THE STATE
OF THE WORLD's
FOREST GENETIC RESOURCES
COUNTRY REPORT
PHILIPPINES

This country report is prepared as a contribution to the FAO publication, The Report on the State of the World's Forest Genetic Resources. The content and the structure are in accordance with the recommendations and guidelines given by FAO in the document Guidelines for Preparation of Country Reports for the State of the World's Forest Genetic Resources (2010). These guidelines set out recommendations for the objective, scope and structure of the country reports. Countries were requested to consider the current state of knowledge of forest genetic diversity, including:

- Between and within species diversity
- List of priority species; their roles and values and importance
- List of threatened/endangered species
- Threats, opportunities and challenges for the conservation, use and development of forest genetic resources

These reports were submitted to FAO as official government documents. The report is presented on www. fao.org/documents as supportive and contextual information to be used in conjunction with other documentation on world forest genetic resources.

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Department of Environment and Natural Resources
ECOSYSTEMS RESEARCH AND DEVELOPMENT BUREAU
College, Laguna, Philippines

Country Report on Forest Genetic Resources Philippines

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FRONT and BACK COVER PHOTO: Seed Production Area of *A. mangium* in Bansud, Oriental Mindoro, Philippines.

Country Report on Forest Genetic Resources Philippines

Foreword

The world's forest genetic resources are in a state of siege. For too long a time, the forests of the world have been subjected to severe exploitation to satisfy the needs of an ever growing population. This is not surprising as indeed the forests are springs of resources that can satisfy most basic needs of man. History tells us that the forests have been the dominant habitats of the early human civilization. Before the advent of sedentary agriculture, the forest resources have largely supported the nomadic life of human beings. In most countries of the world, the forests and the various natural resources they contain have also provided the foundation for progress and development. Even in these current times, people have been turning to the forests for their sources of livelihood, and food and fuel during periods of scarcity. It is no wonder then that in the course of history, we have seen the steady decline in both the quantity and quality of the forests around the world.

Nowhere in the world could such be true as in the Philippines. Significant stages in the economy of the country in the past could be tied with the state of forest and forest resources use. It was in the Philippines where systematic logging of the tropical forests in Southeast Asia had been first demonstrated. For a time during the early part of the last quarter of the previous century, the forestry sector has been the top contributor to the Philippines' gross domestic product. Back then, the Philippines had been exporting quality logs to countries abroad. Other than being the top dollar earner for the country that time, the forest industries had been providing work to several thousands of Filipinos and boosting the economy in the local areas where timber concessions were operating. But that was long ago. From a high of about 19 million hectares or about 65% of the total area of the country at the start of the last century, the forests of the country have steadily been decimated through the years. At the end of the last century, the forest of the country was down to a measly 17% of the total area of the nation.

A belated recognition of the implications of such sobering circumstance was the irreversible consequences of such to the forest genetic resources of the country. It cannot be denied that

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with the systematic and indiscriminate cutting of the country's forests in the past, a huge part of these genetic resources has been removed never to benefit the Filipinos again today and in the years to come. That the Philippines has been declared as one of the biodiversity hotspots of the world points to the fact that it had lost a significant portion of such forest genetic resources, and that the loss will continue unless drastic measures are instituted to reverse such phenomenon. The Philippines' forest genetic resources are indeed not inexhaustible resources as they were once perceived to be.

Today, there are indications of an increasing awareness on the need to conserve and protect whatever remains of the forest genetic resources of the country. Several big initiatives, both by the government and the private sectors, are achieving limited gains in so far as curbing the further depletion of the Philippines forest genetic resources is concerned. But more needs to be done. It should be obvious to everyone that the current efforts towards forest genetic conservation in the country are still wanting, with the current programs and activities largely fragmented in nature. There is the felt need to harmonize all these initiatives and formulate and implement seriously a national program on the conservation of forest genetic resources in the country.

The preparation of this country report on the state of the forest genetic resources in the Philippines as part of the program of the Food and Agriculture Organization of the United Nations on the "State of the World's Forest Genetic Resources" could very well be the means to jumpstart a meaningful national initiative. Other than providing this impetus, this country report also hopes to strengthen further the current awareness on the value of forest genetic resources and the urgent need to sustainably manage and/or conserve such.

The report can very well provide the foundation for a more concerted effort on the sustainable management and conservation of the Philippines forest genetic resources. This needs to be done, and undertaken in the immediate future, before it becomes too late.

