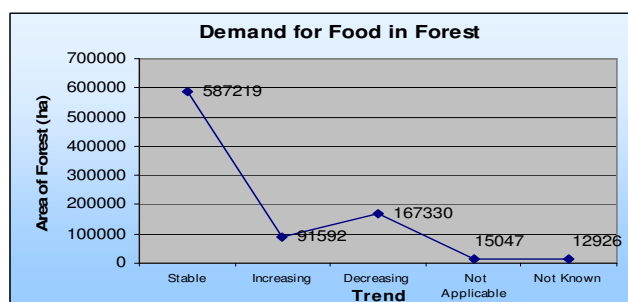
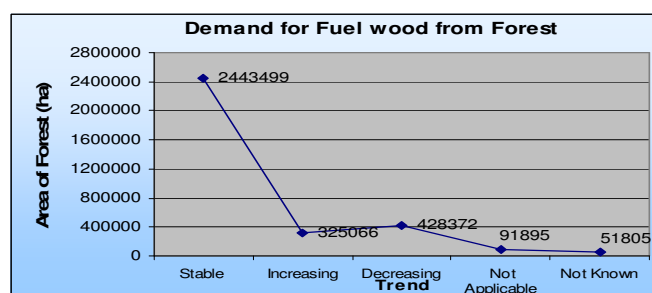
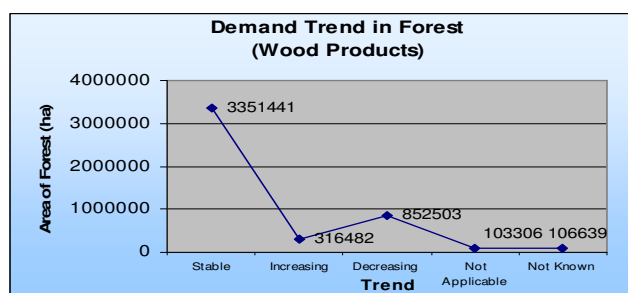
10.6.3 Demand Trend for Wood and Non-wood Products Provided by Forest and Trees Outside Forest

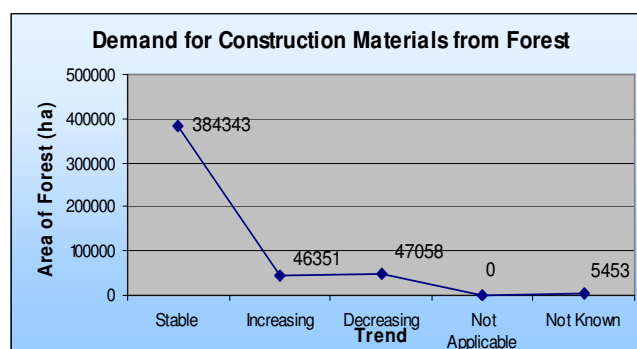
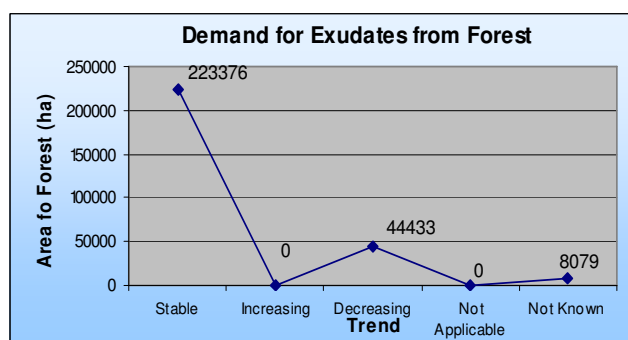
10.6.3.1 Demand trend for wood and non-wood products provided by Forest

Table 8e shows that the demand for wood, fuel-wood, food, fodder, tannins, exudates, construction materials, ornamental plants, living animals, and honey & beeswax is stable. At the same, demand for medicinal plants and materials for utensil and handicraft making is decreasing.

Table 8e: Demand trend for wood and non-wood products provided by the Forest

Products	Demand Trend (Area in ha)						Percent in Forest
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Wood	3351441	316482	852503	103306	106639	4730372	66.0%
Fuel wood	2443499	325066	428372	91895	51805	3340636	46.6%
Food	587219	91592	167330	15047	12926	874113	12.2%
Fodder	52410	19187	29487	0	2525	103609	1.4%
Medicines	22721	37364	40797	0	0	100883	1.4%
Essential oils	0	0	30295	0	0	30295	0.4%
Tannins	39989	0	0	0	0	39989	0.6%
Spices, herbs	126229	0	25246	0	0	151475	2.1%
Exudates	223376	0	44433	0	8079	275887	3.9%
Utensils, handicrafts	298911	82403	344556	0	0	725870	10.1%
Construction materials	384343	46351	47058	0	5453	483206	6.7%
Ornamentals	100984	0	0	0	0	100984	1.4%
Seeds	0	0	13128	0	0	13128	0.2%
Bio fertilizers, insecticides	0	0	0	0	0	0	0.0%
Living animals	180256	0	61600	0	0	241856	3.4%
Bush meat	0	0	0	0	0	0	0.0%
Honey, beeswax	292347	25246	36354	0	0	353947	4.9%





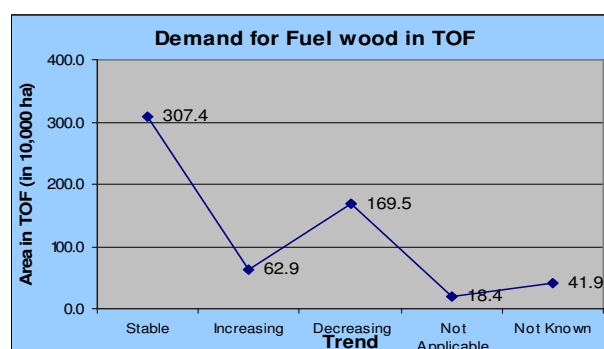
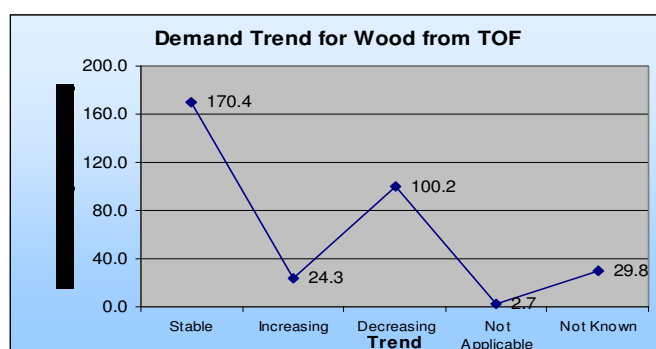
### 10.6.3.2 Demand trend for wood and non-wood products Provided by TOF

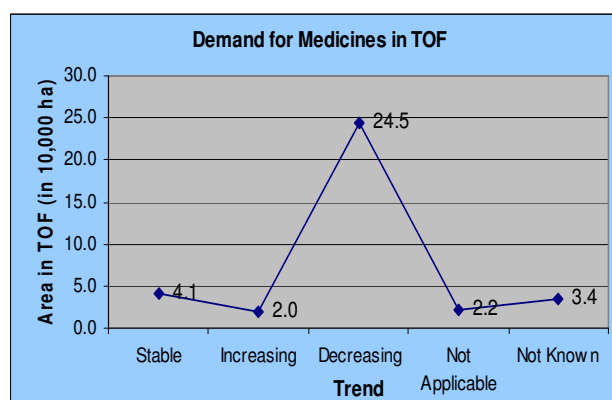
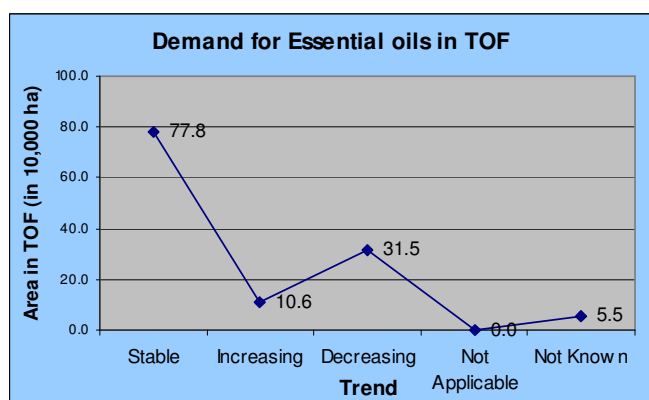
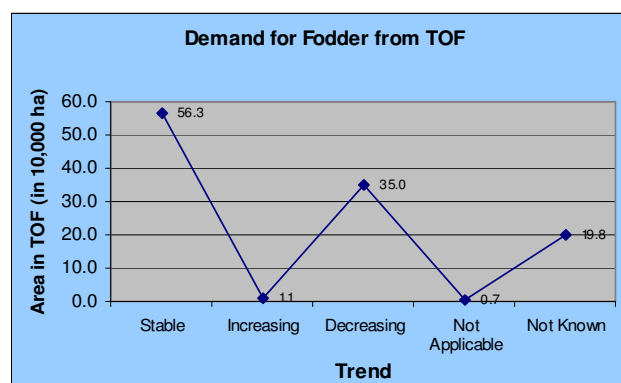
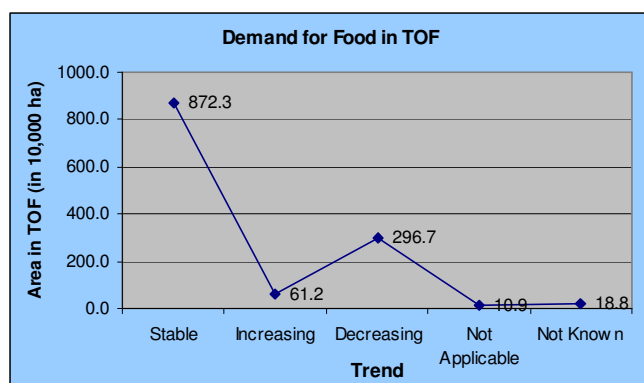
Table 8f shows that most of the wood and non-wood products provided by TOF have stable demand, except medicinal plants that have decreasing demand.

About 1,598,243 ha or 55.2% of the TOF area serves as sources for food while 3,073,674 ha or 26.3% serves as source for fuel wood.

Table 8f: Demand trend for wood and non-wood products provided by TOF

Products	Demand Trend (Area in ha)						Percent in TOF
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Wood	1703546	243012	1001569	27411	298011	3273549	14.3%
Fuel wood	3073674	628880	1694672	184236	419429	6000891	26.3%
Food	8723138	612187	2966752	108503	187662	12598243	55.2%
Fodder	563163	10806	349934	6853	197766	1128522	4.9%
Medicines	40853	19944	244594	21964	34264	361619	1.6%
Essential oils	777709	106219	314791	0	54911	1253630	5.5%
Tannins	0	0	0	0	0	0	0.0%
Spices, herbs	0	0	0	0	0	0	0.0%
Exudates	57986	4393	2987	4393	0	69758	0.3%
Utensils, handicrafts	104550	2636	85836	0	0	193022	0.8%
Construction materials	1252576	499642	528723	96730	105165	2482837	10.9%
Ornamentals	70901	5271	21964	6765	0	104901	0.5%
Seeds	0	0	0	0	0	0	0.0%
Bio fertilizers, insecticides	56404	0	0	0	0	56404	0.2%
Living animals	529865	879	174660	0	1054	706457	3.1%
Bush meat	136178	12124	21964	0	12388	182655	0.8%
Honey, beeswax	52714	0	21964	0	0	74678	0.3%





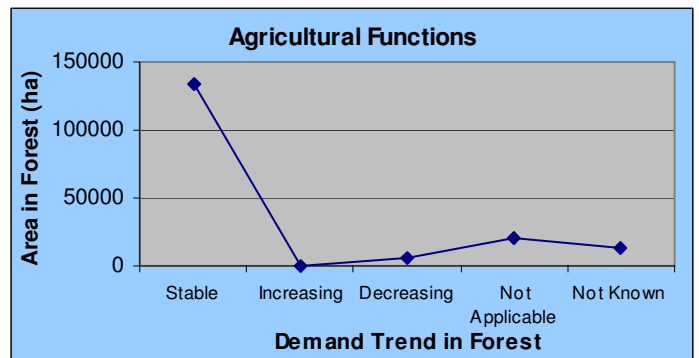
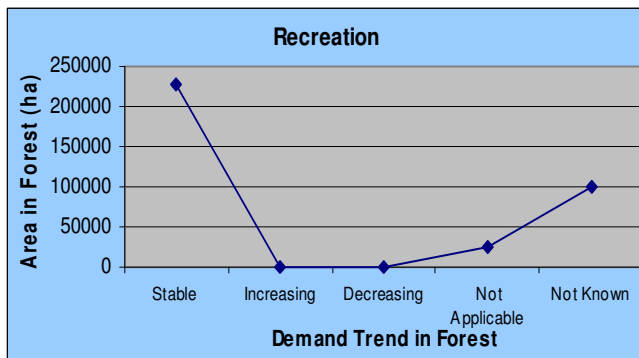
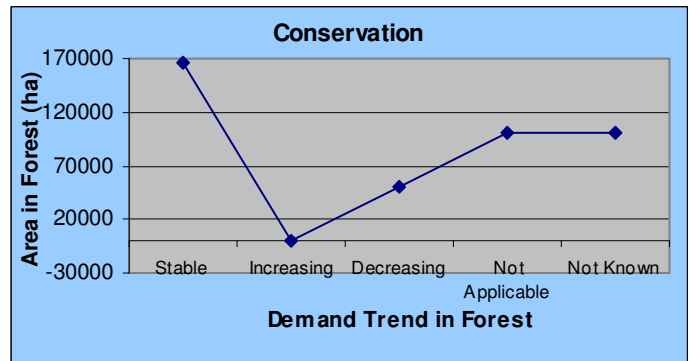
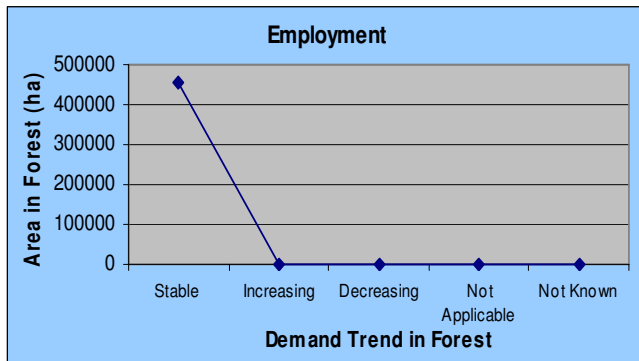
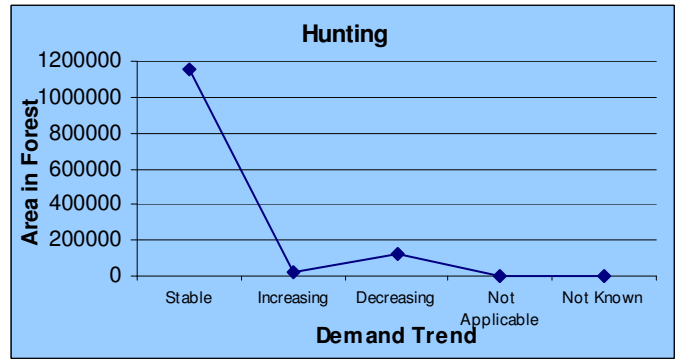
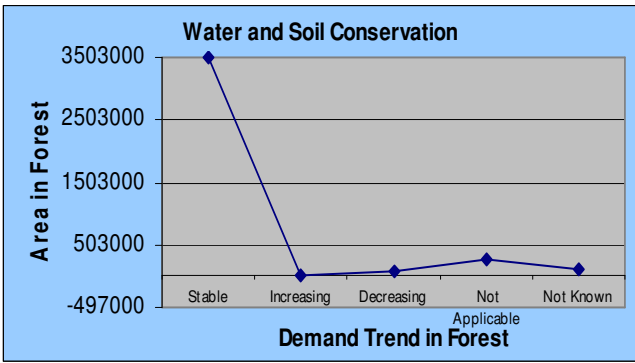
#### 10.6.4 Demand Trend for Social, Economic and Environmental Services Provided by the Forest and Trees Outside Forest

##### 10.6.4.1 Demand trend for social, economic and environmental services provided by the Forest

Table 8g shows that the demand trend for most of the social, economic and environmental services provided by the Forest is stable. Water & soil conservation, hunting and employment cover the largest area.

Table 8g: Demand trend for social, economic and environmental services provided by the Forest

Service	Demand Trend (Forest Area Covered in ha)						Percent in Forest
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Employment (salary)	453315	0	0	0	0	453315	6.3%
Hunting	1154141	24842	128956	0	0	1307939	18.3%
Grazing	22721	0	0	0	9997	32719	0.5%
Exploration of natural resources	0	0	0	30093	0	30093	0.4%
Conservation	165613	0	50492	100984	100984	418072	5.8%
Agricultural functions	134510	0	6362	20702	12623	174197	2.4%
Water and soil conservation	3502614	3938	82907	266698	103003	3959160	55.3%
Recreation	227213	0	0	25246	100984	353442	4.9%
Religious/spiritual	0	0	0	0	0	0	0.0%

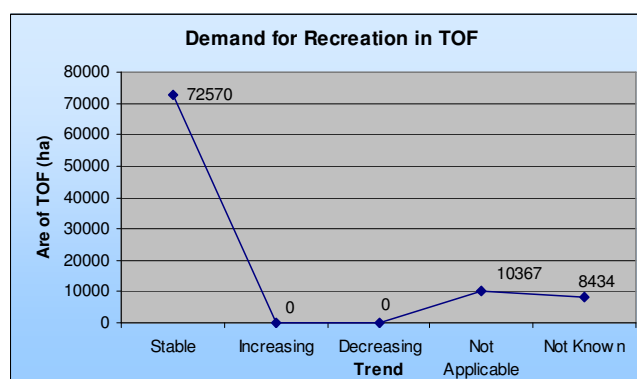
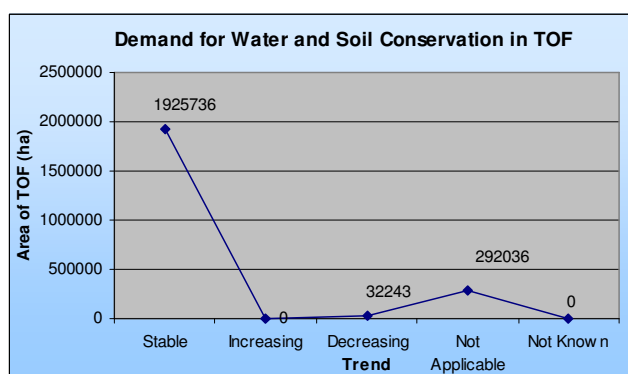
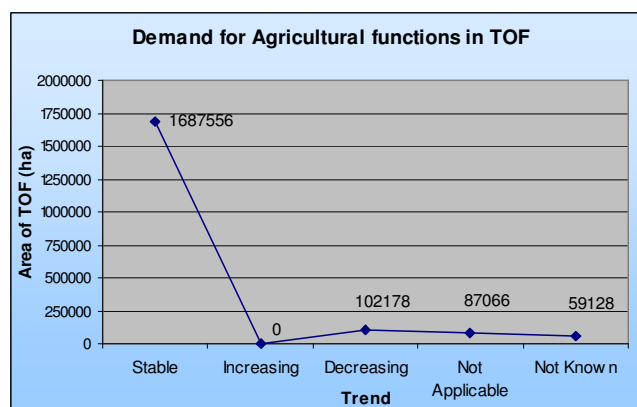
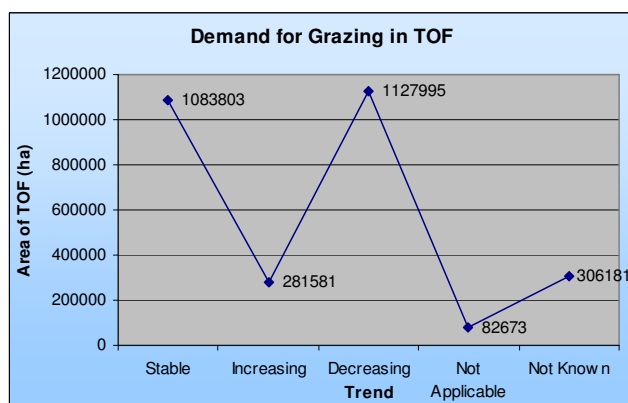
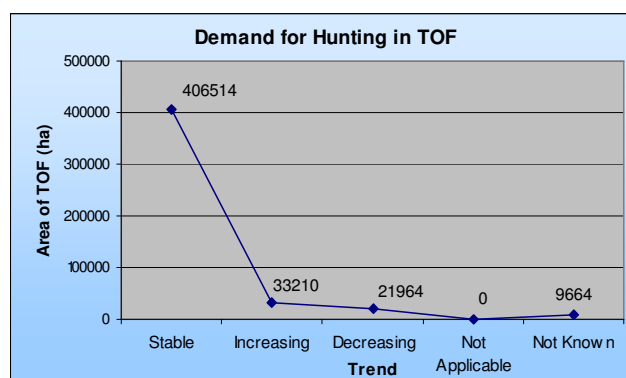
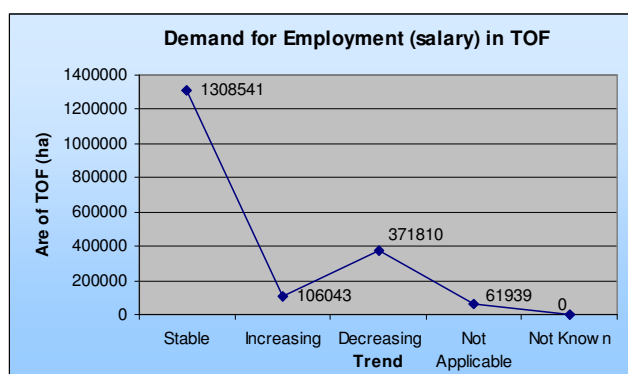


10.6.4.2 Demand trend for social, economic and environmental services provided by Trees Outside Forest

Table 8h shows that grazing, water and soil conservation, agricultural functions, and employment are the most dominant services provided by TOF. The demand trend for these services is stable except for grazing. Grazing, which covers the largest area, has a slightly decreasing demand.

Table 8h: Demand trend for social, economic and environmental services provided by TOF

Service	Demand Trend (Area in ha)						Percent in TOF
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Employment (salary)	1308541	106043	371810	61939	0	1848334	8.1%
Hunting	406514	33210	21964	0	9664	471352	2.1%
Grazing	1083803	281581	1127995	82673	306181	2882234	12.6%
Exploration of natural res.	0	0	0	0	82761	82761	0.4%
Conservation	13618	0	0	0	0	13618	0.1%
Agricultural functions	1687556	0	102178	87066	59128	1935927	8.5%
Water and soil conservation	1925736	0	32243	292036	0	2250016	9.9%
Recreation	72570	0	0	10367	8434	91371	0.4%
Religious/spiritual	21964	0	0	22931	0	44895	0.2%



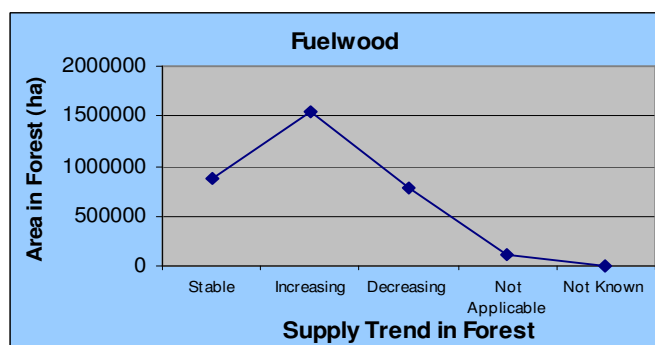
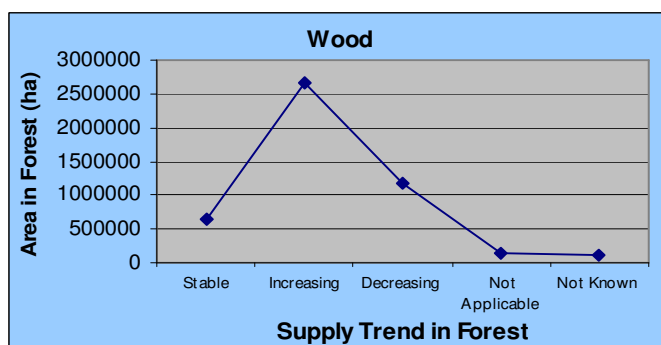
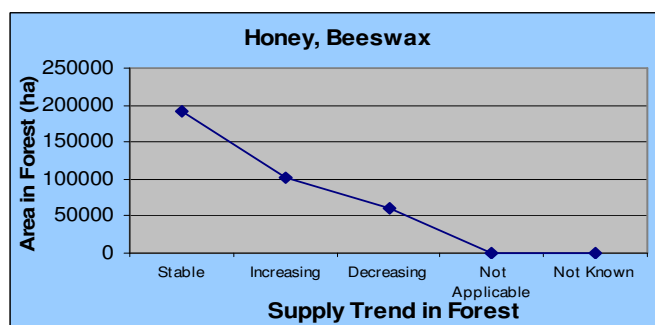
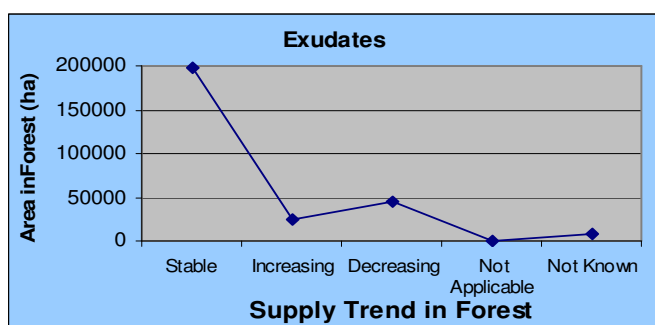
10.6.5 Supply Trend for Wood and Non-wood Products Provided by Forest and Trees Outside Forest

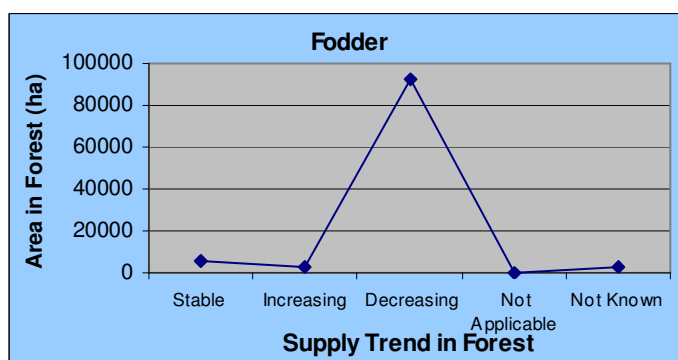
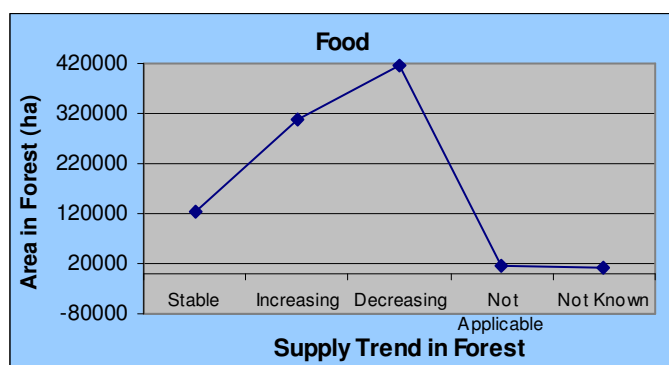
10.6.5.1 Supply trend for wood and non-wood products provided by the Forest

Table 8i shows that there is an increasing supply of wood, fuel-wood, utensils & handicraft materials, construction materials, and living animals. At the same time, the supply of food, fodder, and medicinal plants is decreasing.