RAMON J. P. PAJE, *CESO I*
Secretary
Department of Environment
and Natural Resources
Philippines

Preface

The Country Report on the State of the Forest Genetic Resources is the Philippines contribution to the preparation of the "The State of the World's Forest Genetic Resources (SoW-FGR)" by the Food and Agriculture Organization of the United Nations. The latter is a response of the FAO to the felt need to continually guarantee the sustainable use and conservation of the world's forest biological diversity to insure that such is able to provide for food security, poverty alleviation, environmental conservation, as well as the economic and social advancement and the maintenance of cultural and spiritual values in the communities that depend on them. As envisioned by the FAO, the country reports were to provide the foundation for the drafting of the SoW-FGR. To provide for a common framework on the reporting process and to insure the uniformity of the information that shall be used in the writing of the Sow-FGR, the FAO prescribed a set of guidelines in the preparation of the country reports. This report endeavored to conform mostly to the framework and prescriptions in the guidelines.

In addition to heightening the awareness on the critical need for more sustainable use and management of the country's forest genetic resources, the Report also provides a platform for the planning and implementation of activities that should lead to the conservation of the same on a national level. In keeping with the FAO instituted guidelines, the Philippine Country Report has attempted to provide a comprehensive assessment of the following: the state of forest genetic resources in the Philippines and their roles in the forest and forestry production systems in the country, including the associated biodiversity and the factors driving the changes; the current contribution of forest genetic resources to sustainable forest development, and food, and agriculture; how the contribution of forest genetic resources to sustainable forest development, and food and agriculture can be enhanced, identifying opportunities and obstacles, as well as strategies to realize the opportunities and overcome any obstacles, and; the needs and priorities for capacity building to enable the conservation, sustainable use and development of forest genetic resources.

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The Report contains insights on the past and current management of the forest genetic resources in the Philippines, the different *in-situ* and *ex-situ* forest genetic resources conservation programs, a description of the few tree improvement and breeding activities undertaken, existing infrastructures and facilities as well as laws, rules and regulations and other policy issuances related to forest genetic resources use and conservation, the country's participation in regional and international agreements and collaborative projects, existing knowledge base and education programs, research and development programs and projects, and the different capacity building initiatives on the sustainable use and conservation of forest genetic resources in the country.

The Ecosystems Research and Development Bureau of the Department of Environment and Natural Resources took the lead in the drafting and finalization of the country report. The completion of this Report would not have been possible without the help of a number of persons and institutions. Their work is acknowledged with much appreciation. They have contributed so much in advancing the cause of conserving and managing the forest genetic resources of the Philippines in a sustainable manner.

MARCIAL C. AMARO, JR., *CESO III*
Director
Ecosystems Research and Development Bureau

Executive Summary

The need to conserve forest genetic resources has long been seriously recognized. Taking the lead in the efforts to stem the tide of the continuous loss of and/or conserve the world's forest genetic resources is the Food and Agriculture Organization (FAO) of the United Nations which has organized the Panel of Experts on Forest Gene Resources or the Forest Gene Panel as early as 1967. This urgent concern was further translated into action with the FAO Commission on Genetic Resources for Food and Agriculture agreeing on the preparation of a report on "The State of the World's Forest Genetic Resources." The global report will draw from the country reports that shall be prepared by the member countries. This is the Country Report on the Forest Genetic Resources (FGR) of the Philippines.

This country report was prepared in accordance with the Guidelines for the Preparation of Country Reports for the State of the World's Forest Resources prepared by the FAO. The FAO designed the Country Reports to cover genetic resources of environmental, economic, social and cultural values. Specifically, the country reports were expected to bring insights on current management activities of forest genetic resources, *in-situ* and *ex-situ* genetic conservation as well as improvement and breeding activities, support facilities, and participation and/or involvement in regional and international cooperation and collaboration pertaining to forest genetic resources, and capacity building needs on both knowledge and genetic resources management.

In keeping with the guidelines, this report is an attempt to assess the state of the Philippine's forest genetic resources and their roles and values. In the assessment, "aspects of forest biodiversity, the production systems and the environment in which these resources are used, the range of products and services which they provide, the consumption patterns and socio-cultural practices associated with them, the ecosystem functions which they sustain and their roles in achieving sustainable forest management, food security and poverty alleviation" were likewise discussed.