Table 8i: Supply trend for wood and non-wood products provided by the Forest

Products	Supply Trend (Area in ha)						Percent in Forest
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Wood	636,297	2,671,519	1,169,591	149,759	103,205	4,730,372	66.0%
Fuel wood	878,557	1,549,289	786,056	118,151	8,584	3,340,636	46.6%
Food	124,109	306,485	415,547	15,047	12,926	874,113	12.2%
Fodder	6,059	2,929	92,097	0	2,525	103,609	1.4%
Medicines	0	0	100,883	0	0	100,883	1.4%
Essential oils	0	0	30,295	0	0	30,295	0.4%
Tannins	28,881	0	0	11,108	0	39,989	0.6%
Spices, herbs	0	126,229	25,246	0	0	151,475	2.1%
Exudates	198,130	25,246	44,433	0	8,079	275,887	3.9%
Utensils, handicrafts	30,093	352,332	343,445	0	0	725,870	10.1%
Construction materials	66,245	301,436	94,925	0	5,453	483,206	6.7%
Ornamentals	0	75,738	25,246	0	0	100,984	1.4%
Seeds	0	0	13,128	0	0	13,128	0.2%
Bio fertilizers, insecticides	0	0	0	0	0	0	0.0%
Living animals	39,687	165,815	36,354	0	0	241,856	3.4%
Bush meat	0	0	0	0	0	0	0.0%
Honey, beeswax	191,061	101,286	61,600	0	0	353,947	4.9%





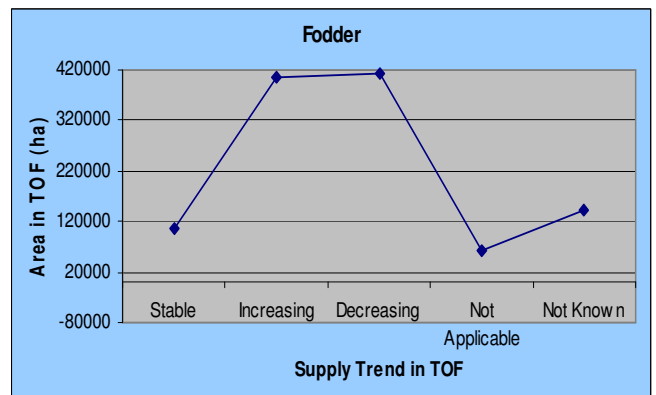
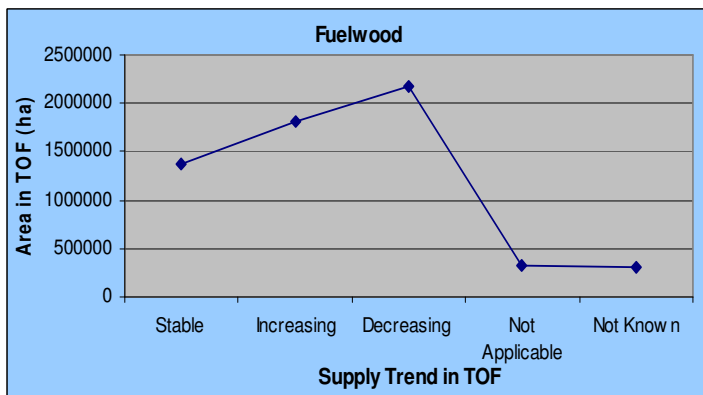
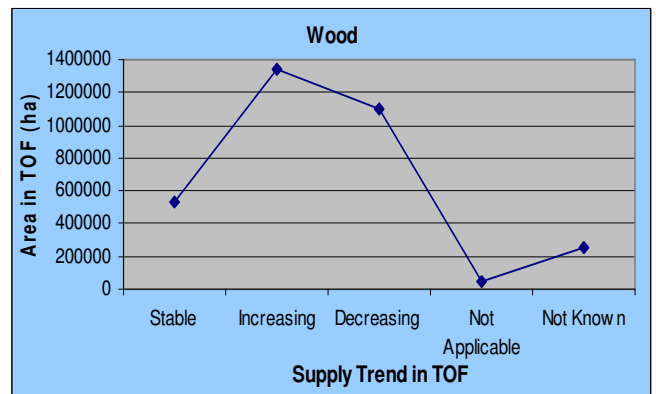
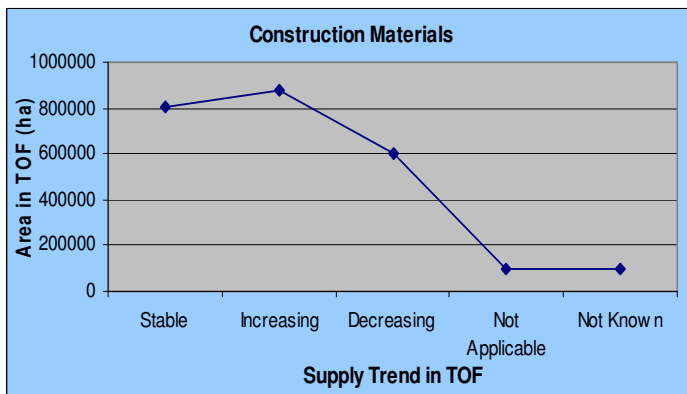
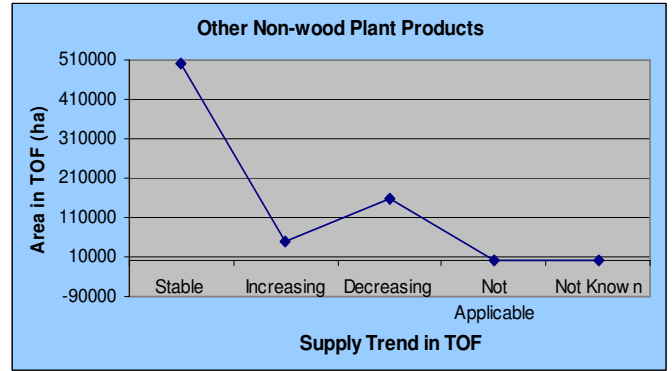
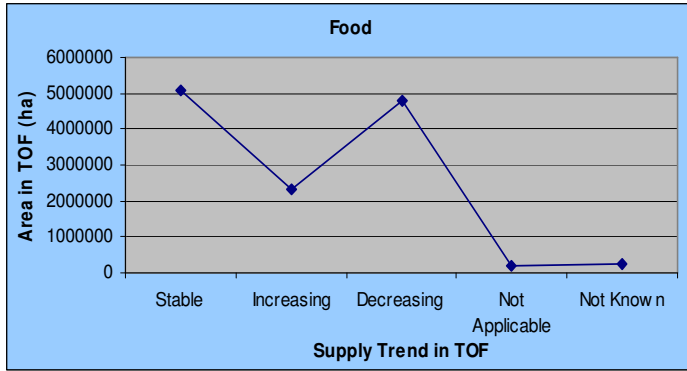
### 10.6.5.2 Supply trend for wood and non-wood products provided by TOF

Among the wood and non-wood products provided by the Forest with stable supply are food, essential oils, exudates, ornamental plants, bio-fertilizer & insecticide materials, living animals, and honey/beeswax. Those products with increasing supply are fuel-wood and construction materials. At the same time, those products with decreasing supply are fodder, medicinal plants, utensils and handicraft materials, and bush meat.

In TOF, about 12.6 million ha or 55.2% is the source for food and 6.0 million ha or 26.2% is the source for fuel-wood. There is no record for tannin, spices/herbs, and seed source.

Table 8j: Supply trend for wood and non-wood products provided by TOF

Products	Supply Trend (Area in ha)						Percent in TOF
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Wood	529,689	1,347,725	1,099,705	43665	252764	3273549	14.3%
Fuel wood	1,367,142	1,814,070	2,183,157	317691	296869	5978927	26.2%
Food	5,073,122	2,325,573	4,807,443	170442	224299	12600879	55.2%
Fodder	106,746	404,405	412,752	63521	141098	1128522	4.9%
Medicines	21,964	32,595	273,674	21964	11421	361619	1.6%
Essential oils	476,712	353,624	368,384	0	54911	1253630	5.5%
Tannins	0	0	0	0	0	0	0.0%
Spices, herbs	0	0	0	0	0	0	0.0%
Exudates	62,378	0	2,987	4393	0	69758	0.3%
Utensils, handicrafts	29,783	38,657	103,232	21349	0	193022	0.8%
Construction materials	807,317	878,833	603,577	96730	96379	2482837	10.9%
Ornamentals	53,593	5,271	33,825	12212	0	104901	0.5%
Seeds	0	0	0	0	0	0	0.0%
Bio fertilizers, insecticides	56,404	0	0	0	0	56404	0.2%
Living animals	502,190	47,091	156,122	0	1054	706457	3.1%
Bush meat	82,410	12,388	87,857	0	0	182655	0.8%
Honey, beeswax	43,928	0	30,750	0	0	74678	0.3%



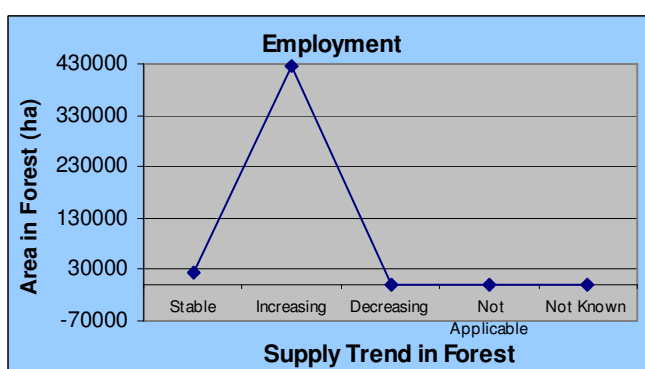
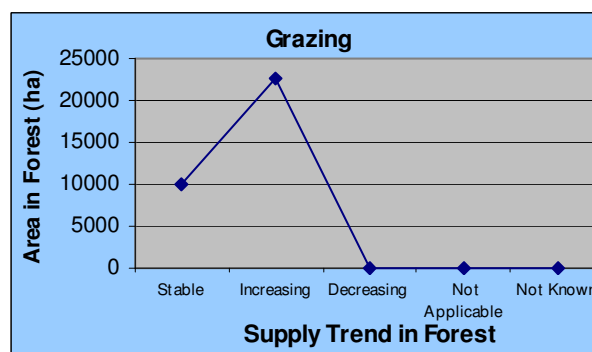
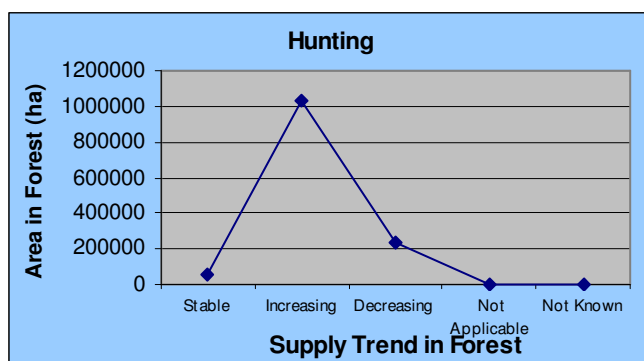
10.6.6 Supply Trend for Social, Economic and Environmental Services Provided by the Forest and Trees Outside Forest

10.6.6.1 Supply Trend for Social, Economic and Environmental Services Provided by the Forest

In Forest, the services/activities with increasing supply trend are hunting, grazing and employment. The remaining services have no clear supply trend.

Table 8k: Supply trend for social, economic and environmental services provided by the Forest

Services	Supply Trend (Area in ha)						Percent in Forest
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Employment (salary)	25,246	426,151	0	0	1919	453315	6.3%
Hunting	50,492	1,027,507	229,940	0	0	1307939	18.3%
Grazing	9,997	22,721	0	0	0	32719	0.5%
Exploration of natural res.	0	0	0	30,093	0	30093	0.4%
Conservation	0	0	75,738	342,334	0	418072	5.8%
Agricultural functions	3,635	0	30,093	127,845	12623	174197	2.4%
Water & soil conservation	22,620	57,157	45,039	3,832,325	2020	3959160	55.3%
Recreation	25,246	25,246	100,984	201,967	0	353442	4.9%
Religious/spiritual	0	0	0	0	0	0	0.0%

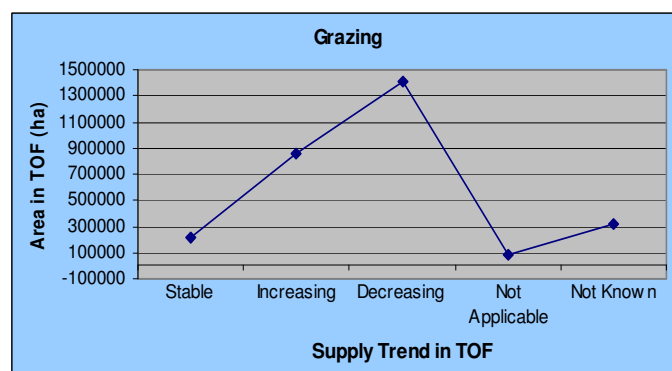
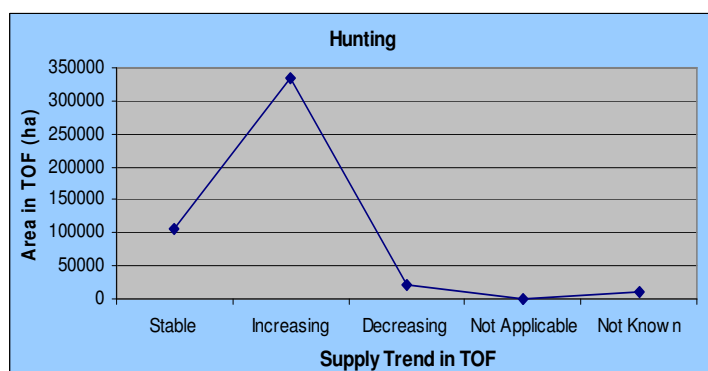
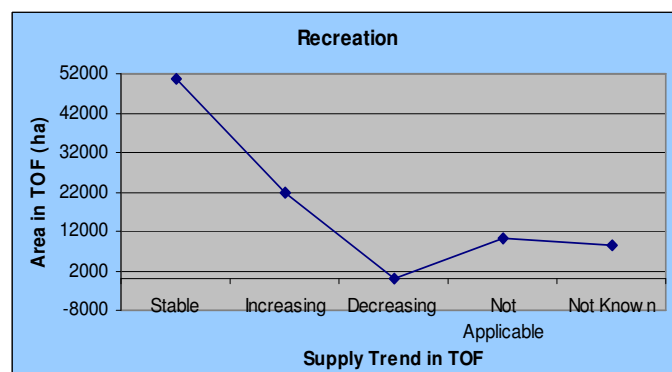
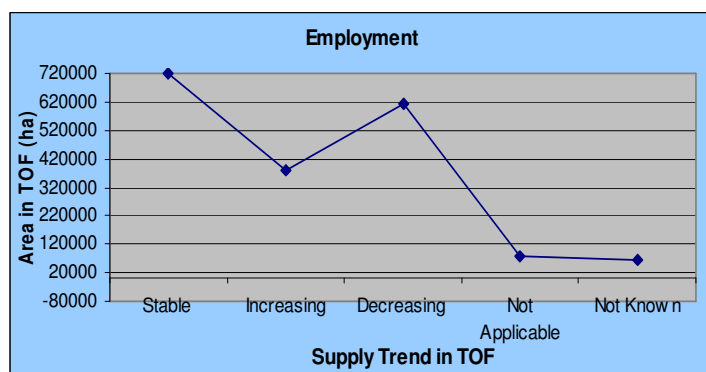


10.6.6.2 Supply Trend for Social, Economic and Environmental Services Provided by Trees Outside Forest

In TOF, grazing and water & soil conservation are the services that provide the highest percentage of area coverage at 12.6% and 9.9%, respectively. Grazing has a decreasing supply trend; however, water & soil conservation has no clear supply trend. Employment and recreation, which cover 8.1% and 0.4%, respectively are the only services that have stable supply trend in TOF.

Table 8: Supply trend for social, economic and environmental services provided by TOF

Services	Supply Trend (Area in ha)						Percent in TOF
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Employment (salary)	717,967	376,730	613,066	74678	65893	1848334	8.1%
Hunting	106,131	333,593	21,964	0	9664	471352	2.1%
Grazing	215,249	856,517	1,410,104	82673	317691	2882234	12.6%
Exploration of natural res.	0	0	0	0	82761	82761	0.4%
Conservation	0	0	0	13618	0	13618	0.1%
Agricultural functions	186,520	33,122	103,408	1556385	56492	1935927	8.5%
Water & soil conservation	23,721	2,636	1,054	2222604	0	2250016	9.9%
Recreation	50,606	21,964	0	10367	8434	91371	0.4%
Religious/spiritual	21,964	0	0	22931	0	44895	0.2%



### 10.6.7 Activity Trend for Wood and Non-wood Products in Forest and Trees Outside Forest

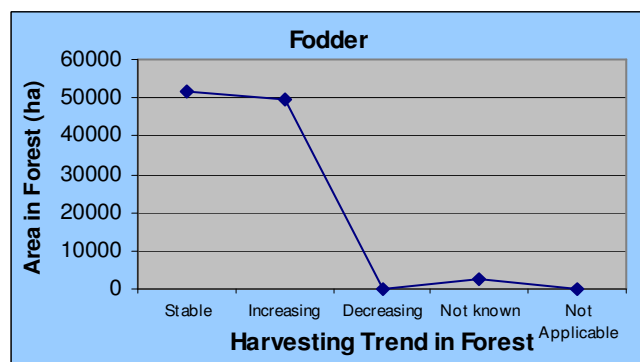
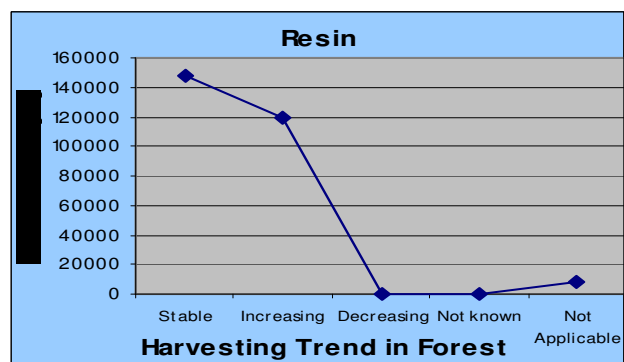
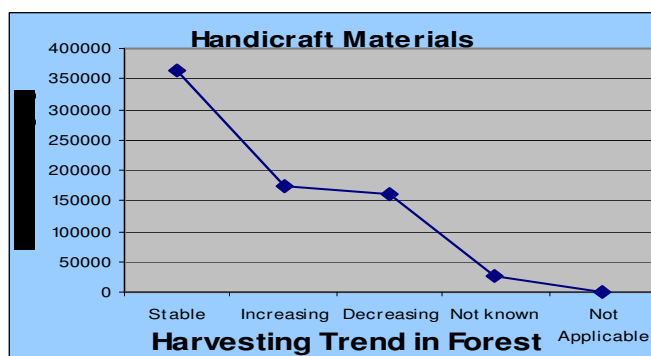
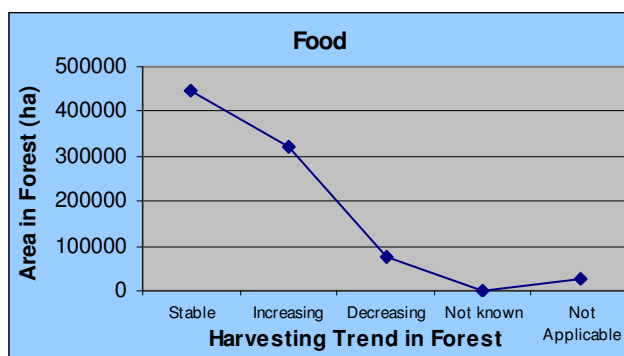
#### 10.6.7.1 Activity Trend for Wood and Non-Wood Products in Forest

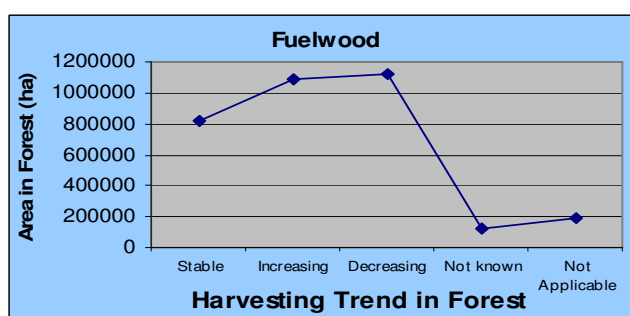
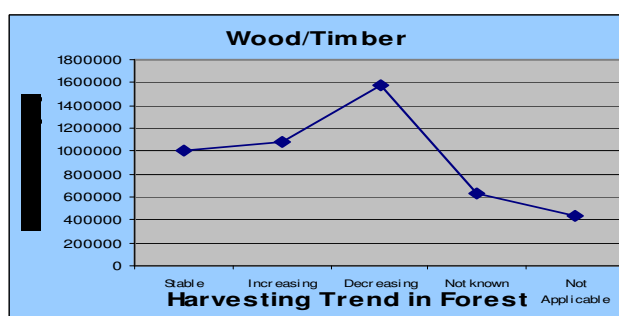
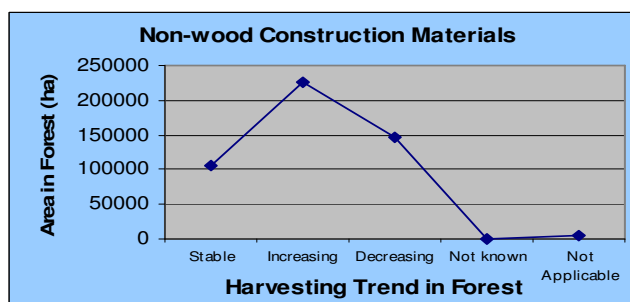
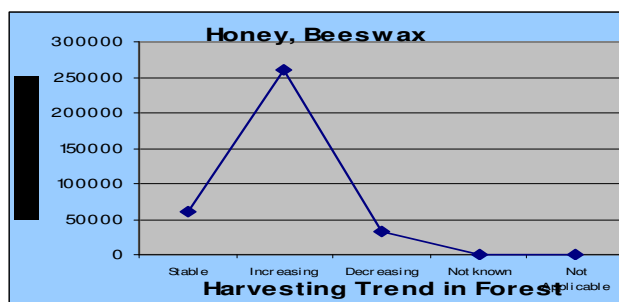
NFA results show that timber extraction is decreasing in Forest. This may be attributed to the reduction in the number of logging companies due to the DENR policy on non-renewal of expired timber license agreements (TLA) as well as in the implementation of selective logging ban in the country. At the

same time, the extraction of fuel wood decreased resulting from its substitution by other oil products such as the liquefied petroleum gas (LPG).

Table 8m: Activity trend for wood and non-wood products provided by Forest

Product/Service	Activity Trend (Area in ha)						Percent in Forest
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Timber	1,001,757	1,083,351	1,580,594	627,209	437461	4730372	66.0%
Firewood	818,472	1,083,856	1,126,269	119,766	192273	3340636	46.6%
Food	445,741	322,844	77,555	0	27972	874113	12.2%
Fodder	51,603	49,482	0	2,525	0	103609	1.4%
Medical products	86,341	0	14,542	0	0	100883	1.4%
Oils, soap, cosmetics	22,721	0	0	0	7574	30295	0.4%
Tannins	0	28,881	0	11,108	0	39989	0.6%
Herbs and spices	25,246	126,229	0	0	0	151475	2.1%
Resin	148,143	119,665	0	0	8079	275887	3.9%
Handicraft	363,642	174,702	162,281	25,246	0	725870	10.1%
Non-wood constructions	105,730	225,395	146,628	0	5453	483206	6.7%
Ornamentals	0	100,984	0	0	0	100984	1.4%
Seeds	13,128	0	0	0	0	13128	0.2%
Fertilizers, biological pesticides	0	0	0	0	0	0	0.0%
Other Non-wood forest products	25,246	151,475	302,951	0	0	479672	6.7%
Wild animals	61,600	166,926	13,330	0	0	241856	3.4%
Bush meat	0	0	0	0	0	0	0.0%
Honey, beeswax	61,600	260,033	32,315	0	0	353947	4.9%



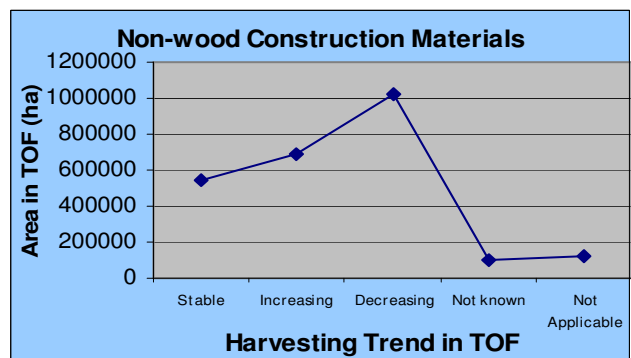
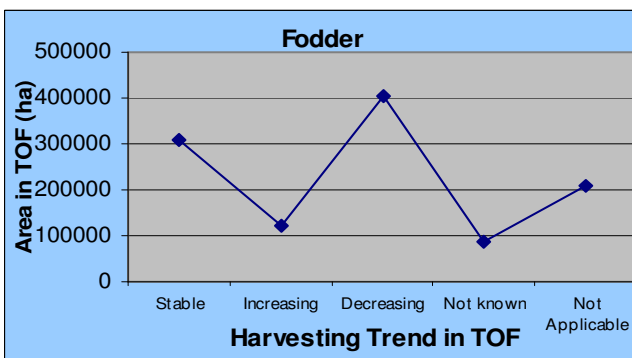
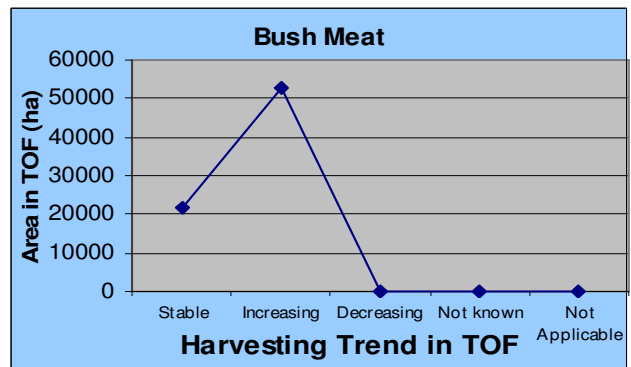
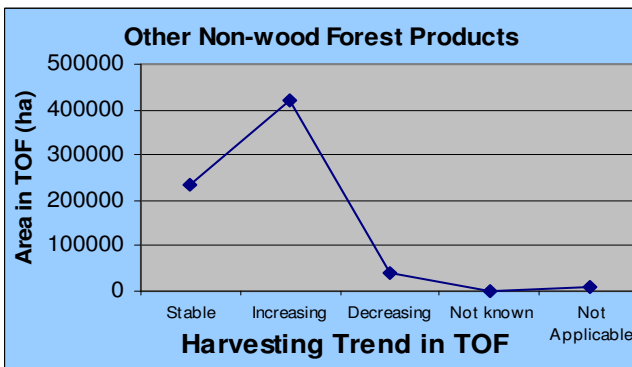
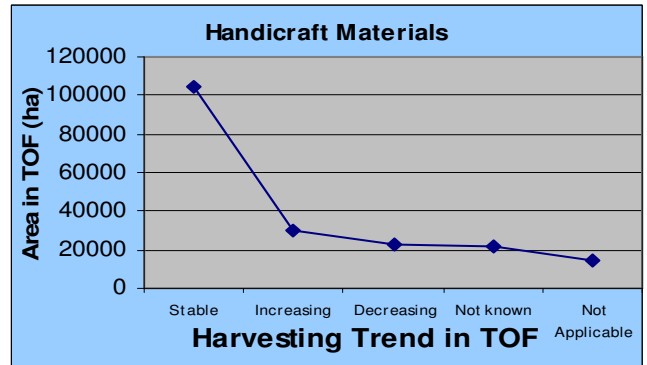
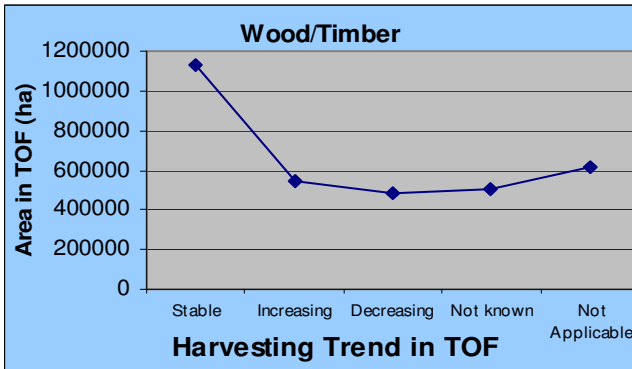
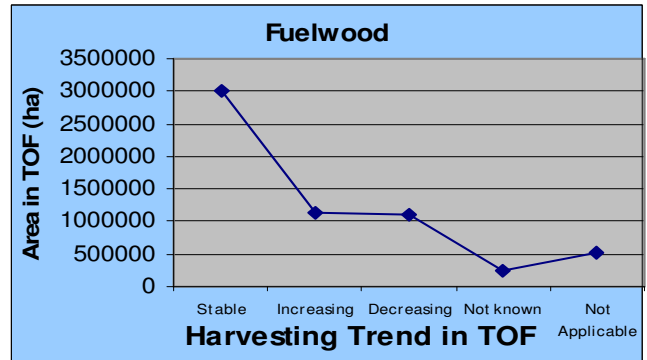
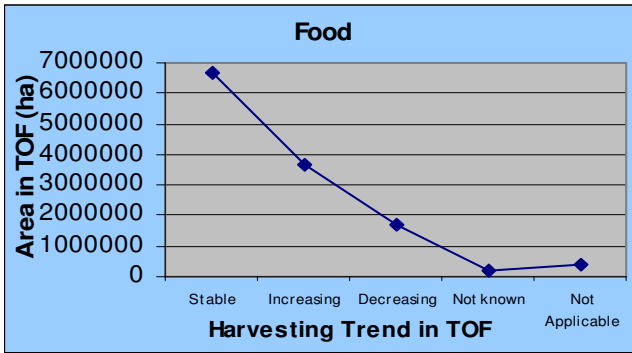


### 10.6.7.2 Activity trend for wood and non-wood products provided by TOF

In TOF, the harvesting trend for wood/timber; fuel-wood; food; oil, soap, & cosmetics materials; handicraft materials; medicinal plants; and collection of wild animals is stable. At the same time, other non-wood forest products and bush meat have increasing trend. For fodder and non-wood construction materials, the trend is decreasing.

Table 8n: Activity trend for wood and non-wood products provided by TOF

Products	Activity Trend (Area in ha)						Percent in TOF
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Wood/Timber	1,131,421	542,780	483,916	503,244	612,187	3,273,549	14.3%
Firewood	3,016,392	1,123,075	1,112,796	237,653	510,976	6,000,891	26.3%
Food	6,656,919	3,687,179	1,702,579	193,022	361,180	12,600,879	55.2%
Fodder	306,621	123,439	402,560	86,715	209,187	1,128,522	4.9%
Medical products	288,698	0	25,479	21,964	25,479	361,619	1.6%
Oils, soap, cosmetics	665,516	287,907	243,100	0	57,107	1,253,630	5.5%
Tannins	0	0	0	0	0	0	0.0%
Herbs and spices	0	0	0	0	0	0	0.0%
Resin	60,973	4,393	0	4,393	0	69,758	0.3%
Handicraft	104,725	29,783	22,843	21,349	14,321	193,022	0.8%
Non-wood construction	540,144	693,894	1,018,613	103,056	127,129	2,482,837	10.9%
Ornamentals	39,096	19,329	5,271	41,205	0	104,901	0.5%
Seeds	0	0	0	0	0	0	0.0%
Fertilizers, biological pesticides	27,148	7,292	21,964	0	0	56,404	0.2%
Other non-wood forest products	235,808	420,044	39,623	0	10,982	706,457	3.1%
Wild animals	136,178	46,476	0	0	0	182,655	0.8%
Bush meat	21,964	52,714	0	0	0	74,678	0.3%
Honey, beeswax	7,468	0	0	0	6,150	13,618	0.1%



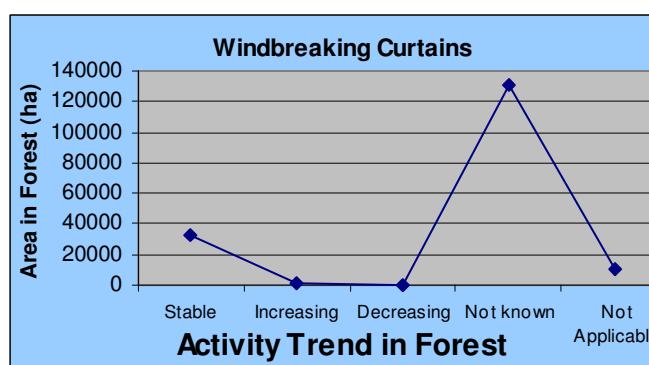
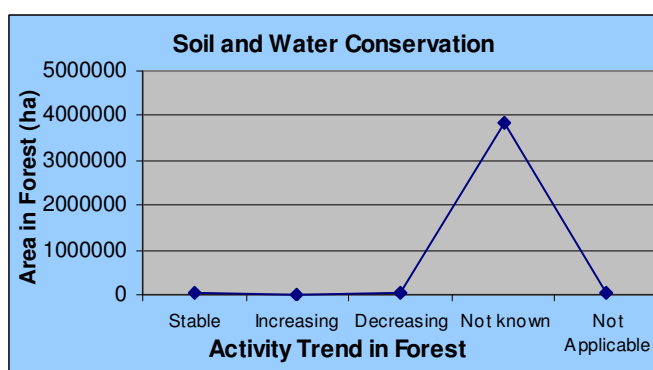
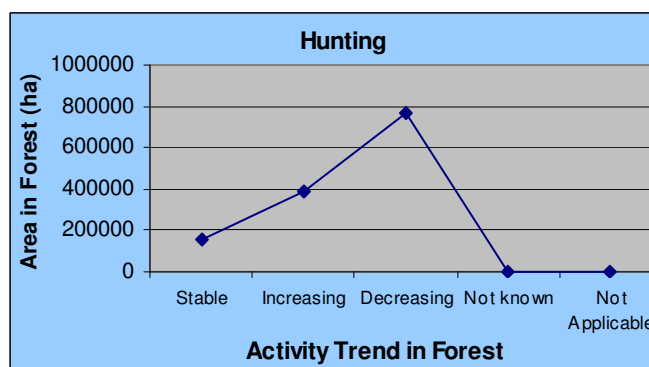
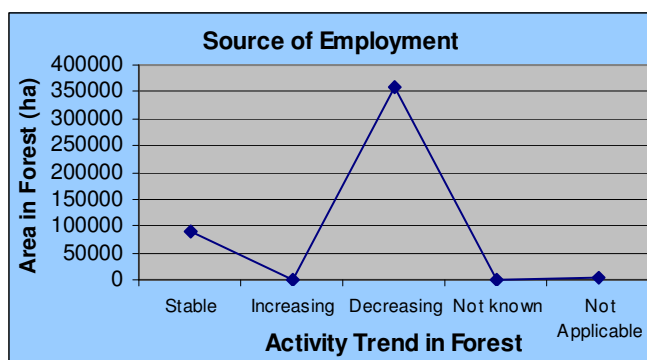
10.6.8. Activity Trend for Social, Economic and Environmental Services Provided by the Forest and Trees Outside Forest

10.6.8.1. Activity trend for social, economic and environmental services provided by the Forest

Table 8o shows that employment generation in forest and forestry-related activities has a decreasing trend. Statistics show that only about 453,000 ha of the forest have provided employment during the period of data collection. Hunting activities also have decreasing trend. This maybe attributed to the dwindling wildlife faunal resources resulting from the disturbance of their natural habitat.

Table 8o: Activity trend for social, economic and environmental services provided by the Forest

Product/Service	Activity Trend (Area in ha)						Percent in Forest
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Source for employment	90,885	0	360,511	0	1,919	453,315	6.3%
Hunting (sport)	154,202	387,777	765,960	0	0	1,307,939	18.3%
Grazing	0	9,997	22,721	0	0	32,719	0.5%
Scientific studies	0	0	0	30,093	0	30,093	0.4%
Conservation	50,492	0	0	367,580	0	418,072	5.8%
Recreation and tourism	100,984	0	0	201,967	50,492	353,442	4.9%
Religious, spiritual	0	0	0	0	0	0	0.0%
Soil & water conservation	52,612	9,089	36,455	3,819,298	41,706	3,959,160	55.3%
Wind-breaking curtains	32,416	1,313	0	130,370	10,098	174,197	2.4%

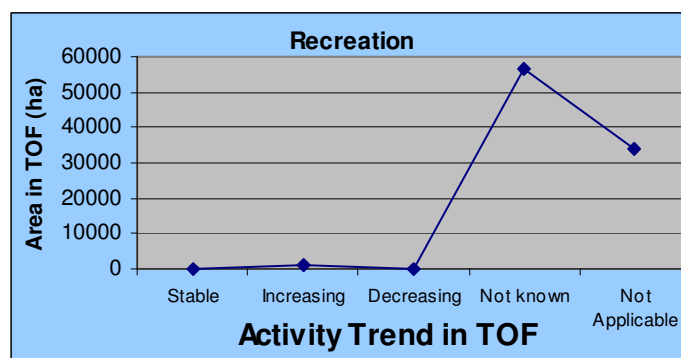
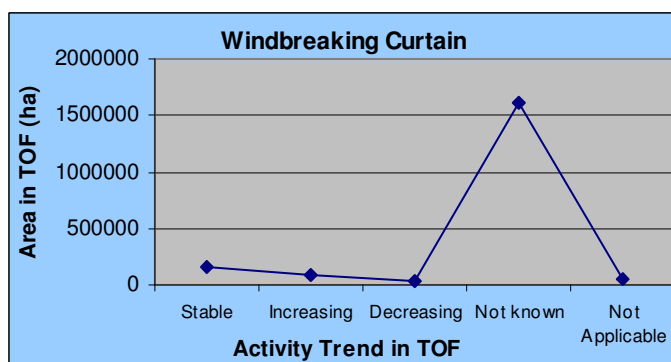
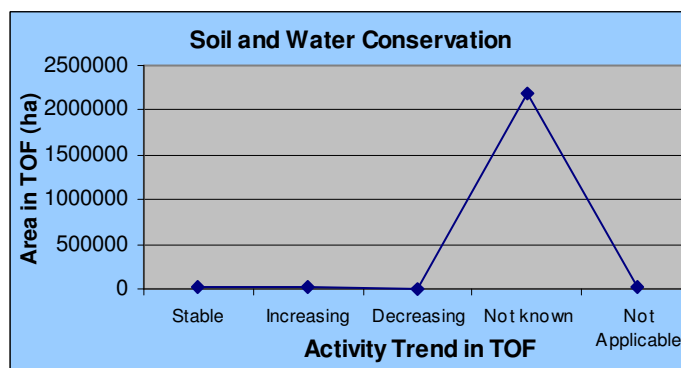
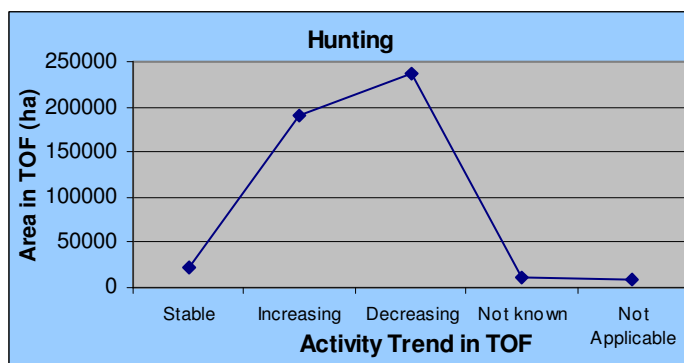
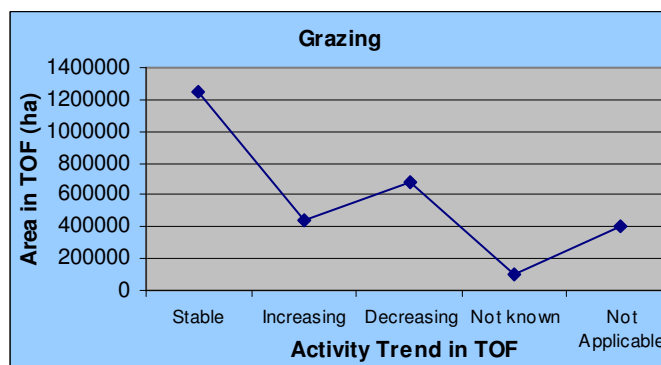
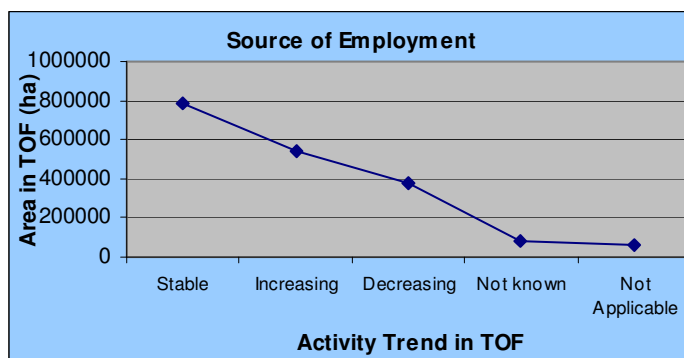


10.6.8.2 Activity trend for social, economic and environmental services provided by Trees Outside Forest

In TOF, grazing and employment have stable activity trend. Hunting activity, on the other hand, is decreasing. The remaining services have no clear activity trend.

Table 8p: Activity trend for social, economic and environmental services provided by the Forest

Services	Activity Trend (Area in ha)						Percent in TOF
	Stable	Increasing	Decreasing	Not Applicable	Not Known	Total	
Source for employment	784,650	536,806	379,805	81,180	65893	1848334	8.1%
Hunting (sport)	21,964	189,771	237,829	12,124	9664	471352	2.1%
Grazing	1,254,773	435,331	686,163	106,395	399573	2882234	12.6%
Scientific studies	0	0	0	61,676	21086	82761	0.4%
Conservation	0	0	0	13,618	0	13618	0.1%
Recreation and tourism	0	966	0	56,492	33913	91371	0.4%
Religious, spiritual	0	21,964	0	22,931	0	44895	0.2%
Soil & water conservation	23,019	18,011	0	2,193,524	15463	2250016	9.9%
Wind-breaking curtains	161,042	84,079	26,796	1,607,518	56492	1935927	8.5%



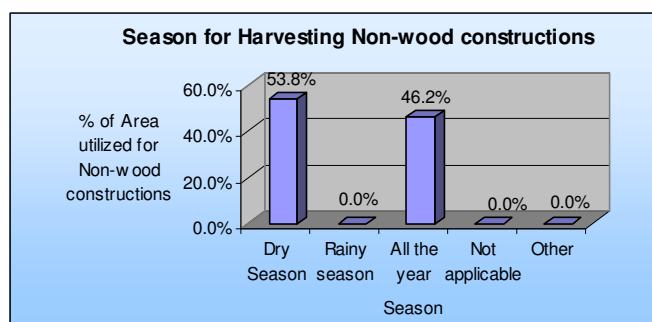
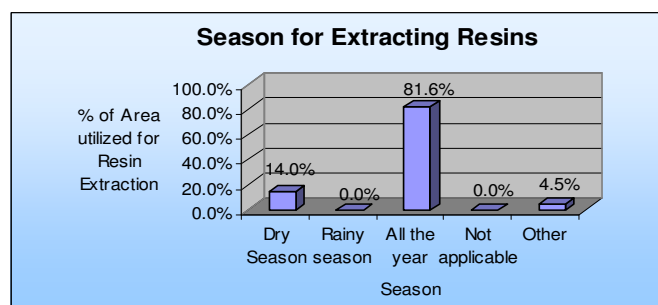
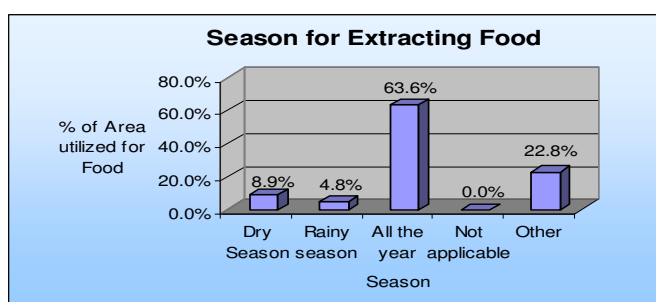
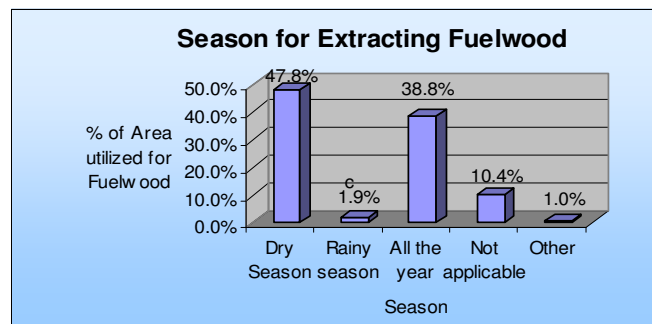
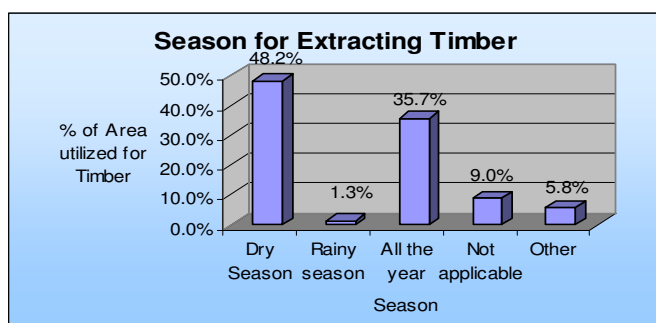
10.6.9 Season extraction of wood and non-wood products and services in Forest

10.6.9.1 Season extraction of wood and non-wood products in Forest

In Forest, timber, fuelwood, and construction materials are generally collected during the dry season. Although timber and fuelwood are also collected during the rainy season, it is only on occasional basis. Food and resin, on the other hand, are collected whole year round.