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The Philippines lies just above the equator between 4°30' and 21°20' North latitude and 116°40' and 126°34' East longitude and is made up of over 7,107 islands. Of the total land area, 94% comes from the 11 largest islands. The land area is 300,000 square kilometres (sq km) or 30,000,000 hectares (ha). Water within the land occupies an area of 1,830 sq km. The coastline measures 36,289 km. The prevailing climate is tropical rain monsoon from November to April and Southwest monsoon from May to October. There are only two seasons, wet and dry as per the monsoon rains. The terrain is mostly mountainous with narrow coastal lowlands. Natural hazards include 20-22 cyclonic typhoons per year, landslides, flooding, active volcanoes, destructive earthquakes and tsunamis. Current environmental issues include uncontrolled deforestation especially in watershed areas, soil erosion, air and water pollution in major urban areas, coral reef degradation, and increasing pollution of coastal mangrove swamps that are important as fish breeding grounds.

In situ conservation of forest genetic resources in the Philippines largely takes place in protected areas in the Philippines. *In situ* conservation in protected areas started in the Philippines as early as 1932, through the institution of the National Parks System. In totality, 60 national parks and 8 game refuges and bird sanctuaries were established under this system. These parks, refuges and sanctuaries became a core component of the National Integrated Protected Areas System (NIPAS) which was established in 1992 through Republic Act (RA) 7586. The objective of NIPAS is to *"integrate outstanding remarkable areas and biologically important public lands that are habitats of rare and endangered species of plants and animals, biogeographic zones and related ecosystems whether terrestrial, wetland or marine, all of which shall be designated as protected areas"*. The national parks established before 1992 became the initial components of NIPAS. Currently, there are 302 of these in the NIPAS with a total area of more than 5.5 million ha, including natural parks, protected landscapes and seascapes, natural monuments or landmarks, resource reserves, wildlife sanctuaries, natural biotic areas, and marine parks and mangrove swamps. Only about 93 have, thus far, been given Presidential Proclamation or Congressional actions covering some 2.95 million ha or just 9.8% of the total land area of the Philippines. Constraints in the *in situ* conservation of forest genetic resources in the country include inadequate inventories of their plant biodiversity or detailed information on which rare and threatened species occur in which protected areas, the abundance of rare, endangered, or threatened species in production forests, the threat of alien invasive species in PAs, lack of knowledge and skills of field personnel doing timber cruising on rare, endangered and threatened tree species, non-delineation on the ground of the boundaries of the PAs, encroachment of farming activities into the PAs, and institutional and management limitations.

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Ex situ conservation efforts for forest genetic resources in the Philippines generally involve establishment of field genebanks or plantations, botanical gardens, and seed banks. For a time genebanks mostly of commercial fast growing exotic species in the form of tree plantations were maintained by large integrated wood industries (e.g. PICOP Resources, Inc.) in the country. But such living collections were also subjected to harvesting. To date, there may still be a few remaining collections but they are no longer being maintained and that records pertaining to accessions in such areas are mostly missing. There are now three rattan genebanks, a field genebank of agroforestry tree species, two palmetum, two mangrovetum, and three bambusetum. All are adequately maintained. There are botanic gardens in several areas in the country notable of which is the Makiling Botanic Gardens of the University of the Philippines Los Baños (UPLB) in the Province of Laguna. There are clonal multiplication gardens of dipterocarps and tree plantation species. There are seed production areas identified but their maintenance and documentation are inadequate. There are a few seed orchards established by ERDB. There are significant efforts on clonal propagation, both macro- and micro-propagation. Few researches related to *ex situ* conservation have been undertaken so far. Initiatives on the *ex situ* conservation of forest genetic resources in the Philippines are largely fragmented and clearly, more needs to be done along this area.

Much needs to be done also when it comes to the sustainable use and management of forest genetic resources in the country. The continuous destruction of the environment poses a great threat to the availability of forest genetic resources. Destruction is mainly caused by land conversion for settlement, agricultural development, shifting cultivation, logging, forest fire, and to some extent mining, energy projects, and pest and diseases. The country's forest genetic resources are threatened by overexploitation for commercial purposes (e.g. collection of wild orchids for export), land conversion (logging and shifting cultivation) and habitat fragmentation. Furthermore, previous efforts and current activities on the genetic improvement and/or breeding of forest species in the Philippines are few and largely fragmented. The country doesn't have a national tree improvement program as yet to tie in all the initiatives on forest genetic improvement including forest genetic resources conservation.