Table 8q: Season extraction of products in Forests

Product	Dry Season	Rainy season	All the year	Not applicable
Timber	48.2%	1.3%	35.7%	9.0%
Fuelwood	47.8%	1.9%	38.8%	10.4%
Food	8.9%	4.8%	63.6%	0.0%
Resin	14.0%	0.0%	81.6%	0.0%
Non-wood constructions	53.8%	0.0%	46.2%	0.0%

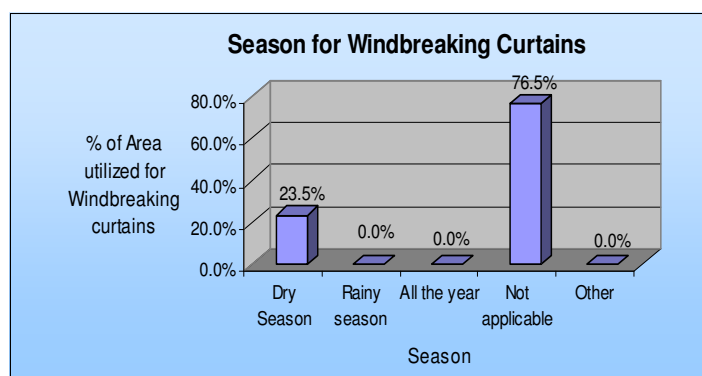
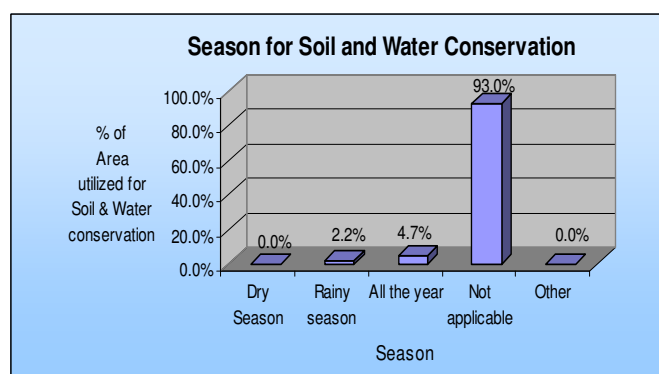
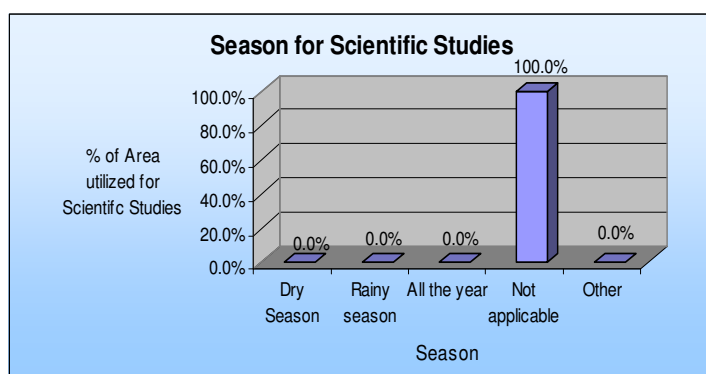
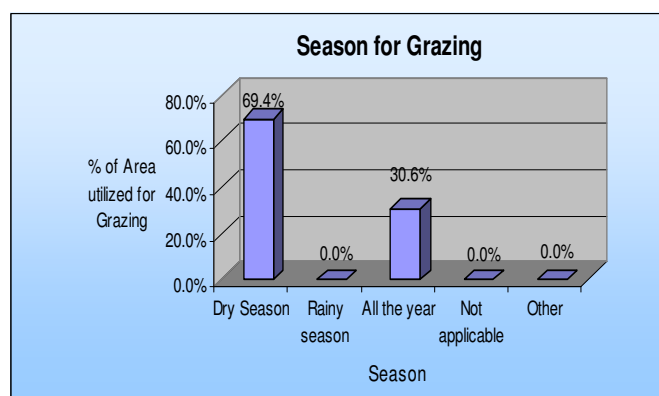
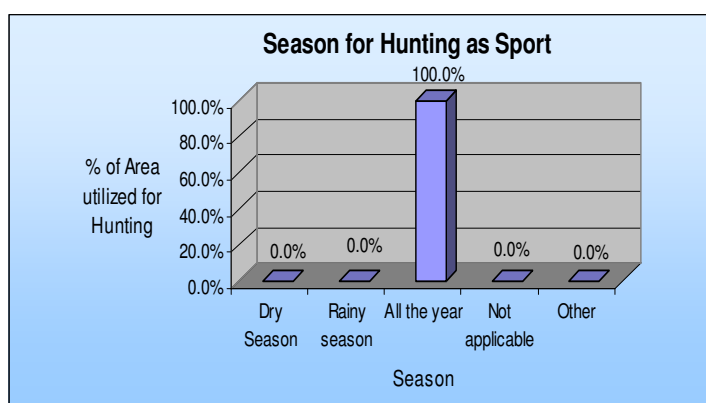


10.6.9.2 Season extraction of services in Forest

Grazing is generally carried out during the dry season while hunting and soil & water conservation give beneficial services all through out the year.

Table 8r: Season extraction of services in Forest

Services	Dry Season	Rainy season	All the year	Not applicable
Hunting (sport)	0.0%	0.0%	100.0%	0.0%
Grazing	69.4%	0.0%	30.6%	0.0%
Scientific studies	0.0%	0.0%	0.0%	100.0%
Soil and water conservation	0.0%	2.2%	4.7%	93.0%
Wind-breaking curtains	23.5%	0.0%	0.0%	76.5%



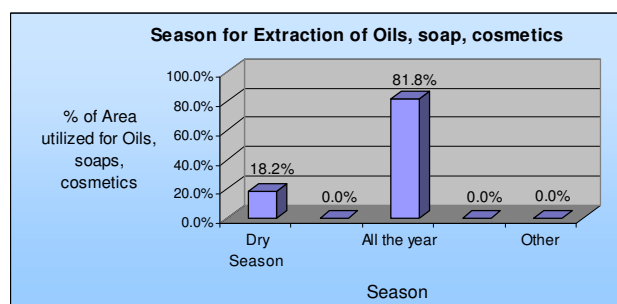
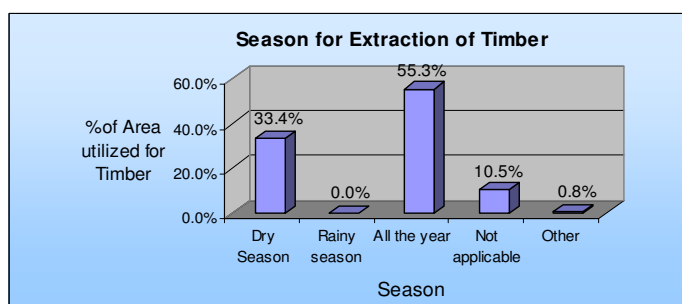
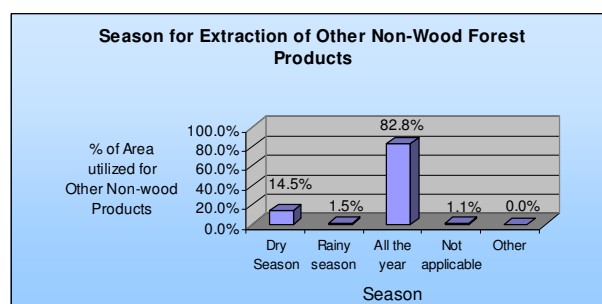
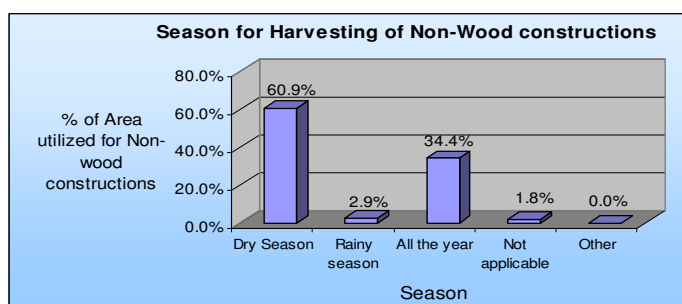
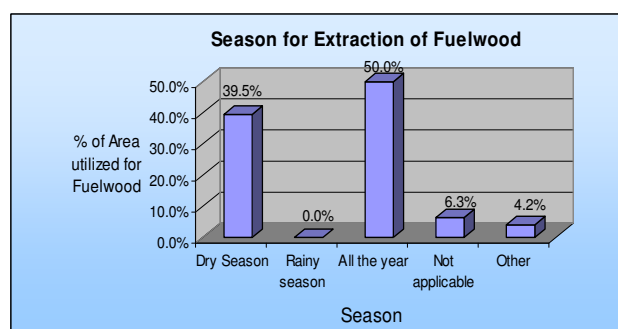
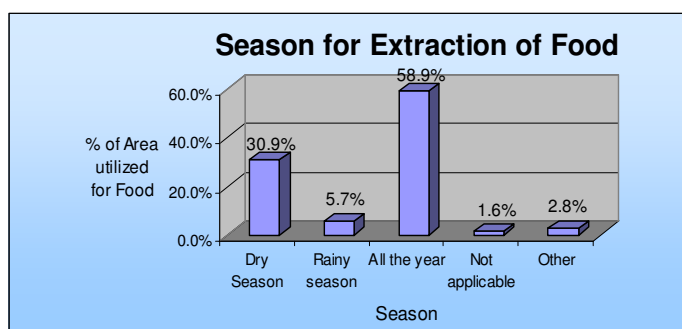
10.6.10 Season extraction of wood and non-wood products and services in Trees Outside Forest

10.6.10.1 Season extraction of wood and non-wood products in TOF

In TOF, all products provided by the forest are generally collected all through out the year except for non-wood construction materials which is collected most of the time during the dry season.

Table 8s: Season extraction of wood and non-wood products in TOF

Products	Dry Season	Rainy season	All the year	Not applicable	Other
Food	30.9%	5.7%	58.9%	1.6%	2.8%
Fuelwood	39.5%	0.0%	50.0%	6.3%	4.2%
Timber	33.4%	0.0%	55.3%	10.5%	0.8%
Oils, soap, cosmetics	18.2%	0.0%	81.8%	0.0%	0.0%
Non-wood constructions	60.9%	2.9%	34.4%	1.8%	0.0%
Other Non-wood forest products	14.5%	1.5%	82.8%	1.1%	0.0%
Fodder	35.7%	0.0%	25.4%	38.9%	0.0%

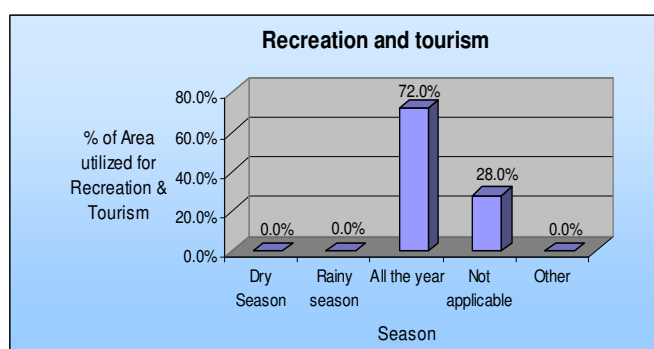
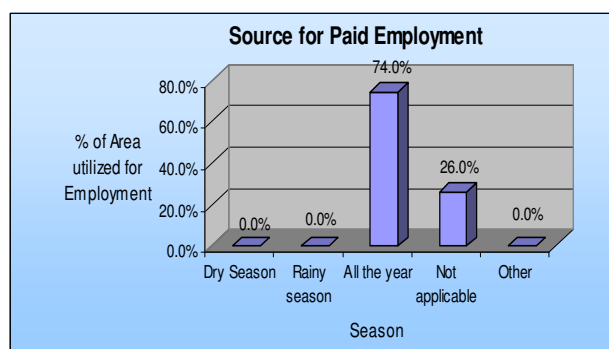
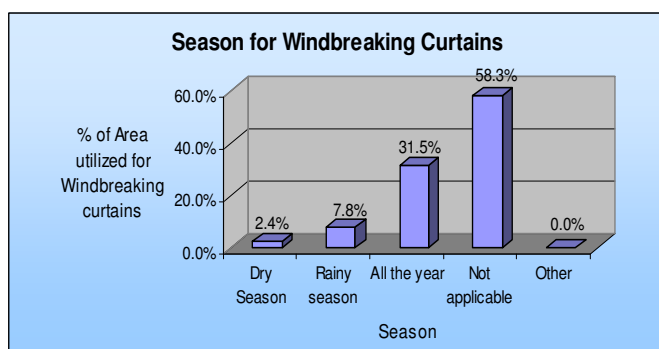
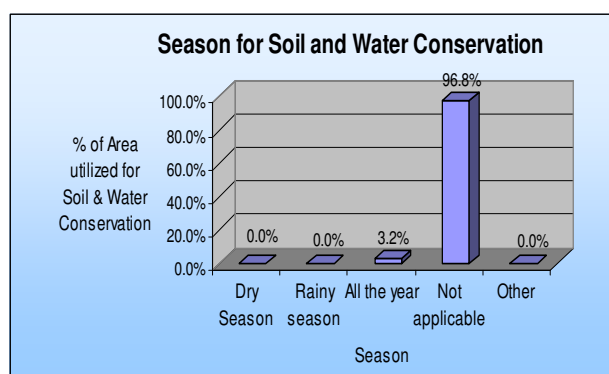
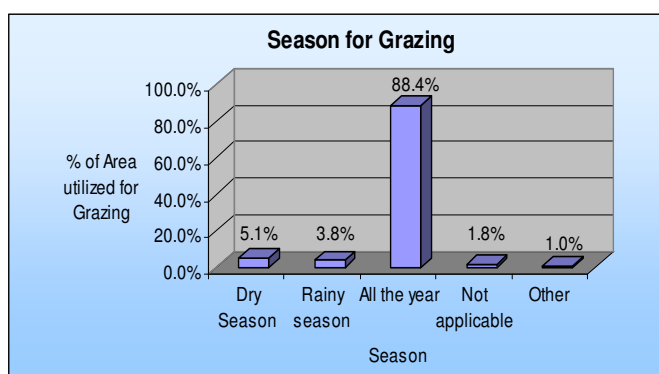


10.6.10.2 Season extraction of services in TOF

The services provided by trees outside forest are generally beneficial all through out the year except for soil and water conservation which has no clear extraction pattern.

Table 8.t: Season extraction of services in TOF

Services	Dry Season	Rainy season	All the year	Not applicable	Other
Grazing	5.1%	3.8%	88.4%	1.8%	1.0%
Soil and water conservation	0.0%	0.0%	3.2%	96.8%	0.0%
Wind-breaking curtains	2.4%	7.8%	31.5%	58.3%	0.0%
Source for employment (paid)	0.0%	0.0%	74.0%	26.0%	0.0%
Recreation & Tourism	0.0%	0.0%	72.0%	28.0%	0.0%



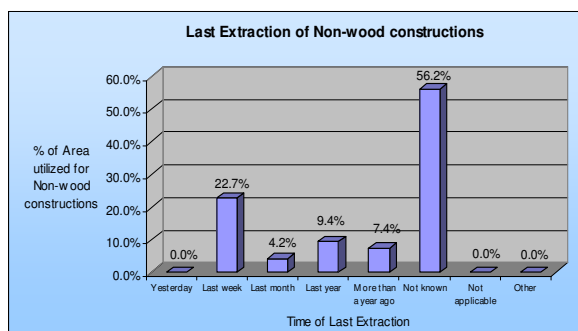
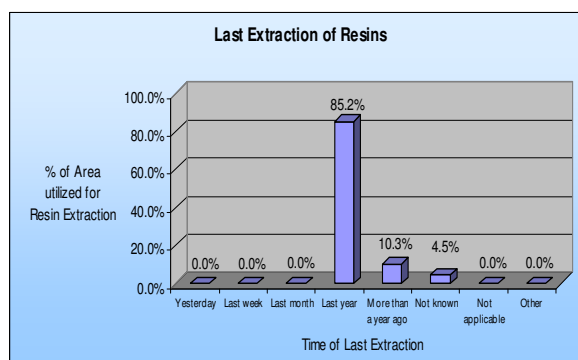
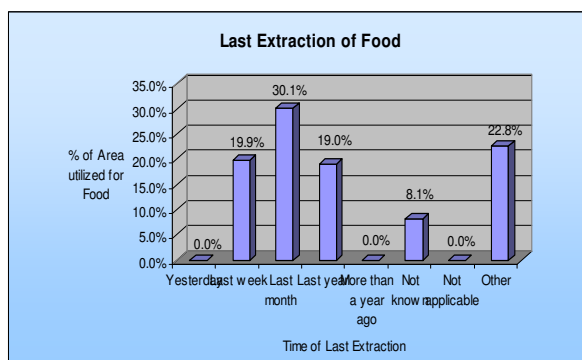
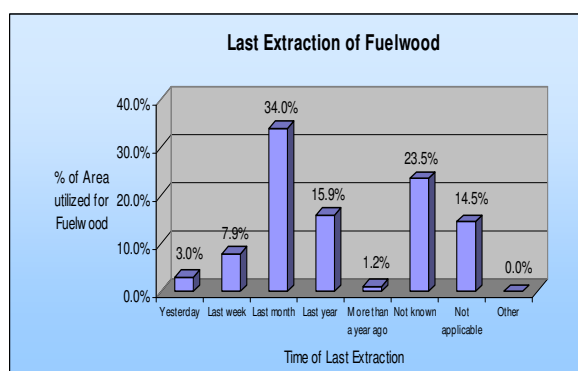
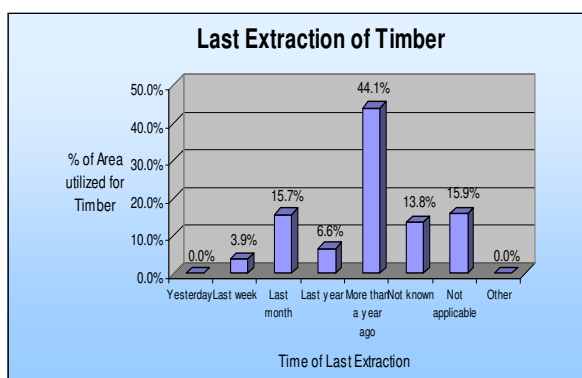
10.6.11 Last extraction of wood and non-wood products and service in Forest

Data shows that in most of the areas visited, timber extraction was carried out more than a year ago whereas food and fuelwood extraction were done mostly in the previous month.

10.6.11.1 Last extraction of wood and non-wood products in Forest

Table 8u: Last extraction of wood and non-wood products in Forest

Products	Yesterday	Last week	Last month	Last year	More than a year ago	Not known	Not applicable	Other
Timber	0.0%	3.9%	15.7%	6.6%	44.1%	13.8%	15.9%	0.0%
Firewood	3.0%	7.9%	34.0%	15.9%	1.2%	23.5%	14.5%	0.0%
Food	0.0%	19.9%	30.1%	19.0%	0.0%	8.1%	0.0%	22.8%
Resin	0.0%	0.0%	0.0%	85.2%	10.3%	4.5%	0.0%	0.0%
Non-wood constructions	0.0%	22.7%	4.2%	9.4%	7.4%	56.2%	0.0%	0.0%

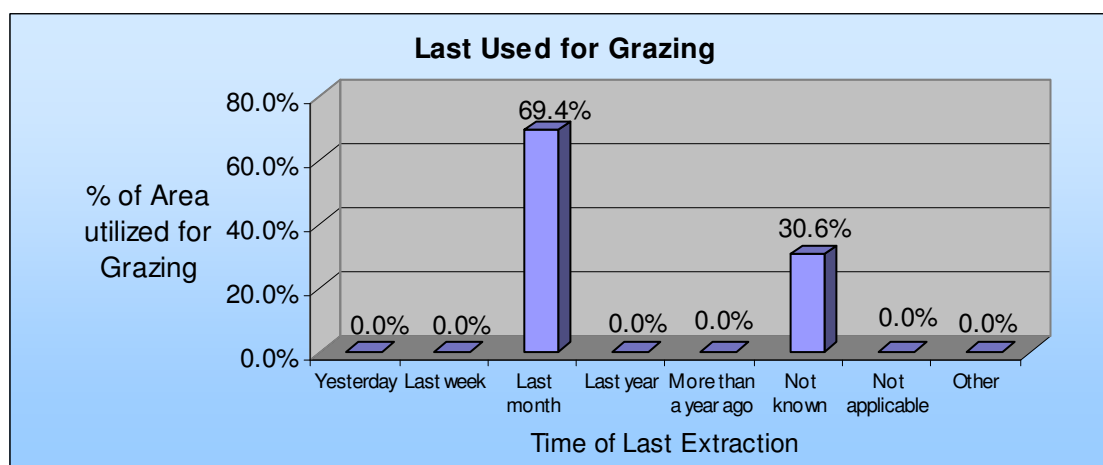
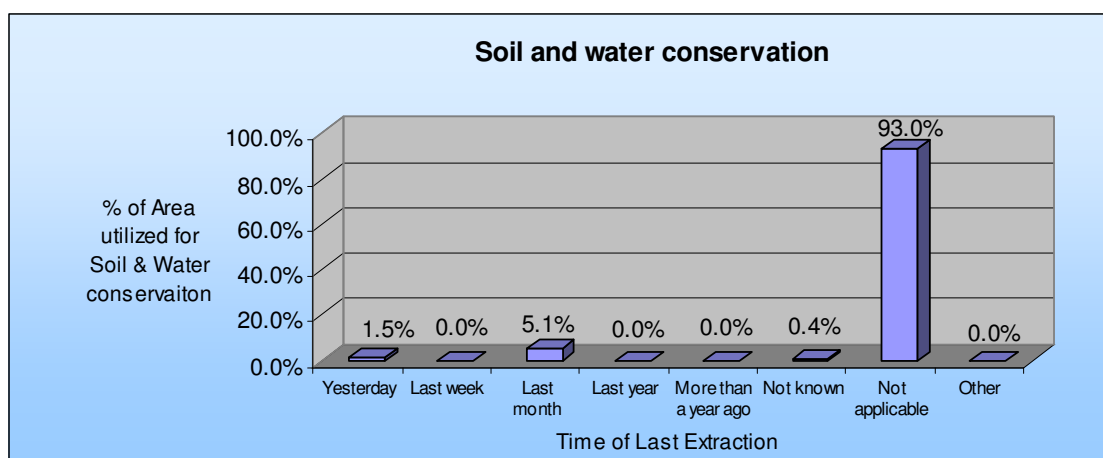


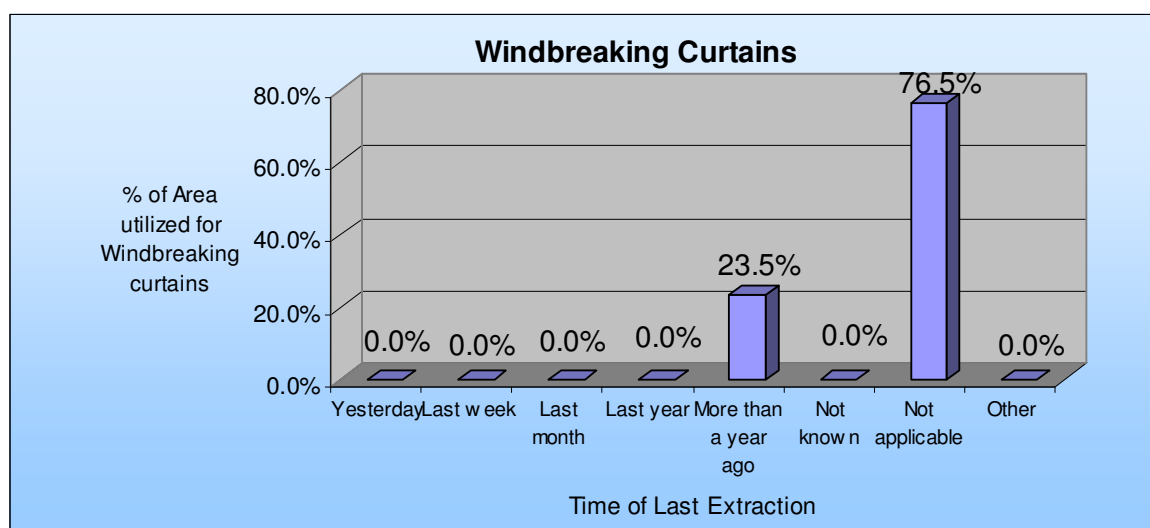
10.6.11.2 Last extraction of services provided by the Forests

Temporal information on the last extraction of most of the services provided by the forest is difficult to capture as most of these services are intangible and cannot be quantified, except for grazing which was mostly carried out in the previous month.

Table 8.v: Last extraction of services provided by the Forest

Services	Yesterday	Last week	Last month	Last year	More than a year ago	Not known	Not applicable
Soil and water conservation	1.5%	0.0%	5.1%	0.0%	0.0%	0.4%	93.0%
Grazing	0.0%	0.0%	69.4%	0.0%	0.0%	30.6%	0.0%
Wind breaking curtains	0.0%	0.0%	0.0%	0.0%	23.5%	0.0%	76.5%





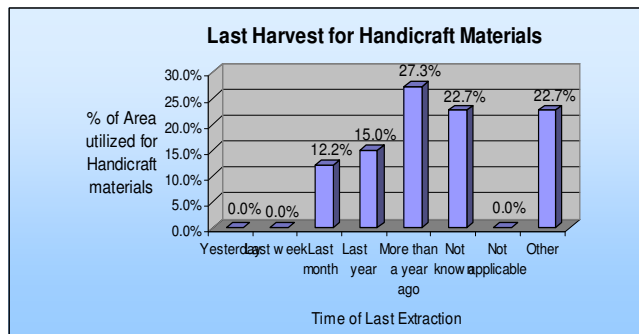
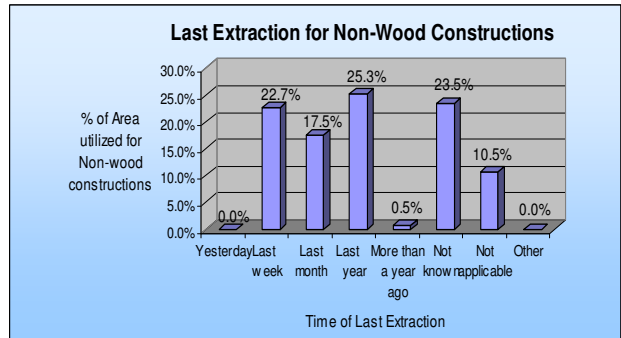
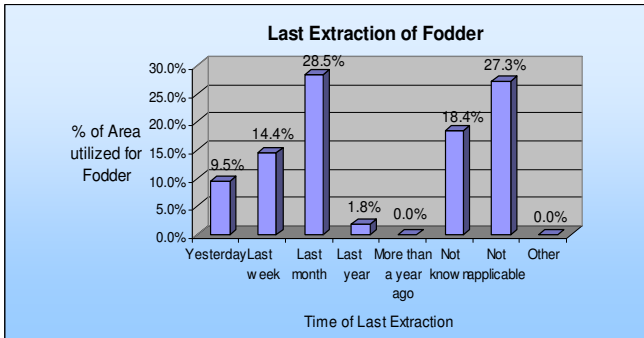
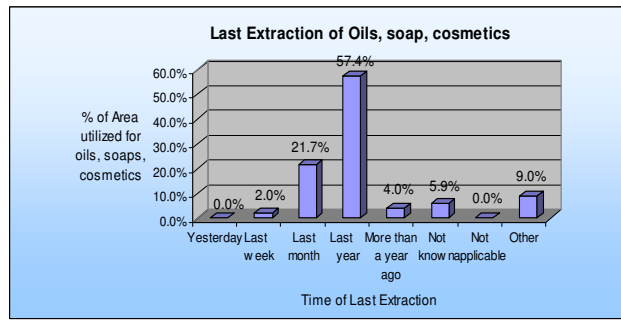
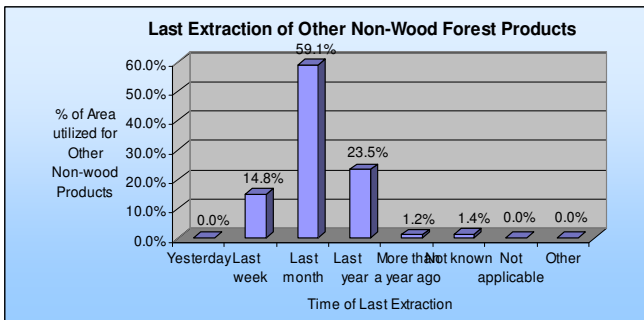
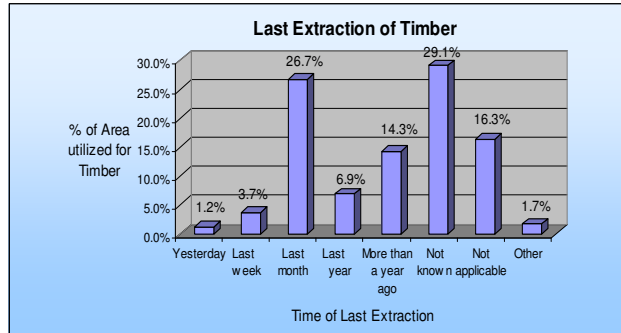
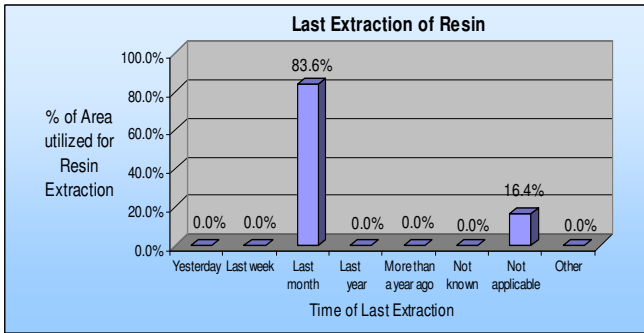
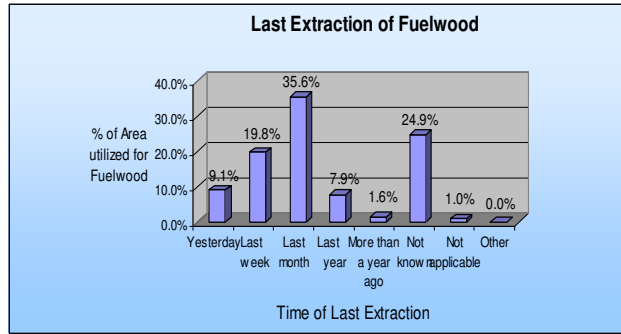
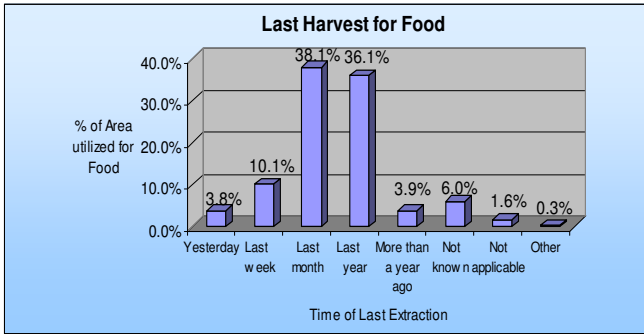
#### 10.6.12 Last extraction of wood and non-wood products and services in TOF

##### 10.6.12.1 Last extraction of wood and non-wood products provided by TOF

In most of the areas visited food, firewood, other non-wood forest products, fodder, and resin were mostly extracted in the previous month. On the other hand, most of the respondents have no concrete information when was the last extraction of timber, non-wood construction and handicraft materials.

Table 8.w: Last extraction of wood and non-wood products provided by TOF

Products	Yesterday	Last week	Last month	Last year	More than a year ago	Not known	Not applicable	Other
Food	3.8%	10.1%	38.1%	36.1%	3.9%	6.0%	1.6%	0.3%
Firewood	9.1%	19.8%	35.6%	7.9%	1.6%	24.9%	1.0%	0.0%
Timber	1.2%	3.7%	26.7%	6.9%	14.3%	29.1%	16.3%	1.7%
Oils, soap, cosmetics	0.0%	2.0%	21.7%	57.4%	4.0%	5.9%	0.0%	9.0%
Non-wood constructions	0.0%	22.7%	17.5%	25.3%	0.5%	23.5%	10.5%	0.0%
Other Non-wood forest products	0.0%	14.8%	59.1%	23.5%	1.2%	1.4%	0.0%	0.0%
Fodder	9.5%	14.4%	28.5%	1.8%	0.0%	18.4%	27.3%	0.0%
Medical products	37.6%	21.6%	29.1%	11.6%	0.0%	0.0%	0.0%	0.0%
Handicraft	0.0%	0.0%	12.2%	15.0%	27.3%	22.7%	0.0%	22.7%
Resin	0.0%	0.0%	83.6%	0.0%	0.0%	0.0%	16.4%	0.0%



## 11. Conclusions

The sampling design, although it was based on relatively low sampling intensity, has generated fundamental data that reflects the true picture of the current forest and trees resources situation at the macro-level.

The comprehensive statistical data generated on land classification and land use, including data on forest cover, forest ownership and management status, stand and volume density, biomass and carbon stock, socio-economic and other pertinent information related to forest and trees outside forest provide adequate databases and baseline information necessary in decision making and in the formulation of national forest policies, plans and programmes as well as in programme evaluation.

## 12. Recommendations

### 12.1 Monitoring of the resources

The provision of timely, reliable and accurate information is essential for sound environmental policy formulation and resource management. Access to reliable information could enable policy makers and resource planning managers to render sound decisions on how forest resources should be effectively managed.

The regular implementation of national forest assessment could help ensure the availability of recent and reliable data and information that are essential to policy makers and resource planning managers.

National forest assessment therefore should be institutionalized in the DENR department in order to have a consistent basis of information necessary for informed decision-making. This can also provide up-to-date information that would support other present requirements and future needs to report trends in the country's forest and trees resources.

In this regard, it is recommended that FAO-FORM should continually provide support and collaborate with countries that have implemented the NFA approach particularly when revisiting the tracts in order to provide guidance on how to further build the capacity of the implementing organization and update them of recent developments related to the NFA approach. It is also requested that FAO-FORM should financially support the immediate conduct of a complementary forest inventory in the legally classified forestland that would increase the sampling intensity and provide a better picture of forest situation in the area.

### 12.2 Additional information needs and data collection with more intensive sampling

In the Philippines, one of the major potentials of the forestry sector that would contribute to the development of the country both economically and ecologically, as identified in the Philippine Master Plan for Forestry Development (PMPFD), is the expansion of forest through plantation establishment, enrichment planting and assisted natural regeneration. Various modes of plantation development have been adopted to encourage greater public participation and accelerate the plantation development efforts in the country.

Applicable tenurial instruments have been issued to qualified individuals, associations/organizations and corporations including government agencies and government-controlled corporations in order to accelerate the implementation of the program. At present, about 7.5 million hectares of legally forestlands are covered by various tenurial instruments. There are 195 Integrated Forest Management Agreements (IFMA) issued covering a total area of 704,328 hectares and a total of 126,822 hectares planted so far with forest and fruit trees. There are 1,643 Socialized IFMAs (SIFMA) with a total area of 4,269.29 hectares planted so far. A total of 5,322 Community-based Forest Management (CBFM) project sites covering a total project area of 3.43 million hectares have been granted to at least 591,360 families. Of these, about 1.7 million hectares are covered by 1,577 CBFM Agreements granted to organized local communities.

The information generated by the NFA project shows that the country has approximately 620,000 ha of established plantation. The sampling error, however, is quite high. This may be attributed to the relatively low sampling intensity (0.0026%) whereby a tract measuring 1 km x 1 km represents about 38,000 ha.

In this regard, it is recommended that an inventory of established plantation at a higher sampling intensity (5%) should be implemented in collaboration with FAO-FORM in order to increase the level of precision and reflect the actual situation in the field.

### 12.3 Actions for Resources Development

The Philippine Forestry Statistics until 1997 had been using the results of the 2<sup>nd</sup> national forest inventory carried out from 1969 to 1987 as base data in projecting, based on experts' opinion, the country's land use/land cover information. The level of precision of the projected data, therefore, is dependent on the reliability of the projection model used.

Although the NFA approach is based on relatively low sampling intensity, the information generated is highly reliable. It can serve as basis for the FMB to update its statistics.

The NFA results could also serve as basis in revisiting existing environmental laws, policies and regulations so that they match with existing resources and capabilities to help improve the performance of the agency in the management of the countries forest resources.

Data on commercial volume could help rationalize the establishment/maintenance of wood processing plants in proportion to wood supply.

Data on plantation will provide information on the extent of established plantation and harvestable volume that would replace wood supply coming from natural forest, in case logging ban will be totally banned in the natural forest. Based from this information, FMB could initiate a plantation investment program and incentives portfolio to be made available to any and all interested parties with a demonstrated commitment to implement plantation establishment.

## 12.4 International Reporting

The Philippines is a signatory to different forestry-related international processes and instruments like the Convention on Biological Diversity (CBD), United Nations Framework Convention on Climate Change (UNFCCC), International Tropical Timber Agreement (ITTA), United Nations Convention to Combat Desertification (CCD), ASEAN Agreement on Trans-boundary Haze Pollution, etc. As a consequence, the country has an obligation to regularly report to these international bodies.

The forestry terms and definitions adopted by the NFA approach are in harmony with the terms and definitions adopted by most of these international processes. Further, the NFA approach includes variables that generate some of the data and information requirements by these international processes.

## **13. Comparison and Contrast between the NFA Approach and the Second National Forest Inventory (RP-German FRI Project), and NFA Land Use/Forest Cover Data vs. NAMRIA Land Use/Forest Cover Data**

### 13.1 Second Forest Resources Inventory (RP-German Project)

The second national forest inventory was conducted from 1979 to 1988. It was a bilateral project between the Government of the Philippines (GOP) and the federal Republic of Germany. The project was assisted by the Deutsche Forstinventur-Service (DFS) under commission of the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH.

#### 13.1.1 Inventory Design

The RP-German FRI Project adopted a two-stage inventory design using aerial photographs or satellite imagery for obtaining an area frame, and clusters of angle-count samples together with concentric circles for collecting stand and stock data of the most important forest strata. In the first stage, all natural forest areas in the Philippines were mapped using aerial photographs. In the second stage, all economically relevant forest types (dipterocarp and pine forests) were sampled in the field using a stratified restricted random sampling design.

Depending on the forest type to be inventoried, two different field sampling units have been adopted: 6-point clusters in dipterocarp forests and 3-point clusters in pine forest.

The 6-point cluster consisted of a triangular arrangement of 6 record units. One corner of the equivalent triangle pointed towards the south. The sides of the triangle measured 100m in length. The record units were evenly distributed along the perimeter of the triangle and consequently numbered from 1 to 6 starting with the southern corner. All record units comprised an angle-count sample (ACS) using a basal area factor (BAF) of 9 m<sup>2</sup>/ha where all trees with a dbh of ≥15 cm were included. In addition to the ACS, record

units 1, 3 and 5 encompassed each 2 concentric circular plots of 2 m and 5 m radius, respectively. Within the 2m radius circular plot, the regeneration of trees with dbh of < 5cm and with a total height of at least 1.3 m, as well as bamboo and erect palms were enumerated. Regeneration of trees with dbh from 5 cm to 15 cm and rattan were surveyed within the 5 m radius circular plot.

The 3-point cluster consisted of a triangular arrangement of 3 record units. One corner of the equilateral triangle points toward the south. The sides of the triangle measured 75 m in length. The record units were located at the corners of the triangle and consequently numbered from 1 to 3 starting with the southern corner. All record units comprised an ACS using a BAF of 4 m<sup>2</sup>/ha where all trees with dbh of ≥15 cm were included. In addition to the ACS, all record units encompassed each 2 concentric circular plots of 2 m and 5 m, respectively where tree regeneration and eventual rattan and bamboo occurrence were inventoried following the same principles described for the 6-point cluster.

Two thousand six hundred and twenty-seven (2,627) sample clusters were measured during the project, including 726 strip samples in Region 10 and 11 following the FAO design (systematic sampling at 8 km x 8 km).

#### 13.1.2 Data Processing and Data Analysis

Area calculation and timber volume estimation were done not only at the national level but also at the sub-regional level (per region and per province).

- Forest area

The area calculation was based on approximately 300,000 dot counts, keeping the measurement error way below the ±1% for most forest strata. Both classified forest land and certified A&D land have been stratified and mapped.

- Timber volume

Based on 1,901 angle-count sampling units, the total gross volume inside bark had been estimated with a standard error of ±0.7% (simple) or ±1.5% at 95% probability.

### 13.2 Comparison of Results (NFA-Philippines Project vs. RP-German Project)

#### 13.2.1 Land Use and Forest Types

Land use/forest type cannot be compared between the NFA-Philippines Project and the RP-German Project because the two projects adopted different land use classification system.

Table 9a: Land use/ forest cover classification system (NFA Project &amp; RP-German Project)

Land Use/ Land Cover Classification	
NFA Project	RP-German Project
Forest	
Closed broad-leaved forest	Dipterocarp forest, old growth
Open broad-leaved forest	Dipterocarp forest, residual forest
Closed coniferous forest	Pine forest, closed
Open coniferous forest	Pine forest, open
Closed mixed forest	Mossy forest
Open mixed forest	Submarginal forest
Closed broad-leaved plantation	Forest plantations
Open broad-leaved plantation	
Closed coniferous plantation	
Open coniferous plantation	
Closed bamboo/boho formation	
Open bamboo/boho formation	
Closed mangrove forest	Mangrove, old growth
Open mangrove forest	Mangrove, reproduction
Other Wooded Land	Brushland
Shrubs	
Fallow	
Wooded grassland	
Other Land	Other land use
Barren land	
Lahar	
Grassland	
Marshland	
Annual crop	
Perennial crop	
Pastures	
Built-up area	
Primary paved road	
Primary unpaved road	
Inland Water	
Inland water pond	
Fishpond	

### 13.2.2 Forest Area

Prior to the NFA project, *FOREST* was defined as areas of one hectare or more which are at least 10 percent stocked with forest trees (including seedlings and saplings), wild palm, bamboo, or brush. Narrow strips of land bearing forest must be at least 60 meters wide and one hectare in size to qualify as forest. Industrial tree plantations and tree farms one hectare or more in size are also included. (Source: 1978 Philippine Forestry Statistics)

Inasmuch as the two projects adopted different land use/land cover classification system, it is not possible to make comparison by forest type; however, it is possible in total area of forest. Based on the RP-German Project (1988), the country's forest cover was 6.46 million hectares or 21.5%. On the other hand, the NFA Project (2004) shows that the country's forest is about 7.16 million hectares or 23.9%. This shows an increase of about 0.7 million hectares.

Table 9b: Forest area (NFA Project vs RP-German Project)

Forest Area (ha)		
NFA Project	RP-German Project	Difference
7,162,560	6,460,600	+701,960

Table 9.b shows that between 1988 and 2004, for a period of 16 years, the country's forest cover increased by about 702,000 ha or an average increase per year of 43,872 ha. The increase in forest cover could be attributed to the citizenry's increased awareness in plantation establishment and the decrease in the number of existing timber license agreements (TLA) from 120 TLAs covering 4.74 million ha in 1988 to 16 TLAs covering 0.66 million ha in 2003, resulting to the significant reduction in forest loss.

### 13.2.3 Timber Volume in Forest

#### 13.2.3.1 Gross/Bole Volume

Data on gross volume between the NFA Project and the RP-German Project are not comparable because they used different diameter limit in the calculation of gross/bole volume. In the NFA Project, the diameter limit is  $\geq 10$  cm whereas in the RP-German Project, it was  $\geq 15$  cm. Further, in the NFA Project all forest types were included in the calculation of gross volume whereas in the RP-German Project, it was confined only to the productive forests (dipterocarp and pine).

Table 9c: Data on gross volume (NFA Project vs. RP-German Project)

Gross/Bole Volume (in million m <sup>3</sup> )	
NFA Project ( $\geq 10$ cm)	RP-German Project ( $\geq 15$ cm)
1,247.86	744.07

#### 13.2.3.2 Commercial Volume

At the same time, data on commercial volume between the NFA Project and the RP-German Project are not comparable because they also used different diameter limit in the calculation of commercial volume. In the NFA Project, the diameter limit is  $\geq 50$  cm whereas in the RP-German Project, it was  $\geq 55$  cm.

Table 9d: Data on commercial volume (NFA Project vs. RP-German Project)

Commercial Volume (in million m <sup>3</sup> )	
NFA Project ( $\geq 50$ cm)	RP-German Project ( $\geq 55$ cm)
386.96	253.55

### 13.2.4 Timber Volume in TOF

The RP-German Project has no data on timber volume in trees outside forest.

### 13.3 Comparison of Land Use/Forest Cover Data (NFA Project vs. NAMRIA)

In 2003, NAMRIA, through its Remote Sensing and Resource Data Analysis Department (RSRDAD) came up with the Land Use/Forest Cover data through the interpretation of 2002 Landsat imageries. In the interpretation, NAMRIA adopted the land use classification system used in the NFA Project. Comparison of data between NAMRIA and the NFA Project is shown in Table 9.e.

Table 9e: Land use/forest cover data (NFA Project vs. NAMRIA)

Land Use	Area (ha)		
	NFA Project	NAMRIA	Variance
Forest	7,162,560	7,168,400	5,840
Other Wooded Land	3,611,204	7,589,260	3,978,056
Other Land	18,423,641	14,943,856	3,181,301
Inland Water	802,595	298,484	504,111
Total	30,000,000	30,000,000	

It can be observed in Table 9e that in land use classified as Forest, the NFA data and NAMRIA data have a difference of only about 5,840 ha. However, in the other land use classes, the variance is quite high.

The significant variance in the other land use classes may be attributed to the resolution of the Landsat. A picture element (pixel) covers an area of 900 m<sup>2</sup> (30m x 30); therefore, small land use sections were not captured in the imagery. In inland water, the variance may be attributed to the fact that NAMRIA considered only major rivers and lakes whereas in the NFA Project even those river systems with a width  $\geq$  5 meters were classified as inland water.

In April 2004, the NFA Project forwarded to NAMRIA the results of its land use classification in 87 tracts, for comparison with the NAMRIA interpretation. The results of the comparison showed that NAMRIA achieved a 91% accuracy rate.

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**Annex 1: Volume equations used in Philippine forestry**

Volume Equation Code	Region	Dipterocarp Species (Volume = ...)	Non-Dipterocarp Species (Volume = ...)
A	CAR, 1, 2, 3	0.00005203 (D <sup>2</sup> H)	0.00005109 (D <sup>2</sup> H)
B	4 & 5, except Palawan	0.00005171 (D <sup>2</sup> H)	0.00005204 (D <sup>2</sup> H)
C	8 and Bohol	0.00005231 (D <sup>2</sup> H)	0.00004874 (D <sup>2</sup> H)
D	6,7 and Palawan	0.00004649 (D <sup>2</sup> H)	0.00004874 (D <sup>2</sup> H)
E	Eastern Mindanao (Portion of Agusan east of Agusan River, Davao & Surigao)	0.00005087 (D <sup>2</sup> H)	0.00004961 (D <sup>2</sup> H)
F	Central Mindanao (Bukidnon, Cotabato, Lanao, Misamis, & Portion of Agusan west of Agusan River)	0.00005019 (D <sup>2</sup> H)	0.00005039 (D <sup>2</sup> H)
G	Western Mindanao (Basilan, Sulu & Zamboanga)	0.00004668 (D <sup>2</sup> H)	0.00004840 (D <sup>2</sup> H)

\*Note: D is measured in cm, H is measured in m

**Annex 2: Sampling error in land use area calculation**

Land use area	No. of samples	Area of Samples (ha)	Sampling error (%)
<b>A. Area</b>			
<b>1. Area by land use</b>			
Forest	169	166.116	7.92
Other wooded Land	136	83.752	10.21
Other Land	299	427.286	3.38
Inland Water	110	18.614	20.72
<b>2. Area by forest type</b>			
Closed broadleaved forest	90	99.418	6.81
Open broadleaved forest	66	40.4	14.12
Closed coniferous forest	2	1.03	70.41
Open coniferous forest	4	3.874	63.0
Closed mixed forest	1	0.42	100.5
Open mixed forest	1	1.5	99.54
Closed broadleaved plantation	17	6.456	33.81
Open broadleaved plantation	28	7.846	31.98
Closed coniferous plantation	1	0.2	100.29
Open coniferous plantation	1	0.044	99.6
Closed bamboo/boho formation	8	2.602	46.26
Open bamboo/boho formation	7	1.384	47.18
Closed mangrove forest	1	0.72	100.28
Open mangrove forest	2	0.222	75.419
<b>3. Area of Forest by Ecological Zone</b>			
Forest in Tropical Rain Forest	165	161.4	1.74
Forest in Tropical Mountain System	4	4.716	59.41
<b>4. Area of Forest by Management System</b>			
Formal	30	48.772	15.52
Not Known	143	117.344	6.45
<b>5. Area of Forest by Ownership</b>			
State owned	128	141.172	3.04
Privately owned	57	24.224	17.7
<b>6. Area of Forest by Protection/Designation Status</b>			
Production	143	126.688	5.85
Natural Reserve	12	12.468	123.70
National Park	3	6	511.71
National Monument	-	-	-
Managed Protected Area	17	20.96	77.33
<b>7. Area of forest by Stand Structure</b>			
1-layer	63	22.926	30.6
2-layer	76	49.886	18.57
3-layer	49	45.256	27.17
>3-layer	38	48.048	32.84

### Annex 3: Sampling error in gross volume calculation by land use area

	Area	Gross Volume	SeR %	Comm Volume	SeR %
<b>1. Volume by Land Use</b>					
Forest	141.856	24714.107	8.78	7663.757	17.80
Other wooded Land	80.202	1763.996	12.05	309.646	21.89
Other Land	423.062	8465.89	9.04	558.492	15.84
Inland Water	16.614	82.926	40.72	15.591	60.61
<b>2. Volume by Forest Type</b>					
Closed broadleaved forest	85.792	18998.959	9.69	6246.059	20.21
Open broadleaved forest	33.89	4284.886	11.43	1059.196	21.09
Closed coniferous forest	0.91	247.148	13.80	111.931	20.67
Open coniferous forest	1.37	305.788	36.66	184.475	48.20
Closed mixed forest	0	0	0	0	0
Open mixed forest	0.42	25.283	0	1.04	0
Closed broadleaved plantation	6.456	345.649	14.77	11.22	239.34
Open broadleaved plantation	7.846	274.421	26.89	11.127	0
Closed coniferous plantation	0.2	24.326	0	6.439	0
Open coniferous plantation	0.044	0	0	0.044	0
Closed bamboo/boho formation	2.602	98.283	52.69	31.07	86.08
Open bamboo/boho formation	1.384	7.939	39.01	1.191	105.72
Closed mangrove forest	0.72	88.994	0	0	0
Open mangrove forest	0.222	12.426	42.84	0	0
<b>3. Volume by Ecological Zone</b>					
Tropical Rain Forest	138.26	23953.08	8.99	7491.481	18.22
Tropical Mountain System	2.596	761.029	14.81	172.277	15.46
<b>4. Volume by Forest Management System</b>					
Formal	44.752	11473.528	14.2	4234.489	28.16
Not Known	97.104	13240.58	9.2	3429.269	15.52
<b>5. Volume by Ownership</b>					
State owned	22.244	2288.346	21.96	723.30	42.15
Privately owned	119.252	22388.364	9.26	6939.933	18.99
Municipality owned	0.22	23.171	0	0.525	0
Community owned	0.14	14.227	0	0	0
<b>6. Volume by Protection/Designation Status</b>					
Production	106.762	15715.853	7.49	4399.729	13.09
Natural Reserve	12.468	3166.392	20.43	812.322	37.35
National Park	6.0	3196.101	39.63	1840.248	52.61
National Monument	-	-	-	-	-
Managed Protected Area	16.626	2635.761	17.07	611.458	30.61
<b>7. Volume by Stand Structure</b>					
1-layer	18.692	1120.52	17.51	191.178	45.7
2-layer	41.48	5719.297	12.64	1818.982	24.05
3-layer	35.636	6228.061	11.99	1597.747	19.84
>3-layer	46.048	11646.229	13.79	4055.851	28.91

**Annex 4: Trees species outside forests**

Order	Scientific name	Common name	Number	%
1	<i>Cocos nucifera</i>	Coconut	9458	50.1%
2	<i>Gmelina arborea</i>	yemane	1078	5.7%
3	<i>Mangifera indica</i>	mangga	537	2.8%
4	<i>Leucaena leucocephala</i>	ipil-ipil	448	2.4%
5	<i>Artocarpus blancoi</i>	antipolo	269	1.4%
6	<i>Macaranga tanarius</i>	binunga	237	1.3%
7	<i>Sandoricum koetjape</i>	santol	229	1.2%
8	<i>Artocarpus heterophylla</i>	nangka	215	1.1%
9	<i>Swietenia macrophylla</i>	big-leafed mahogany	204	1.1%
10	<i>Ficus nota</i>	tibig	200	1.1%
11	<i>Syzygium cumini</i>	duhat	188	1.0%
12	<i>Pterocarpus indicus</i>	narra	185	1.0%
13	<i>Polyscias nodosa</i>	bongliw	170	0.9%
14	<i>Trema orientalis</i>	anabiong	148	0.8%
15	<i>Samanea saman</i>	raintree	143	0.8%
16	<i>Alstonia macrophylla</i>	batino	133	0.7%
17	<i>Gliricida sepium</i>	madre-cacao	131	0.7%
18	<i>Persea americana</i>	avocado	126	0.7%
19	<i>Albizia procera</i>	akleng-parang	123	0.7%
20	<i>Chrysophyllum cainito</i>	starapple	120	0.6%
21	<i>Theobroma cacao</i>	cacao	112	0.6%
22	<i>Shorea contorta</i>	white lauan	96	0.5%
23	<i>Tamarindus indica</i>	sampalok	91	0.5%
24	<i>Pterocymbium tinctorium</i>	taluto	82	0.4%
25	<i>Bauhinia monandra</i>	fringon	81	0.4%
26	<i>Vitex parviflora</i>	molave	81	0.4%
27	<i>Melanolepis multiglandulosus</i>	alim	80	0.4%
28	<i>Anacardium occidentale</i>	kasui	80	0.4%
29	<i>Erythrina orientalis</i>	dap-dap	77	0.4%
30	<i>Artocarpus communis</i>	rimas	76	0.4%
31	<i>Antidesma ghaesembilla</i>	binayuyu	75	0.4%
32	<i>Artocarpus odoratissimus</i>	marang	68	0.4%
33	<i>Lagerstroemia speciosa</i>	banaba	67	0.4%
34	<i>Kleinhovia hospita</i>	bitan-ag	67	0.4%
35	<i>Ficus variegata</i>	tangisang bayawak	64	0.3%
36	<i>Ceiba pentandra</i>	kapok	62	0.3%
37	<i>Nauclea orientalis</i>	bangkal	60	0.3%
38	<i>Canarium asperum</i>	pagsahingin	60	0.3%
39	<i>Leucaena</i>		59	0.3%
40	<i>Paraserianthes falcataria</i>	Moluccan sau	57	0.3%
41	<i>Ficus minahassae</i>	hagimit	55	0.3%
42	<i>Alstonia scholaris</i>	dita	53	0.3%
43	<i>Antidesma bunius</i>	bignai	51	0.3%
44	<i>Ficus septica</i>	haulii	50	0.3%
45	<i>Buchanania arborescens</i>	balinghasai	46	0.2%
46	<i>Macaranga grandifolia</i>	bingabing	46	0.2%
47	<i>Streblus asper</i>	kalios	46	0.2%
48	<i>Wrightia laniti</i>	lanete	45	0.2%
49	<i>Litsea perrottetii</i>	bakan	44	0.2%

50	<i>Pithecellobium dulce</i>	kamachile	44	0.2%
51	<i>Artocarpus ovata</i>	anubing	43	0.2%
52	<i>Cananga odorata</i>	ilang-ilang	42	0.2%
53	<i>Colona serrafolia</i>	anilau	40	0.2%
54	<i>Piliostigma malabaricum</i>	alibangbang	36	0.2%
55	<i>Leucosyke capitellata</i>	alagasi	35	0.2%
56	<i>Myristica philippinensis</i>	duguan	35	0.2%
57	<i>Psidium guajava</i>	bayabas	34	0.2%
58	<i>Cordia dichotoma</i>	anonang	33	0.2%
59	<i>Lansium domesticum</i>	lansones	33	0.2%
60	<i>Spondias purpurea</i>	sineguelas	33	0.2%
61	<i>Dipterocarpus grandiflorus</i>	apitong	32	0.2%
62	<i>Securinega flexuosa</i>	anislag	31	0.2%
63	<i>Koordersiodendron pinnatum</i>	amugis	29	0.2%
64	<i>Ficus balete</i>	balete	29	0.2%
65	<i>Annona muricata</i>	guyabano	29	0.2%
66	<i>Intsia bijuga</i>	ipil	29	0.2%
67	<i>Lithocarpus llanosii</i>	ulayan	29	0.2%
68	<i>Combretodendron quadrialatum</i>	toog	28	0.1%
69	<i>Parashorea plicata</i>	bagtikan	27	0.1%
70	<i>Citrus grandis</i>	lukban	27	0.1%
71	<i>Shorea squamata</i>	mayapis	27	0.1%
72	<i>Hevea brasiliensis</i>	para rubber	26	0.1%
73	<i>Melia dubia</i>	bagalunga	24	0.1%
74	<i>Syzygium nitidum</i>	makaasim	24	0.1%
75	<i>Canarium ovatum</i>	pili	24	0.1%
76	<i>Radermachera pinnata</i>	banai-banai	23	0.1%
77	<i>Macaranga bicolor</i>	hamindang	23	0.1%
78	<i>Palaquium luzoniense</i>	nato	23	0.1%
79	<i>Coffea arabica</i>	kafe	22	0.1%
80	<i>Toona calantas</i>	kalantas	22	0.1%
81	<i>Artocarpus odoratissima</i>	marang-banguhan	22	0.1%
82	<i>Teijsmanniodendron ahernianum</i>	sasalit	22	0.1%
83	<i>Octomeles sumatrana</i>	binuang	21	0.1%
84	<i>Averrhoa bilimbi</i>	kamias	21	0.1%
85	<i>Parinari corymbosa</i>	liusin	21	0.1%
86	<i>Terminalia catappa</i>	talisai	21	0.1%
87	<i>Ficus ruficaulis</i>	tabgun	20	0.1%
88	<i>Ardisia squamulosa</i>	tagpo	20	0.1%
89	<i>Terminalia foetidissima</i>	talisai-gubat	19	0.1%
90	<i>Artocarpus</i>		19	0.1%
91	<i>Firmiana simplex</i>	bitnong	18	0.1%
92	<i>Albizia lebbekoides</i>	kariskis	18	0.1%
93	<i>Pittospermum pentandrum</i>	mamalis	18	0.1%
94	<i>Shorea polysperma</i>	tangile	18	0.1%
95	<i>Avicennia officinalis</i>	api-api	17	0.1%
96	<i>Diospyros philosanthera</i>	bolong-eta	17	0.1%
97	<i>Aglaiia llanosiana</i>	bayanti	16	0.1%
98	<i>Mallotus multiglandulosus v. pendulus</i>	alim-bitin	15	0.1%
99	<i>Sapium luzonicum</i>	balakat-gubat	15	0.1%
100	<i>Pinus kesiya</i>	Benguet pine	15	0.1%
101	<i>Nephelium philippinense</i>	bulala	15	0.1%

102	<i>Dracontomelon dao</i>	dao	15	0.1%
103	<i>Anthocephalus cadamba</i>	Kaatoan bangkal	15	0.1%
104	<i>Duabanga moluccana</i>	loktob	15	0.1%
105	<i>Tristania decorticata</i>	malabayabas	15	0.1%
106	<i>Anisoptera thurifera</i>	palosapis	15	0.1%
107	<i>Bischofia javanica</i>	tuai	15	0.1%
108	<i>Shorea negrosensis</i>	kaliyaan	14	0.1%
109	<i>Celtis luzonica</i>	magabuyo	14	0.1%
110	<i>Guettarda speciosa</i>	tabug	14	0.1%
111	<i>Syzygium aqueum</i>	tambis	14	0.1%
112	<i>Pouteria campechiana</i>	tiesa	14	0.1%
113	<i>Shorea astylosa</i>	yakal	14	0.1%
114	<i>Shorea almon</i>	almon	13	0.1%
115	<i>Allaeanthus luzonicus</i>	himbaba-o	13	0.1%
116	<i>Sonneratia alba</i>	pagatpat	13	0.1%
117	<i>Cratoxylum celebicum</i>	paguringon	13	0.1%
118	<i>Calophyllum blancoi</i>	bitanghol	12	0.1%
119	<i>Durio zibethinus</i>	durian	12	0.1%
120	<i>Cratoxylum blancoi v. apiculatum</i>	kansilai	12	0.1%
121	<i>Dillenia philippinensis</i>	katmon	12	0.1%
122	<i>Premna adorata</i>	alagau	11	0.1%
123	<i>Antidesma ilocanum</i>	arosip	11	0.1%
124	<i>Morinda citrifolia</i>	bangkoro	11	0.1%
125	<i>Garuga floribunda</i>	bogo	11	0.1%
126	<i>Artocarpus nitida</i>	kubi	11	0.1%
127	<i>Spondias pinnata</i>	libas	11	0.1%
128	<i>Semecarpus cuneiformis</i>	ligas	11	0.1%
129	<i>Celtis philippinensis</i>	malaikmo	11	0.1%
130	<i>Broussonetia paprifera</i>	paper-mulberry	11	0.1%
131	<i>Azelia rhomboidea</i>	balayong	10	0.1%
132	<i>Barringtonia asiatica</i>	botong	10	0.1%
133	<i>Pometia pinnata</i>	eba	10	0.1%
134	<i>Neonauclea formicaria</i>	hambabalud	10	0.1%
135	<i>Ficus ulmifolia</i>	is-is	10	0.1%
136	<i>Diospyros philippensis</i>	kamagong	10	0.1%
137	<i>Ziziphus mauritiana</i>	manzanitas	10	0.1%
138	<i>Mangifera altissima</i>	pahunan	10	0.1%
139	<i>Symplocos villarii</i>	agosip	9	0.0%
140	<i>Semecarpus elmeri</i>	anagas	9	0.0%
141	<i>Annona reticulata</i>	anonas	9	0.0%
142	<i>Ficus botryocarpa</i>	basikong	9	0.0%
143	<i>Myrica javanica</i>	hindang	9	0.0%
144	<i>Terminalia microcarpa</i>	kalumpit	9	0.0%
145	<i>Clethra lancifolia</i>	kamog	9	0.0%
146	<i>Randia racemosa</i>	kapi-kapi	9	0.0%
147	<i>Hibiscus tiliaceus</i>	malubago	9	0.0%
148	<i>Cinnamomum mindanaense</i>	Mindanao cinnamon	9	0.0%
149	<i>Canthium monstrosum</i>	tadiang-anuang	9	0.0%
150	<i>Acacia auriculiformis</i>	Tan Wattle	9	0.0%
151	<i>Mallotus paniculatus</i>	anaplan	8	0.0%
152	<i>Endospermum peltatum</i>	gubas	8	0.0%
153	<i>Pterospermum obliquum</i>	kulatingan	8	0.0%
154	<i>Neonauclea bartlingii</i>	lisak	8	0.0%

155	<i>Syzygium samarangense</i>	makopa	8	0.0%
156	<i>Garcinia vidalii</i>	piris	8	0.0%
157	<i>Alangium javanicum</i> var. jaheri	putian	8	0.0%
158	<i>Nephelium lappaceum</i>	rambutan	8	0.0%
159	<i>Tectona grandis</i>	teak	8	0.0%
160	<i>Eucalyptus deglupta</i>	bagras	7	0.0%
161	<i>Mallotus philippinenses</i>	banato	7	0.0%
162	<i>Drypetes microphylla</i>	butong-manuk	7	0.0%
163	<i>Parasponia parviflora</i>	hanagdong	7	0.0%
164	<i>Shorea polita</i>	malaanonang	7	0.0%
165	<i>Vatica mangachapoi</i>	narig	7	0.0%
166	<i>Dillenia marsupialis</i>	palali	7	0.0%
167	<i>Ficus casidyana</i>	uuangan	7	0.0%
168	<i>Saurauia elegans</i>	uyok	7	0.0%
169	<i>Diplodiscus paniculatus</i>	balobo	6	0.0%
170	<i>Mussaenda philippica</i>	boyon	6	0.0%
171	<i>Muntingia calabura</i>	datiles	6	0.0%
172	<i>Camptostemon philippinense</i>	gapas-gapas	6	0.0%
173	<i>Podocarpus philippinensis</i>	malakauayan	6	0.0%
174	<i>Acacia mangium</i>	mangium	6	0.0%
175	<i>Ptychopyxis philippina</i>	panglangkaen	6	0.0%
176	<i>Trichospermum eriopodum</i>	sayapo	6	0.0%
177	<i>Ficus ribes</i>	adagei	5	0.0%
178	<i>Premna subglabra</i>	adgau	5	0.0%
179	<i>Spathodea campanulata</i>	African tulip	5	0.0%
180	<i>Ficus irisana</i>	aplas	5	0.0%
181	<i>Homalanthus populneus</i>	balanti	5	0.0%
182	<i>Averrhoa carambola</i>	balimbing	5	0.0%
183	<i>Lagerstroemia piriformis</i>	batitinan	5	0.0%
184	<i>Iteadaphne philippinensis</i>	boga	5	0.0%
185	<i>Semecarpus philippinensis</i>	kamiring	5	0.0%
186	<i>Parkia roxburghii</i>	kupang	5	0.0%
187	<i>Canthium dicoccum</i>	malakape	5	0.0%
188	<i>Mangifera monandra</i>	malapaho	5	0.0%
189	<i>Moringa oleifera</i>	malunggai	5	0.0%
190	<i>Maesopsis eminii</i>	Musizi	5	0.0%
191	<i>Cynometra luzoniensis</i>	oringon	5	0.0%
192	<i>Pangium edule</i>	pangi	5	0.0%
193	<i>Syzygium brevistylum</i>	sagimsim	5	0.0%
194	<i>Musanga cecropioides</i>	umbrella tree	5	0.0%
195	<i>Pouteria macrantha</i>	White nato	5	0.0%
196	<i>Aglaiia cumingiana</i>	alauhau	4	0.0%
197	<i>Acacia farnesiana</i>	aroma	4	0.0%
198	<i>Cynometra ramiflora</i>	balitbitan	4	0.0%
199	<i>Ochroma pyramidale</i>	balsa	4	0.0%
200	<i>Delonix regia</i>	firetree	4	0.0%
201	<i>Antidesma impressinerve</i>	inyam	4	0.0%
202	<i>Colona lanceolata</i>	kadiin	4	0.0%
203	<i>Citrus microcarpa</i>	kalamunding	4	0.0%
204	<i>Albizia retusa</i>	kasai	4	0.0%
205	<i>Sesbania grandiflora</i>	katurai	4	0.0%
206	<i>Laportea luzonensis</i>	lipa	4	0.0%
207	<i>Aleurites moluccana</i>	lumbang	4	0.0%

208	<i>Aglaiia diffusa</i>	malasaging	4	0.0%
209	<i>Syzygium gigantifolium</i>	malatalisai	4	0.0%
210	<i>Aglaiia elaeagnoidea</i>	mata-mata	4	0.0%
211	<i>Breynia rhamnoides</i>	matang-hipon	4	0.0%
212	<i>Canarium hirsutum</i>	milipili	4	0.0%
213	<i>Ficus odorata</i>	pakiling	4	0.0%
214	<i>Ilex pulogensis</i>	papatak	4	0.0%
215	<i>Actinodaphne dolichophylla</i>	pipi	4	0.0%
216	<i>Xylocarpus granatum</i>	tabigi	4	0.0%
217	<i>Diospyros copelandii</i>	talang-gubat	4	0.0%
218	<i>Neonauclea media</i>	uisak	4	0.0%
219	<i>Sterculia glabrifolia</i>	uos	4	0.0%
220	<i>Agathis philippinensis</i>	almaciga	3	0.0%
221	<i>Trema cannabina</i>	anagdung	3	0.0%
222	<i>Glochidion traindrum</i>	bagna	3	0.0%
223	<i>Syzygium rizalense</i>	bangkalauan	3	0.0%
224	<i>Sterculia philippinensis</i>	banilad	3	0.0%
225	<i>Wallaceodendron celebicum</i>	banuyo	3	0.0%
226	<i>Alstonia parvifolia</i>	batinong-liitan	3	0.0%
227	<i>Xantophyllum excelsum</i>	bok-bok	3	0.0%
228	<i>Engelhardia rigida</i>	buntan	3	0.0%
229	<i>Excoecaria agallocha</i>	buta-buta	3	0.0%
230	<i>Palaquium merrillii</i>	dulitan	3	0.0%
231	<i>Vaccinium barandanum</i>	dusong	3	0.0%
232	<i>Dipterocarpus warburgii</i>	hagakhak	3	0.0%
233	<i>Syzygium escritorii</i>	igot	3	0.0%
234	<i>Cinnamomum mercadoi</i>	kalingag	3	0.0%
235	<i>Taxotrophis macrophylla</i>	kuyos-kuyos	3	0.0%
236	<i>Homalanthus megaphyllus</i>	labulti	3	0.0%
237	<i>Dracontomelon edule</i>	lamio	3	0.0%
238	<i>Planchonia spectabilis</i>	lamog	3	0.0%
239	<i>Mitrephora lanotan</i> *****	lanutan	3	0.0%
240	<i>Litchi chinensis</i>	licheas	3	0.0%
241	<i>Laportea brunnea</i>	lingaton	3	0.0%
242	<i>Vitex turczaninowii</i>	lingo-lingo	3	0.0%
243	<i>Sterculia oblongata</i>	malabuho	3	0.0%
244	<i>Sandoricum vidalii</i>	malasantol	3	0.0%
245	<i>Hopea acuminata</i>	manggachapui	3	0.0%
246	<i>Palaquium tenuipetiolatum</i>	maniknik	3	0.0%
247	<i>Melicope triphylla</i>	matang-arau	3	0.0%
248	<i>Ficus pseudopalma</i>	niog-niogan	3	0.0%
249	<i>Calophyllum pseudowallichianum</i>	pameklaten	3	0.0%
250	<i>Pterocarpus vidalianus</i>	prickly narra	3	0.0%
251	<i>Codiaeum luzonicum</i>	putak	3	0.0%
252	<i>Trigonachras cuspidata</i>	salab	3	0.0%
253	<i>Albizia saponaria</i>	salingkugi	3	0.0%
254	<i>Cassia siamea</i>	Thailand shower	3	0.0%
255	<i>Hopea malibato</i>	yakal-kaliot	3	0.0%
256	<i>Bixa orellana</i>	achuete	2	0.0%
257	<i>Casuarina equisetifolia</i>	agoho	2	0.0%
258	<i>Guioa koelreuteria</i>	alahan	2	0.0%
259	<i>Aphanthe philippinensis</i>	alasiis	2	0.0%

260	<i>Hymenodictyon excelsum</i>	aligango	2	0.0%
261	<i>Euphoria didyma</i>	alupag	2	0.0%
262	<i>Abarema scutifera</i>	anagap	2	0.0%
263	<i>Glochidion psidioides</i>	anam	2	0.0%
264	<i>Diospyros elmeri</i>	balingagta	2	0.0%
265	<i>Baccaurea philippinensis</i>	baloiboi	2	0.0%
266	<i>Diploknema ramiflora</i>	baniti	2	0.0%
267	<i>Voacanga globosa</i>	bayag-usa	2	0.0%
268	<i>Pterospermum diversifolium</i>	bayok	2	0.0%
269	<i>Macaranga sinensis</i>	binungang-pula	2	0.0%
270	<i>Syzygium curranii</i>	Curran lipote	2	0.0%
271	<i>Ficus virgata</i> v. <i>philippinensis</i>	diakit	2	0.0%
272	<i>Heritiera littoralis</i>	dungon-late	2	0.0%
273	<i>Hopea philippinensis</i>	gisok-gisok	2	0.0%
274	<i>Shorea guiso</i>	guijo	2	0.0%
275	<i>Cratoxylum blancoi</i>	guyong-guyong	2	0.0%
276	<i>Michelia platyphylla</i>	hangilo	2	0.0%
277	<i>Cicca acida</i>	iba	2	0.0%
278	<i>Diospyros longiciliata</i>	itom-itom	2	0.0%
279	<i>Phoebe sterculioides</i>	kaburo	2	0.0%
280	<i>Saurauia latibractea</i>	kolalabang	2	0.0%
281	<i>Syzygium claviflorum</i>	kurasam	2	0.0%
282	<i>Laportea meyeniana</i>	lipang-kalabau	2	0.0%
283	<i>Salmalia malabarica</i>	malabulak	2	0.0%
284	<i>Vernonia arborea</i>	malasambong-gubat	2	0.0%
285	<i>Syzygium hutchinsonii</i>	malatambis	2	0.0%
286	<i>Ficus congesta</i>	malatibig	2	0.0%
287	<i>Premna nauseosa</i>	malauin-aso	2	0.0%
288	<i>Mitragyna rotundifolia</i>	mambog	2	0.0%
289	<i>Koompassia excelsa</i>	manggis	2	0.0%
290	<i>Garcinia mangostana</i>	mangosteen	2	0.0%
291	<i>Breynia cernua</i>	matang-katang	2	0.0%
292	<i>Syzygium costulatum</i>	paitan	2	0.0%
293	<i>Guioa acuminata</i>	pasi	2	0.0%
294	<i>Canarium luzonicum</i>	piling-liitan	2	0.0%
295	<i>Cassia nodosa</i>	pinkshower	2	0.0%
296	<i>Litsea glutinosa</i>	sablot	2	0.0%
297	<i>Aegiceras corniculatum</i>	saging-saging	2	0.0%
298	<i>Cratoxylum formosum</i>	salinggogon	2	0.0%
299	<i>Ficus variegata</i> v. <i>garciae</i>	tablot-ot	2	0.0%
300	<i>Ficus benguetensis</i>	tabul	2	0.0%
301	<i>Palaquium pinnatinervium</i>	tagkan	2	0.0%
302	<i>Pterospermum cumingii</i>	talinuanga	2	0.0%
303	<i>Shorea polysperma</i> f. <i>tiaong</i>	tiaong	2	0.0%
304	<i>Crypteronia paniculata</i>	tiaui	2	0.0%
305	<i>Alphitonia philippinensis</i>	tulo	2	0.0%
306	<i>Ficus ampelas</i>	upling-gubat	2	0.0%
307	<i>Syzygium malaccense</i>	yambu	2	0.0%
308	<i>Aglaiia</i>		2	0.0%
309	<i>Diospyros</i>		2	0.0%
310	<i>Radermachera</i>		2	0.0%
311	<i>Serialbizia acle</i>	akle	1	0.0%
312	<i>Pittosporum ramosii</i>	albon	1	0.0%

313	<i>Abroma augusta</i>	anabo	1	0.0%
314	<i>Diospyros pyrrhocarpa</i>	anang	1	0.0%
315	<i>Cassia javanica</i>	antsoan	1	0.0%
316	<i>Clethra luzonica</i>	apiit	1	0.0%
317	<i>Homalium foetidum</i>	aranga	1	0.0%
318	<i>Litsea hutchinsonii</i>	asasala	1	0.0%
319	<i>Diospyros mindanaensis</i>	ata-ata	1	0.0%
320	<i>Annona squamosa</i>	ates	1	0.0%
321	<i>Gnetum gnemon</i> v. <i>gnemon</i>	bago	1	0.0%
322	<i>Ormosia calavensis</i>	bahai	1	0.0%
323	<i>Euphorbia plumerioides</i>	bait	1	0.0%
324	<i>Rhizophora mucronata</i>	bakauan-babae	1	0.0%
325	<i>Mangifera caesia</i>	baluno	1	0.0%
326	<i>Pongamia pinnata</i>	bani	1	0.0%
327	<i>Cleistanthus pilosus</i>	banitlong	1	0.0%
328	<i>Grewia eriocarpa</i>	bariuan	1	0.0%
329	<i>Tarenna stenantha</i>	basa	1	0.0%
330	<i>Garcinia brevirostris</i>	basan	1	0.0%
331	<i>Garcinia busuangaensis</i>	batuhan	1	0.0%
332	<i>Pterospermum niveum</i>	bayok-bayokan	1	0.0%
333	<i>Phytolacca dioica</i>	bella-sombra	1	0.0%
334	<i>Antidesma pentadrum</i>	bignai-pogo	1	0.0%
335	<i>Leucosyke elmeri</i>	bilan-bilan	1	0.0%
336	<i>Syzygium subfoetidum</i>	bintang	1	0.0%
337	<i>Spiraeopsis celebica</i>	bognag	1	0.0%
338	<i>Adenanthera intermedia</i>	bolong kadyos	1	0.0%
339	<i>Dillenia bolsteri</i>	Bolster katmon	1	0.0%
340	<i>Glochidion camiguinense</i>	bonot-bonot	1	0.0%
341	<i>Araucaria bidwilli</i>	bunya pine	1	0.0%
342	<i>Canthium gynochthodes</i>	butlig-babui	1	0.0%
343	<i>Manilkara sapota</i>	chico	1	0.0%
344	<i>Garcinia binukau</i>	Choisy binukau	1	0.0%
345	<i>Macaranga caudatifolia</i>	daha	1	0.0%
346	<i>Cyathocalyx globosus</i>	dalinas	1	0.0%
347	<i>Pipturus arborescens</i>	dalunot	1	0.0%
348	<i>Calophyllum obliquinervium</i>	dangkalan	1	0.0%
349	<i>Pseuduvaria grandiflora</i>	dangloi-iloko	1	0.0%
350	<i>Erythrina variegata</i>	dapdap	1	0.0%
351	<i>Ficus pedunculosa</i> v. <i>imberbis</i>	dularog	1	0.0%
352	<i>Canarium hirsutum</i> f. <i>multipinnatum</i>	dulit	1	0.0%
353	<i>Ficus pedunculosa</i>	gambit-gambit	1	0.0%
354	<i>Garcinia venulosa</i>	gatasan	1	0.0%
355	<i>Canarium vrieseanum</i>	gisau	1	0.0%
356	<i>Pavetta indica</i>	gusokan	1	0.0%
357	<i>Goniothalamus gitingensis</i>	guyog	1	0.0%
358	<i>Weinmannia hutchinsonii</i>	Hutchinson kalilan	1	0.0%
359	<i>Alectryon excisus</i>	ibu	1	0.0%
360	<i>Viburnum odoratissimum</i>	idog	1	0.0%
361	<i>Macaranga ovatifolia</i>	indang	1	0.0%
362	<i>Garcinia ituman</i>	ituman	1	0.0%
363	<i>Commersonia bartramia</i>	kakaag	1	0.0%
364	<i>Plumeria acuminata</i>	kalachuche	1	0.0%

365	<i>Neonauclea calycina</i>	kalamansanai	1	0.0%
366	<i>Garcinia lateriflora</i>	kandis	1	0.0%
367	<i>Linociera ramiflora</i>	karaksan	1	0.0%
368	<i>Chisocheton pentandrus</i>	katong-matsing	1	0.0%
369	<i>Itea macrophylla</i>	kodai	1	0.0%
370	<i>Psychotria versicolor</i>	kotipo	1	0.0%
371	<i>Memecylon ovatum</i>	kulis	1	0.0%
372	<i>Melochia umbellata</i>	labayo	1	0.0%
373	<i>Wendlandia glabrata</i>	lanipa	1	0.0%
374	<i>Toona philippinensis</i>	lanipga	1	0.0%
375	<i>Gonystylus macrophyllus</i>	lanutan-bagyo	1	0.0%
376	<i>Sterculia multistipularis</i>	lapnit	1	0.0%
377	<i>Vaccinium tenuipes</i> Merr.	likop	1	0.0%
378	<i>Syzygium polycephaloides</i>	lipote	1	0.0%
379	<i>Glochidion mindorense</i>	litok	1	0.0%
380	<i>Flacourtia jangomas</i>	Madagascar plum	1	0.0%
381	<i>Dalbergia mimosella</i>	makapil	1	0.0%
382	<i>Dillenia luzoniensis</i>	malakatmon	1	0.0%
383	<i>Palaquium philippinense</i>	malak-malak	1	0.0%
384	<i>Cleistocalyx operculatus</i>	malaruhut	1	0.0%
385	<i>Stemonurus hallieri</i>	malatadu	1	0.0%
386	<i>Palaquium cuprifolium</i>	malatagkan	1	0.0%
387	<i>Neonauclea reticulata</i>	malauisak	1	0.0%
388	<i>Colona blancoi</i>	mamaued	1	0.0%
389	<i>Azadirachta indica</i>	Margosa	1	0.0%
390	<i>Colona macgregorii</i>	McGregor anilau	1	0.0%
391	<i>Orophea elliphantoides</i>	pagaion	1	0.0%
392	<i>Triplaris cumingiana</i>	palo-santo	1	0.0%
393	<i>Lithocarpus bennettii</i>	pangnan	1	0.0%
394	<i>Decaspermum blancoi</i>	patalsik-pula	1	0.0%
395	<i>Neolitsea vidalii</i>	puso-puso	1	0.0%
396	<i>Barringtonia racemosa</i>	putat	1	0.0%
397	<i>Erythrina subumbrans</i>	rarang	1	0.0%
398	<i>Liquidambar styraciflua</i>	redgum	1	0.0%
399	<i>Sloanea sigun</i>	sala	1	0.0%
400	<i>Wikstroemia meyeniana</i>	salagong-laparan	1	0.0%
401	<i>Zanthoxylum integrifolium</i>	salai	1	0.0%
402	<i>Pistacia chinensis</i>	sangilo	1	0.0%
403	<i>Caesalpinia sappan</i>	sibukau	1	0.0%
404	<i>Ctenolophon philippinense</i>	sudiang	1	0.0%
405	<i>Parinari glaberrima</i>	tabon-tabon	1	0.0%
406	<i>Croton leiophyllus</i>	tagoang-uak	1	0.0%
407	<i>Strombosia philippinensis</i>	tamayuan	1	0.0%
408	<i>Xylopia densifolia</i>	tangisang-bagyo	1	0.0%
409	<i>Neonauclea vidalii</i>	tikim	1	0.0%
410	<i>Canthium ramosii</i>	topas	1	0.0%
411	<i>Cecropia peltata</i>	trumpet tree	1	0.0%
412	<i>Pometia tomentosa</i>	tugau	1	0.0%
413	<i>Micromelum inodorum</i>	tulibas-mabolo	1	0.0%
414	<i>Horsfieldia megacarpa</i>	yabnob	1	0.0%
415	<i>Hopea plagata</i>	yakal-saplungan	1	0.0%
416	<i>Bridelia</i>		1	0.0%
417	<i>Cratoxylum</i>		1	0.0%

418	Dysoxylum		1	0.0%
419	Lagerstroemia		1	0.0%
420	Mallotus		1	0.0%
421	Mearnsia		1	0.0%
422	Mimusops		1	0.0%
423	Palmae		1	0.0%
424	Rubiaceae		1	0.0%
425	Vitex		1	0.0%
426	Unidentified		912	4.8%

**Annex 5: Tree species in forests**

Order	Scientific Name	Common name	Number	%
1	<i>Shorea contorta</i>	white lauan	1592	7.7%
2	<i>Shorea polysperma</i>	tangile	1259	6.1%
3	<i>Shorea negrosensis</i>	red lauan	1219	5.9%
4	<i>Shorea squamata</i>	mayapis	1011	4.9%
5	<i>Dipterocarpus grandiflorus</i>	apitong	887	4.3%
6	<i>Parashorea plicata</i>	bagtikan	539	2.6%
7	<i>Gmelina arborea</i>	yemane	517	2.5%
8	<i>Lithocarpus llanosii</i>	ulayan	502	2.4%
9	<i>Shorea astylosa</i>	yakal	480	2.3%
10	<i>Shorea almon</i>	almon	358	1.7%
11	<i>Pterocarpus indicus</i>	narra	323	1.6%
12	<i>Palaquium luzoniense</i>	nato	264	1.3%
13	<i>Ficus nota</i>	tibig	250	1.2%
14	<i>Syzygium brevistylum</i>	sagimsim	250	1.2%
15	<i>Pinus kesiya</i>	Benguet pine	247	1.2%
16	<i>Shorea guiso</i>	guijo	242	1.2%
17	<i>Ficus elastica</i>	India rubber	237	1.1%
18	<i>Alangium javanicum</i> var. jaheri	putian	203	1.0%
19	<i>Macaranga tanarius</i>	binunga	199	1.0%
20	<i>Leucaena leucocephala</i>	ipil-ipil	187	0.9%
21	<i>Syzygium simile</i>	panglongboien	178	0.9%
22	<i>Myristica philippinensis</i>	duguan	169	0.8%
23	<i>Endospermum peltatum</i>	gubas	156	0.7%
24	<i>Vatica mangachapoi</i>	narig	155	0.7%
25	<i>Cocos nucifera</i>	Coconut	153	0.7%
26	<i>Dillenia philippinensis</i>	katmon	152	0.7%
27	<i>Trema orientalis</i>	anabiong	150	0.7%
28	<i>Ficus variegata</i>	tangisang bayawak	149	0.7%
29	<i>Paraserianthes falcataria</i>	Moluccan sau	144	0.7%
30	<i>Tristania decorticata</i>	malabayabas	143	0.7%
31	<i>Vitex parviflora</i>	molave	143	0.7%
32	<i>Mitrephora lanotan</i> *****	lanutan	142	0.7%
33	<i>Canarium asperum</i>	pagsahingin	137	0.7%
34	<i>Agathis philippinensis</i>	almaciga	127	0.6%
35	<i>Pterocymbium tinctorium</i>	taluto	120	0.6%
36	<i>Hopea foxwothyi</i>	dalingdingan	102	0.5%
37	<i>Anisoptera thurifera</i>	palosapis	100	0.5%
38	<i>Artocarpus blancoi</i>	antipolo	99	0.5%
39	<i>Diospyros philosanthera</i>	bolong-eta	98	0.5%
40	<i>Rhizophora mucronata</i>	bakauan-babae	98	0.5%
41	<i>Euphoria didyma</i>	alupag	97	0.5%
42	<i>Mangifera altissima</i>	pahunan	93	0.4%
43	<i>Teijsmanniodendron ahernianum</i>	sasalit	92	0.4%
44	<i>Toona calantas</i>	kalantas	91	0.4%
45	<i>Artocarpus ovata</i>	anubing	90	0.4%
46	<i>Alstonia macrophylla</i>	batino	89	0.4%
47	<i>Polyscias nodosa</i>	bongliw	84	0.4%

48	<i>Hopea philippinensis</i>	gisok-gisok	83	0.4%
49	<i>Ficus minahassae</i>	hagimit	79	0.4%
50	<i>Sandoricum vidalii</i>	malasantol	79	0.4%
51	<i>Combretodendron quadrialatum</i>	toog	76	0.4%
52	<i>Litsea perrottetii</i>	bakan	75	0.4%
53	<i>Swietenia macrophylla</i>	big-leafed mahogany	74	0.4%
54	<i>Hevea brasiliensis</i>	para rubber	72	0.3%
55	<i>Casuarina</i>		70	0.3%
56	<i>Pometia pinnata</i>	eba	68	0.3%
57	<i>Cananga odorata</i>	ilang-ilang	66	0.3%
58	<i>Canarium ovatum</i>	pili	66	0.3%
59	<i>Terminalia foetidissima</i>	talisai-gubat	66	0.3%
60	<i>Calophyllum blancoi</i>	bitanghol	65	0.3%
61	<i>Antidesma ghaesembilla</i>	binayuyu	64	0.3%
62	<i>Diplodiscus paniculatus</i>	balobo	64	0.3%
63	<i>Ficus balete</i>	balete	59	0.3%
64	<i>Terminalia nitens</i>	sakat	59	0.3%
65	<i>Casuarina equisetifolia</i>	agoho	57	0.3%
66	<i>Garcinia venulosa</i>	gatasan	57	0.3%
67	<i>Kleinhovia hospita</i>	bitan-ag	56	0.3%
68	<i>Diospyros philippensis</i>	kamagong	55	0.3%
69	<i>Koordersiodendron pinnatum</i>	amugis	54	0.3%
70	<i>Alstonia scholaris</i>	dita	52	0.2%
71	<i>Celtis luzonica</i>	magabuyo	52	0.2%
72	<i>Acacia mangium</i>	mangium	51	0.2%
73	<i>Melanolepis multiglandulosus</i>	alim	51	0.2%
74	<i>Pterospermum diversifolium</i>	bayok	48	0.2%
75	<i>Macaranga grandifolia</i>	bingabing	47	0.2%
76	<i>Erythrina orientalis</i>	dap-dap	46	0.2%
77	<i>Saurauia latibractea</i>	kolalabang	46	0.2%
78	<i>Azelia rhomboidea</i>	balayong	43	0.2%
79	<i>Artocarpus odortissima</i>	marang-banguhan	43	0.2%
80	<i>Macaranga bicolor</i>	hamindang	43	0.2%
81	<i>Octomeles sumatrana</i>	binuang	43	0.2%
82	<i>Wrightia laniti</i>	lanete	42	0.2%
83	<i>Aglaia banahaensis</i>	Banahao malasaging	41	0.2%
84	<i>Duabanga moluccana</i>	loktob	41	0.2%
85	<i>Xanthostemon verdugonianus</i>	mangkono	41	0.2%
86	<i>Symplocos salix</i>	maksa	39	0.2%
87	<i>Barringtonia racemosa</i>	putat	38	0.2%
88	<i>Intsia bijuga</i>	ipil	38	0.2%
89	<i>Xylocarpus granatum</i>	tabigi	36	0.2%
90	<i>Bischofia javanica</i>	tuai	35	0.2%
91	<i>Samanea saman</i>	raintree	34	0.2%
92	<i>Ficus septica</i>	hauili	33	0.2%
93	<i>Mangifera indica</i>	mangga	33	0.2%
94	<i>Neotrewia cumingii</i>	apanang	33	0.2%
95	<i>Nauclea orientalis</i>	bangkal	32	0.2%
96	<i>Allaeanthus luzonicus</i>	himbaba-o	31	0.1%
97	<i>Neonauclea formicaria</i>	hambabalud	31	0.1%
98	<i>Leucaena pulverulenta</i>	giant ipil-ipil	30	0.1%
99	<i>Neonauclea calycina</i>	kalamansanai	30	0.1%

100	<i>Ctenolophon philippinense</i>	sudiang	29	0.1%
101	<i>Parasponia parviflora</i>	hanagdong	29	0.1%
102	<i>Syzygium cumini</i>	duhat	29	0.1%
103	<i>Lagerstroemia speciosa</i>	banaba	28	0.1%
104	<i>Sapium luzonicum</i>	balakat-gubat	28	0.1%
105	<i>Garcinia ituman</i>	ituman	27	0.1%
106	<i>Tristania micrantha</i>	tiga	27	0.1%
107	<i>Calophyllum inophyllum</i>	bitaog	26	0.1%
108	<i>Hopea acuminata</i>	manggachapui	26	0.1%
109	<i>Pittospermum pentandrum</i>	mamalis	26	0.1%
110	<i>Syzygium nitidum</i>	makaasim	26	0.1%
111	<i>Bauhinia monandra</i>	fringon	25	0.1%
112	<i>Canarium vrieseanum</i>	gisau	25	0.1%
113	<i>Cratoxylum celebicum</i>	paguringon	25	0.1%
114	<i>Garcinia brevirostris</i>	basan	25	0.1%
115	<i>Syzygium gigantifolium</i>	malatalisai	25	0.1%
116	<i>Viburnum odoratissimum</i>	idog	25	0.1%
117	<i>Pisonia umbillefera</i>	anuling	24	0.1%
118	<i>Celtis philippinensis</i>	malaikmo	22	0.1%
119	<i>Lumnitzera racemosa</i>	kulasi	22	0.1%
120	<i>Nephelium philippinense</i>	bulala	22	0.1%
121	<i>Psychotria luzoniensis</i>	katagpo	22	0.1%
122	<i>Shorea philippinensis</i>	manggasinoro	22	0.1%
123	<i>Syzygium hutchinsonii</i>	malatambis	22	0.1%
124	<i>Albizia procera</i>	akleng-parang	21	0.1%
125	<i>Drypetes littoralis</i>	bato-bato	21	0.1%
126	<i>Podocarpus imbricatus</i>	igem	21	0.1%
127	<i>Dracontomelon dao</i>	dao	20	0.1%
128	<i>Dysoxylum</i>	sagimsiman	20	0.1%
129	<i>Dysoxylum laxum</i>	tauing	20	0.1%
130	<i>Tarrietia sylvatica</i>	dungon	20	0.1%
131	<i>Wallaceodendron celebicum</i>	banuyo	20	0.1%
132	<i>Astronia megalantha</i>	bagaubau	19	0.1%
133	<i>Ficus ampelas</i>	upling-gubat	19	0.1%
134	<i>Ficus botryocarpa</i>	basikong	19	0.1%
135	<i>Neonauclea media</i>	wisak	19	0.1%
136	<i>Palaquium pinnatinervium</i>	tagkan	19	0.1%
137	<i>Pandanus spp</i>	ulango	19	0.1%
138	<i>Claoxylon arboreum</i>	banata	18	0.1%
139	<i>Diospyros elmeri</i>	balingagta	18	0.1%
140	<i>Mallotus philippinenses</i>	banato	18	0.1%
141	<i>Vitex quinata</i>	kulipapa	18	0.1%
142	<i>Musanga cecropioides</i>	umbrella tree	17	0.1%
143	<i>Nephelium lappaceum</i>	rambutan	17	0.1%
144	<i>Ormosia calavensis</i>	bahai	17	0.1%
145	<i>Piliostigma malabaricum</i>	alibangbang	17	0.1%
146	<i>Xantophyllum excelsum</i>	bok-bok	17	0.1%
147	<i>Ficus benguetensis</i>	tabul	16	0.1%
148	<i>Lithocarpus soleriana</i>	manaring	16	0.1%
149	<i>Myrica javanica</i>	hindang	16	0.1%
150	<i>Parinari corymbosa</i>	liusin	16	0.1%
151	<i>Shorea polysperma f. tiaong</i>	tiaong	16	0.1%

152	<i>Syzygium leytense</i>	bagotambis	16	0.1%
153	<i>Aglaia diffusa</i>	malasaging	15	0.1%
154	<i>Aglaia llanosiana</i>	bayanti	15	0.1%
155	<i>Buchanania arborescens</i>	balinghasai	15	0.1%
156	<i>Ficus ruficaulis</i>	tabgun	15	0.1%
157	<i>Parkia roxburghii</i>	kupang	15	0.1%
158	<i>Radermachera pinnata</i>	banai-banai	15	0.1%
159	<i>Securinega flexuosa</i>	anislag	15	0.1%
160	<i>Actinodaphne dolichophylla</i>	pipi	14	0.1%
161	<i>Alphitonia philippinensis</i>	tulo	14	0.1%
162	<i>Araucaria bidwilli</i>	bunya pine	14	0.1%
163	<i>Homalanthus populneus</i>	balanti	14	0.1%
164	<i>Sandoricum koetjape</i>	santol	14	0.1%
165	<i>Saurauia leytenis</i>	tagibokbok	14	0.1%
166	<i>Antidesma cumingii</i>	bignai-kalau	13	0.1%
167	<i>Dipterocarpus warburgii</i>	hagakhak	13	0.1%
168	<i>Dolichandrone spathacea</i>	tui	13	0.1%
169	<i>Ervatamia cumingiana</i>	salibukbuk	13	0.1%
170	<i>Garuga floribunda</i>	bogo	13	0.1%
171	<i>Grewia eriocarpa</i>	bariuan	13	0.1%
172	<i>Leucosyke capitellata</i>	alagasi	13	0.1%
173	<i>Shorea kalunti</i>	kalunti	13	0.1%
174	<i>Alchornea rugosa</i>	aguioi	12	0.1%
175	<i>Dracontomelon edule</i>	lamio	12	0.1%
176	<i>Gliricida sepium</i>	madre-cacao	12	0.1%
177	<i>Homonoia javanse</i>	mala-mala	12	0.1%
178	<i>Palaquium tenuipetiolatum</i>	maniknik	12	0.1%
179	<i>Pterospermum obliquum</i>	kulatingan	12	0.1%
180	<i>Rapanea apoensis</i>	tongog	12	0.1%
181	<i>Vaccinium barandanum</i>	dusong	12	0.1%
182	<i>Avicennia officinalis</i>	api-api	11	0.1%
183	<i>Castanopsis javanica</i>	gasa	11	0.1%
184	<i>Cecropia peltata</i>	trumpet tree	11	0.1%
185	<i>Colona serrafolia</i>	anilau	11	0.1%
186	<i>Cryptocarya oligocarpa</i>	malaigot	11	0.1%
187	<i>Eucalyptus deglupta</i>	bagras	11	0.1%
188	<i>Evodia bintoco</i>	bintoko	11	0.1%
189	<i>Ilex pulogensis</i>	papatak	11	0.1%
190	<i>Macaranga caudatifolia</i>	daha	11	0.1%
191	<i>Meliosma macrophylla</i>	balilang-uak	11	0.1%
192	<i>Semecarpus philippinensis</i>	kamiring	11	0.1%
193	<i>Canarium hirsutum</i>	milipili	10	0.0%
194	<i>Canthium dicoccum</i>	malakape	10	0.0%
195	<i>Chisocheton cumingianus</i>	balukanag	10	0.0%
196	<i>Elaeocarpus parvilimbus</i>	lapitling	10	0.0%
197	<i>Lithocarpus bennettii</i>	pangnan	10	0.0%
198	<i>Michelia platyphylla</i>	hangilo	10	0.0%
199	<i>Pinus merkusii</i>	Mindoro pine	10	0.0%
200	<i>Pterocarpus vidalianus</i>	prickly narra	10	0.0%
201	<i>Aglaia elaeagnoidea</i>	mata-mata	9	0.0%
202	<i>Castanopsis</i>		9	0.0%
203	<i>Chisocheton pentandrus</i>	katong-matsing	9	0.0%

204	<i>Cinnamomum mercadoi</i>	kalingag	9	0.0%
205	<i>Homalium foetidum</i>	aranga	9	0.0%
206	<i>Iteadaphne philippinensis</i>	boga	9	0.0%
207	<i>Morinda citrifolia</i>	bangkoro	9	0.0%
208	<i>Neolitsea lanceolata</i>	lanat	9	0.0%
209	<i>Radermachera biternata</i>	agtap	9	0.0%
210	<i>Shorea</i>		9	0.0%
211	<i>Terminalia microcarpa</i>	kalumpit	9	0.0%
212	<i>Albizia lebbekoides</i>	kariskis	8	0.0%
213	<i>Anthocephalus cadamba</i>	Kaatoan bangkal	8	0.0%
214	<i>Artocarpus heterophylla</i>	nangka	8	0.0%
215	<i>Barringtonia asiatica</i>	botong	8	0.0%
216	<i>Bridelia glauca</i>	balitahan	8	0.0%
217	<i>Canarium luzonicum</i>	piling-liitan	8	0.0%
218	<i>Engelhardia rigida</i>	buntan	8	0.0%
219	<i>Koompassia excelsa</i>	manggis	8	0.0%
220	<i>Mallotus auriculatus</i>	kamanian	8	0.0%
221	<i>Prunus junghuhnianus</i>	Palawan cherry	8	0.0%
222	<i>Sterculia cuneata</i>	malabunot	8	0.0%
223	<i>Strombosia philippinensis</i>	tamayuan	8	0.0%
224	<i>Syzygium roseomarginatum</i>	pamaayasen	8	0.0%
225	<i>Tectona grandis</i>	teak	8	0.0%
226	<i>Terminalia samoensis</i>	luno-luno	8	0.0%
227	<i>Cassia javanica</i>	antsoan	7	0.0%
228	<i>Clethra pulgarensis</i>	tagobahi	7	0.0%
229	<i>Colona philippinensis</i>	anitai	7	0.0%
230	<i>Cordia dichotoma</i>	anonang	7	0.0%
231	<i>Dillenia luzoniensis</i>	malakatmon	7	0.0%
232	<i>Evodia confusa</i>	mangkau	7	0.0%
233	<i>Glochidion camiguinense</i>	bonot-bonot	7	0.0%
234	<i>Litchi philippinensis</i>	alupag-amo	7	0.0%
235	<i>Litsea glutinosa</i>	sablod	7	0.0%
236	<i>Palaquium merrillii</i>	dulitan	7	0.0%
237	<i>Planchonia spectabilis</i>	lamog	7	0.0%
238	<i>Pouteria macrantha</i>	White nato	7	0.0%
239	<i>Pouteria velutina</i>	uakatan	7	0.0%
240	<i>Spathodea campanulata</i>	African tulip	7	0.0%
241	<i>Streblus asper</i>	kalios	7	0.0%
242	<i>Trema cannabina</i>	anagdung	7	0.0%
243	<i>Trichospermum eriopodum</i>	sayapo	7	0.0%
244	<i>Artocarpus nitida</i>	kubi	6	0.0%
245	<i>Avicennia marina</i>	bungalon	6	0.0%
246	<i>Crypteronia paniculata</i>	tiaui	6	0.0%
247	<i>Cynometra luzoniensis</i>	oringon	6	0.0%
248	<i>Dillenia bolsteri</i>	Bolster katmon	6	0.0%
249	<i>Diospyros curranii</i>	malagaitmon	6	0.0%
250	<i>Diospyros mindanaensis</i>	ata-ata	6	0.0%
251	<i>Ficus irisana</i>	aplas	6	0.0%
252	<i>Ficus saxophila</i>	balitarhan	6	0.0%
253	<i>Ficus variegata v. garciae</i>	tablot-ot	6	0.0%
254	<i>Lansium domesticum</i>	lansones	6	0.0%
255	<i>Laportea meyeniana</i>	lipang-kalabau	6	0.0%

256	<i>Litsea garciae</i>	bangulo	6	0.0%
257	<i>Palaquium philippinense</i>	malak-malak	6	0.0%
258	<i>Persea americana</i>	avocado	6	0.0%
259	<i>Pipturus arborescens</i>	dalunot	6	0.0%
260	<i>Podocarpus philippinensis</i>	malakauayan	6	0.0%
261	<i>Syzygium polycephaloides</i>	lipote	6	0.0%
262	<i>Tamarindus indica</i>	sampalok	6	0.0%
263	<i>Terminalia citrina</i>	binggas	6	0.0%
264	<i>Timonius lanceolatus</i>	sibau	6	0.0%
265	<i>Abarema clypearia</i> f. <i>clypearia</i>	tiagkot	5	0.0%
266	<i>Abarema scutifera</i>	anagap	5	0.0%
267	<i>Antidesma pentadrum</i>	bignai-pogo	5	0.0%
268	<i>Artocarpus</i>		5	0.0%
269	<i>Baccaurea philippinensis</i>	baloiboi	5	0.0%
270	<i>CalliCARPA</i>		5	0.0%
271	<i>Camptostemon philippinense</i>	gapas-gapas	5	0.0%
272	<i>Chrsophyllum cainito</i>	starapple	5	0.0%
273	<i>Decaspermum blancoi</i>	patalsik-pula	5	0.0%
274	<i>Derris cumingii</i>	tubling-kahoi	5	0.0%
275	<i>Dipterocarpus caudatus</i>	leaf-tailed panau	5	0.0%
276	<i>Dipterocarpus gracilis</i>	panau	5	0.0%
277	<i>Garcinia rubra</i>	kamandiis	5	0.0%
278	<i>Guioa mindorensis</i>	alahan-mangyan	5	0.0%
279	<i>Hopea malibato</i>	yakal-kaliot	5	0.0%
280	<i>Leptospermum</i>		5	0.0%
281	<i>Mimusops</i>		5	0.0%
282	<i>Nephelium mutabile</i>	kapulasan	5	0.0%
283	<i>Pistacia chinensis</i>	sangilo	5	0.0%
284	<i>Pygeum vulgare</i>	lago	5	0.0%
285	<i>Randia racemosa</i>	kapi-kapi	5	0.0%
286	<i>Shorea falciferoides</i>	yakal-yamban	5	0.0%
287	<i>Sterculia</i>		5	0.0%
288	<i>Syzygium albayense</i>	sambulauan	5	0.0%
289	<i>Terminalia catappa</i>	talisai	5	0.0%
290	<i>Theobroma cacao</i>	cacao	5	0.0%
291	<i>Triplaris cumingiana</i>	palo-santo	5	0.0%
292	<i>Aglaia luzoniensis</i>	kuling-manuk	4	0.0%
293	<i>Carallia branchiata</i>	bakauan-gubat	4	0.0%
294	<i>Clethra lancifolia</i>	kamog	4	0.0%
295	<i>Cryptocarya foxworthyi</i>	baniakau	4	0.0%
296	<i>Endospermum ovatum</i>	malagubas	4	0.0%
297	<i>Ficus congesta</i>	malatibig	4	0.0%
298	<i>Flacourtia rukam</i>	bitongol	4	0.0%
299	<i>Garcinia nervosa</i>	buradgis	4	0.0%
300	<i>Glyptopetalum euphlebiuM</i>	butingi	4	0.0%
301	<i>Gyrocarpus americanus</i>	Gyrocarpus	4	0.0%
302	<i>Kopsia fruticosa</i>	lipata	4	0.0%
303	<i>Mangifera monandra</i>	malapaho	4	0.0%
304	<i>Mangifera philippinensis</i>	paho	4	0.0%
305	<i>Melia dubia</i>	bagalunga	4	0.0%
306	<i>Neanauclea bartlingii</i>	lisak	4	0.0%
307	<i>Olea europaea</i>	common olive	4	0.0%

308	<i>Palaquium foxworthyi</i>	tagatoi	4	0.0%
309	<i>Palaquium gigantifolia</i>	alakaak	4	0.0%
310	<i>Pavetta indica</i>	gusokan	4	0.0%
311	<i>Phoebe sterculioides</i>	kaburo	4	0.0%
312	<i>Polyalthia oblongifolia</i>	lapnisan	4	0.0%
313	<i>Saurauia trunciflora</i>	pulak	4	0.0%
314	<i>Spondias pinnata</i>	libas	4	0.0%
315	<i>Sterculia foetida</i>	kalumpang	4	0.0%
316	<i>Syzygium calubcob</i>	kalubkub	4	0.0%
317	<i>Terminalia</i>		4	0.0%
318	<i>Terminalia pellucida</i>	dalinsi	4	0.0%
319	<i>Vaccinium perrigidum</i>	balau	4	0.0%
320	<i>Vernonia vidalii</i>	malasambong	4	0.0%
321	<i>Vitex turczaninowii</i>	lingo-lingo	4	0.0%
322	<i>Voacanga megacarpa</i>	bayag-aso	4	0.0%
323	<i>Weinmannia hutchinsonii</i>	Hutchinson kalilan	4	0.0%
324	<i>Xylopia</i>		4	0.0%
325	<i>Aegiceras corniculatum</i>	saging-saging	3	0.0%
326	<i>Albizia saponaria</i>	salingkugi	3	0.0%
327	<i>Alectryon excisus</i>	ibu	3	0.0%
328	<i>Aleurites moluccana</i>	lumbang	3	0.0%
329	<i>Artocarpus communis</i>	rimas	3	0.0%
330	<i>Averrhoa bilimbi</i>	kamias	3	0.0%
331	<i>Breynia rhamnoides</i>	matang-hipon	3	0.0%
332	<i>Calophyllum pentapetalum</i>	pamitoyen	3	0.0%
333	<i>Canthium gynochthodes</i>	butlig-babui	3	0.0%
334	<i>Ceiba pentandra</i>	kapok	3	0.0%
335	<i>Cratoxylum blancoi</i>	guyong-guyong	3	0.0%
336	<i>Dasymaschalon clusiflorum</i>	malaates	3	0.0%
337	<i>Delonix regia</i>	firetree	3	0.0%
338	<i>Drypetes bordenii</i>	balikbikan	3	0.0%
339	<i>Ficus ulmifolia</i>	is-is	3	0.0%
340	<i>Firmiana simplex</i>	bitnong	3	0.0%
341	<i>Garcinia busuangaensis</i>	batuhan	3	0.0%
342	<i>Harpullia arborea</i>	uas	3	0.0%
343	<i>Hibiscus tiliaceus</i>	malubago	3	0.0%
344	<i>Hopea cagayanensis</i>	narek	3	0.0%
345	<i>Knema stenocarpa</i>	libago	3	0.0%
346	<i>Litsea leytensis</i>	batikuling	3	0.0%
347	<i>Litsea macgregorii</i>	balanganan	3	0.0%
348	<i>Madhuca betis</i>	betis	3	0.0%
349	<i>Melochia umbellata</i>	labayo	3	0.0%
350	<i>Murraya paniculata</i>	kamuning	3	0.0%
351	<i>Mussaenda philippica</i>	boyon	3	0.0%
352	<i>Pangium edule</i>	pangi	3	0.0%
353	<i>Parartocarpus</i>		3	0.0%
354	<i>Parinari glaberrima</i>	tabon-tabon	3	0.0%
355	<i>Pemphis acidula</i>	bantigi	3	0.0%
356	<i>Radermachera</i>		3	0.0%
357	<i>Schizolobium excelsum</i>	Brazilian firetree	3	0.0%
358	<i>Semecarpus cuneiformis</i>	ligas	3	0.0%
359	<i>Shorea polita</i>	malaanonang	3	0.0%

360	<i>Solenospermum paucinervium</i>	malabuab	3	0.0%
361	<i>Sophora tomentosa</i>	sandalaitan	3	0.0%
362	<i>Swintonia foxworthyi</i>	lomarau	3	0.0%
363	<i>Symplocos acuminatissima</i>	mangkunai	3	0.0%
364	<i>Symplocos villarii</i>	agosip	3	0.0%
365	<i>Syzygium glaucicalyx</i>	mariig	3	0.0%
366	<i>Thevetia peruviana</i>	Peruvian bell	3	0.0%
367	<i>Vavaea amicorum</i>	nangka-nangka	3	0.0%
368	<i>Vernonia arborea v. celebica</i>	bogig	3	0.0%
369	<i>Ziziphus talanai</i>	balakat	3	0.0%
370	<i>Aglaia cuminguiana</i>	alauihau	2	0.0%
371	<i>Ailanthus triphysa</i>	malakamias	2	0.0%
372	<i>Anacardium occidentale</i>	kasui	2	0.0%
373	<i>Anisoptera aurea</i>	dagang	2	0.0%
374	<i>Antidesma bunius</i>	bignai	2	0.0%
375	<i>Antidesma impressinerve</i>	inyam	2	0.0%
376	<i>Astronia</i>		2	0.0%
377	<i>Astronia bicolor</i>	kalingai	2	0.0%
378	<i>Astronia purpuriflora</i>	kaningag	2	0.0%
379	<i>Buchanania nitida</i>	balitantan	2	0.0%
380	<i>Caesalpinia sappan</i>	sibukau	2	0.0%
381	<i>Canarium hirsutum f. multipinnatum</i>	dulit	2	0.0%
382	<i>Casuarina sumatrana</i>	maribuhok	2	0.0%
383	<i>Citrus hystrix</i>	kabuyau-kitid	2	0.0%
384	<i>Elaeocarpus</i>		2	0.0%
385	<i>Euphorbia</i>		2	0.0%
386	<i>Ficus</i>		2	0.0%
387	<i>Ficus benamina</i>	salisi	2	0.0%
388	<i>Glochidion lancifolium</i>	kalian	2	0.0%
389	<i>Graptophyllum hortense</i>	atai-atai	2	0.0%
390	<i>Guioa acuminata</i>	pasi	2	0.0%
391	<i>Hopea</i>		2	0.0%
392	<i>Horsfieldia megacarpa</i>	yabnob	2	0.0%
393	<i>Kopsia arborea</i>	anatau	2	0.0%
394	<i>Laportea brunnea</i>	lingaton	2	0.0%
395	<i>Lepisanthes</i>		2	0.0%
396	<i>Litchi chinensis</i>	licheas	2	0.0%
397	<i>Lithocarpus apoensis</i>	Apo oak	2	0.0%
398	<i>Lithocarpus jordanae</i>	katiluk	2	0.0%
399	<i>Litsea vanoverberghii</i>	baaken	2	0.0%
400	<i>Madhuca amindanaensis</i>	silanangsang	2	0.0%
401	<i>Mallotus multiglandulosus v. pendulus</i>	alim-bitin	2	0.0%
402	<i>Matthaea sancta v. venulosa</i>	balit	2	0.0%
403	<i>Melicope triphylla</i>	matang-arau	2	0.0%
404	<i>Myristica guatteriaefolia</i>	duguan-mabolo	2	0.0%
405	<i>Neolitsea vidalii</i>	puso-puso	2	0.0%
406	<i>Osbornia octodonta</i>	taualis	2	0.0%
407	<i>Palaquium lanceolatum</i>	palak-palak	2	0.0%
408	<i>Pouteria campechiana</i>	tiesa	2	0.0%
409	<i>Premna adenosticta</i>	kalangiauan	2	0.0%
410	<i>Psidium guajava</i>	bayabas	2	0.0%

411	<i>Rauvolfia membranaceae</i>	andarayan	2	0.0%
412	<i>Sesbania grandiflora</i>	katurai	2	0.0%
413	<i>Stemonurus hallieri</i>	malatadu	2	0.0%
414	<i>Sterculia glabrifolia</i>	uos	2	0.0%
415	<i>Syzygium vidalianum</i>	bagilumboi	2	0.0%
416	<i>Tarrietia javanica</i>	lumbayau	2	0.0%
417	<i>Tectona philippinensis</i>	Philippine teak	2	0.0%
418	<i>Thespesia populnea</i>	banalo	2	0.0%
419	<i>Trichadenia philippinensis</i>	malapinggan	2	0.0%
420	<i>Vitex glabrata</i>	bongoog	2	0.0%
421	<i>Voacanga globosa</i>	bayag-usa	2	0.0%
422	<i>Wendlandia glabrata</i>	lanipa	2	0.0%
423	<i>Acalypha</i>		1	0.0%
424	<i>Acmena acuminatissima</i>	binoloan	1	0.0%
425	<i>Aegiceras floridum</i>	tinduk-tindukan	1	0.0%
426	<i>Aglaia laevigata</i>	gisihan	1	0.0%
427	<i>Albizia magallanensis</i>	unaki	1	0.0%
428	<i>Alstonia macrophylla v. mollis</i>	batinong-mabolo	1	0.0%
429	<i>Alstonia parvifolia</i>	batinong-liitan	1	0.0%
430	<i>Antidesma</i>		1	0.0%
431	<i>Antidesma nitidum</i>	bignai-kintab	1	0.0%
432	<i>Aphanamixis perrottetiana</i>	kangko	1	0.0%
433	<i>Ardisia sibuyanensis</i>	lolumboi	1	0.0%
434	<i>Ardisia soligna</i>	dapui	1	0.0%
435	<i>Ardisia squamulosa</i>	tagpo	1	0.0%
436	<i>Azadirachta excelsa</i>	maranggo	1	0.0%
437	<i>Beilschmiedia</i>		1	0.0%
438	<i>Bixa orellana</i>	achuete	1	0.0%
439	<i>Broussonetia paprifera</i>	paper-mulberry	1	0.0%
440	<i>Buddleja asiatica</i>	taliknono	1	0.0%
441	<i>Calophyllum cucullatum</i>	palumut	1	0.0%
442	<i>Calophyllum mindanaense</i>	Mindanao bitanghol	1	0.0%
443	<i>Calophyllum obliquinervium</i>	dangkalan	1	0.0%
444	<i>Chisocheton clementis</i>	dagau	1	0.0%
445	<i>Cinnamomum microphyllum</i>	kalingag-liitan	1	0.0%
446	<i>Citrus macroptera v. southwickii</i>	limau	1	0.0%
447	<i>Colona mollis</i>	keddeng	1	0.0%
448	<i>Commersonia bartramia</i>	kakaag	1	0.0%
449	<i>Cordia cumingiana</i>	anonang-lalaki	1	0.0%
450	<i>Croton heterocarpus</i>	tuba-tuba	1	0.0%
451	<i>Cryptocarya ampla</i>	bagarilau	1	0.0%
452	<i>Cryptocarya lauriflora</i>	lamot	1	0.0%
453	<i>Cubilia cubili (Blanco) Adelb.</i>	kubili	1	0.0%
454	<i>Decaspermum fruticosum</i>	patalsik	1	0.0%
455	<i>Dillenia reifferscheidtia</i>	katmon-kalabau	1	0.0%
456	<i>Diospyros bulusanensis</i>	baganito	1	0.0%
457	<i>Diospyros longiciliata</i>	itom-itom	1	0.0%
458	<i>Diospyros montana</i>	kamagong-bundok	1	0.0%
459	<i>Diplodiscus</i>		1	0.0%
460	<i>Dipterocarpus</i>		1	0.0%
461	<i>Durio zibethinus</i>	durian	1	0.0%
462	<i>Elmerrillia</i>		1	0.0%

463	<i>Ervatamia cordata</i>	sakang-manuk	1	0.0%
464	<i>Euphorbia plumerioides</i>	bait	1	0.0%
465	<i>Evodia</i>		1	0.0%
466	<i>Evodia crassifolia</i>	balasbas	1	0.0%
467	<i>Excoecaria philippinensis</i>	dakau	1	0.0%
468	<i>Ficus cumingii</i>	isis-ibon	1	0.0%
469	<i>Garcinia mangostana</i>	mangosteen	1	0.0%
470	<i>Gardenia megalocarpa</i>	kalapi	1	0.0%
471	<i>Geunsia cumingiana</i>	danasi	1	0.0%
472	<i>Gironniera celtidifolia</i>	magaubau	1	0.0%
473	<i>Glochidion merrillii</i>	pud-pud	1	0.0%
474	<i>Glochidion traindrum</i>	bagna	1	0.0%
475	<i>Gnetum gnemon v. gnemon</i>	bago	1	0.0%
476	<i>Goniothalamus lancifolius</i>	monat	1	0.0%
477	<i>Grewia inflexa</i>	banglad	1	0.0%
478	<i>Grewia setacea</i>	alinau	1	0.0%
479	<i>Guioa koelreuteria</i>	alahan	1	0.0%
480	<i>Heritiera littoralis</i>	dungon-late	1	0.0%
481	<i>Homalanthus alpinus</i>	buta	1	0.0%
482	<i>Homalium panayanum</i>	ampupuyot	1	0.0%
483	<i>Hopea mindanensis</i>	yakal-magasusu	1	0.0%
484	<i>Hydnocarpus</i>		1	0.0%
485	<i>Itea macrophylla</i>	kodai	1	0.0%
486	<i>Ixora macrophylla</i>	asas	1	0.0%
487	<i>Jossinia aherniana</i>	kamania	1	0.0%
488	<i>Lagerstroemia piriformis</i>	batitinan	1	0.0%
489	<i>Leea aculeata</i>	amamali	1	0.0%
490	<i>Lepisanthes macrocarpa</i>	balungai	1	0.0%
491	<i>Linociera ramiflora</i>	karaksan	1	0.0%
492	<i>Lithocarpus buddii</i>	Camus-babaisakan	1	0.0%
493	<i>Litsea baractanensis</i>	sablot-linis	1	0.0%
494	<i>Litsea euphlebia</i>	matang-usa	1	0.0%
495	<i>Litsea luzonica</i>	dungoi	1	0.0%
496	<i>Litsea urdanetensis</i>	dilak-manuk	1	0.0%
497	<i>Lunasia amara</i>	lunas	1	0.0%
498	<i>Macaranga cumingii</i>	anitap	1	0.0%
499	<i>Mangifera caesia</i>	baluno	1	0.0%
500	<i>Mangifera longipes</i>	apali	1	0.0%
501	<i>Memecylon venosum</i>	gikayan	1	0.0%
502	<i>Nauclea multicephala</i>	kabak	1	0.0%
503	<i>Neonauclea</i>		1	0.0%
504	<i>Neonauclea reticulata</i>	malauisak	1	0.0%
505	<i>Ochna foxworthyi</i>	bansilai	1	0.0%
506	<i>Parartocarpus venenosus</i> subsp. <i>Papuanus</i>	malanangka	1	0.0%
507	<i>Parinari</i>		1	0.0%
508	<i>Pometia tomentosa</i>	tugai	1	0.0%
509	<i>Premna integrifolia</i>	alagau-dagat	1	0.0%
510	<i>Premna membranifolia</i>	agbau	1	0.0%
511	<i>Pterospermum cumingii</i>	talinuanga	1	0.0%
512	<i>Rhizophora stylosa</i>	bangkau	1	0.0%
513	<i>Saurauia elegans</i>	uyok	2	0.0%
514	<i>Securinega</i>		1	0.0%

515	<i>Semecarpus gigantifolia</i>	manalu	1	0.0%
516	<i>Serialbizia acle</i>	akle	1	0.0%
517	<i>Shorea malibato</i>	yakal-malibato	1	0.0%
518	<i>Shorea seminis</i>	malayakal	1	0.0%
519	<i>Spiraeopsis celebica</i>	bognag	1	0.0%
520	<i>Spondias purpurea</i>	sineguelas	1	0.0%
521	<i>Sterculia graciliflora</i>	bolat	1	0.0%
522	<i>Sterculia oblongata</i>	malabuho	1	0.0%
523	<i>Sterculia philippinensis</i>	banilad	1	0.0%
524	<i>Symplocos bulusanensis</i>	magoting	1	0.0%
525	<i>Syzygium aqueum</i>	tambis	1	0.0%
526	<i>Syzygium costulatum</i>	paitan	1	0.0%
527	<i>Syzygium mananquil</i>	manangkil	1	0.0%
528	<i>Syzygium martelinoi</i>	bagohangin	1	0.0%
529	<i>Syzygium samarangense</i>	makopa	1	0.0%
530	<i>Syzygium subsessiliflorum</i>	malagulagan	1	0.0%
531	<i>Syzygium tula</i>	tula	1	0.0%
532	<i>Teijsmanniodendron pteropodum</i>	tikoko	1	0.0%
533	<i>Terminalia calamansanai</i>	malakalumpit	1	0.0%
534	<i>Timonius arboreus</i>	mabalod	1	0.0%
535	<i>Trigonachras cuspidata</i>	salab	1	0.0%
536	<i>Tristania littoralis</i>	taba	1	0.0%
537	<i>Villebrunea rebescens</i>	alipasio	1	0.0%
538	<i>Ziziphus</i>		1	0.0%
539	<i>Ziziphus trinervia</i>	duklap	1	0.0%
540		***various unidentified species (or species with local names)	1206	5.8%

## Annex 6: Summary DBH Class by Forest Type

Forest Type	Area	Trees/ha by diameter class													
		Tree Count /ha	DBH 15 (10-19)	DBH 25 (20-29)	DBH 35 (30-39)	DBH 45 (40-49)	DBH 55 (50-59)	DBH 65 (60-69)	DBH 75 (70-79)	DBH 85 (80-89)	DBH 95 (90-99)	DBH 105 (100-109)	DBH 115 (110-119)	DBH 125 (120-129)	DBH 135 & up (130 up)
FB - Closed	4316601	463	327	53	39	24	10	5	2	1	1	0	0	0	0
FB- Open	1716627	216	127	43	23	13	4	3	1	1	1	0	0	0	0
FC - Close	22836	226	0	42	42	42	26	42	32	0	0	0	0	0	0
FC - Open	189750	127	75	18	7	10	7	6	4	1	1	0	0	0	0
FM - Close	64629	no measurement was conducted													
FM - Open	18096	67	0	31	26	7	2	0	0	0	0	0	0	0	0
PB - Close	263944	93	61	24	7	1	0	0	0	0	0	0	0	0	0
PB - Open	345462	120	55	50	11	2	1	0	0	0	0	0	0	0	0
PC - Close	8617	110	0	40	5	40	15	10	0	0	0	0	0	0	0
PC - Open	1896	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BB - Close	96943	17	10	2	4	1	0	0	0	0	0	0	0	0	0
BB- Open	59631	9	0	4	3	0	1	0	0	0	0	1	0	0	0
Mg - Close	31022	570	475	39	41	15	0	0	0	0	0	0	0	0	0
Mg - Open	9565	80	71	9	1	1	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>7145619</b>														

**Legend:**

**FB – Close: Natural Broadleaved Forest Close**  
**FB – Open: Natural Broadleaved Forest Open**  
**FC – Close: Natural Coniferous Forest Close**  
**FC – Open: Natural Coniferous Forest Open**  
**FM – Close: Mixed Forest Close**  
**FM – Open: Mixed Forest Open**  
**PB – Close: Broadleaved Plantation Close**  
**PB – Open: Broadleaved Plantation Open**  
**PC – Close: Coniferous Plantation Close**  
**PC – Open: Coniferous Plantation Open**  
**BB – Close: Bamboo/Boho Formation Close**  
**BB- Open: Bamboo/Boho Formation Open**  
**Mg – Close: Mangrove Forest Close**  
**Mg – Open: Mangrove Forest Open**