There are several types of organizations that are known to be conducting field and laboratory works on forest genetic resources conservation. These are the Department of Environment and Natural Resources through its Ecosystems Research and Development Bureau and its regional field research units (Ecosystems Research and Development Services), the academic institutions (e.g. the UPLB, the Visayas State University in Leyte Province, and other state colleges and universities), conservation-oriented NGOs

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and a few private wood industries in the past. The government's NIPAS program is a positive force in the efforts towards in-situ conservation of FGR. The recently launched National Greening Program seeks to contribute to ex-situ conservation. There are few organizations that have undertaken serious FGR conservation initiatives with some being national in scope. The achievements of these organizations and their programs are potential building blocks for reinforcing FGR conservation efforts in the country in the future.

Institutionally, the Philippines has also established the structure to guarantee the continuity of initiatives towards the conservation of forest genetic resources in the country. Various laws have been enacted and local ordinances have been promulgated that are designed to safeguard such resources. These efforts are complemented by a continuing program on information, education, and communication designed to promote the conservation of forest genetic resources.

The Philippines is also a party to a number of multilateral environmental agreements (MEAs) which aims to conserve and sustainably use biological diversity. These include the United Nations Environment Programme (UNEP) Convention on Biological Diversity (CBD), the Cartagena Protocol on Biosafety, and the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES). In like manner, the country is a member of international organizations whose thrusts include the sustainable use of FGR like the IUFRO and the APAFRI and has been collaborating with regional initiatives whose objectives are to seek better understanding of FGR related topics. The latter includes the International Neem Network, the ASEAN Peatland Forests Project, and the ASEAN Biodiversity Centre. All these involvements have given a boost to the government's efforts geared towards implementing programs and projects designed to create better appreciation of the value of and the need to conserve and sustainably use the country's forest genetic resources. The formulation and implementation of a National Forest Tree Improvement Program is an imperative to tie in all the past and present efforts on the conservation and the sustainable use of country's forest genetic resources.

This report also highlights the wealth of the Philippines in terms of its forest genetic resources. From its forests comes a multitude of goods – food, wood, medicine and "cosmeceuticals", non-wood forest products, and raw materials for the handicrafts and novelty items. Methods are now evolving towards the effective valuing of the services that come with the sustainable management of the forest genetic resources. With this development is the increasing appreciation of the concept of payment for environmental services that will work towards more vigorous efforts towards the sustainable

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use of such resources. In the Philippines too, current interest on REDD+ very well complements the thrust on the conservation of existing forest genetic resources of the nation.

In the face of such developments are challenges that the country will have to address to further the moves towards such conservation efforts. These include the need for more skills and knowledge on forest genetic resources among the country's environmental managers and the general public, the conduct of more scientific studies aimed at generating additional basic knowledge on forest genetic resources and producing better technologies to address the regeneration of the same including more efficient utilization schemes, the need for more surveys of the protected areas in the country, establishment of more facilities for the *ex-situ* conservation of forest genetic resources, and the implementation of an efficient and effective monitoring system of conservation priority protected areas.

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List of Acronyms

ACB	ASEAN Centre for Biodiversity
ADB	Asian Development Bank
AFFLA	Agroforestry Farm Lease Agreement
AFTA	ASEAN Free Trade Area
APAFRI	Asia Pacific Association of Forest Research Institutions
APFP	ASEAN Peatland Forests Project
ASEAN	Association of Southeast Asian Nations
ATSAL	Agroforestry Tree Seed Association of Lantapan
ATSC	Australian Tree Seed Centre
BFI	Bukidnon Forests, Inc.
BK	Bantay Kalikasan
BMS	Biodiversity Monitoring System
CADT	Certificate of Ancestral Domain Title
CALT	Certificate of Ancestral Land Title
CBD	Convention on Biological Diversity
CBFM	Community Based Forest Management
CBFMP	Community-Based Forest Management Program
CBFMA	Community Based Forest Management Agreement
CDM	Clean Development Mechanism
CFNR	College of Forestry and Natural Resources
CFP	Community Forestry Program
CIA	Central Intelligence Agency
CITES	Convention on International Trade of Endangered Species of Wild Flora and Fauna
COP	Conference of Parties
CPPAP	Conservation of Priority Protected Areas Project
C & I	Criteria and Indicator
CSC	Certificate of Stewardship Contract
CSIRO	Commonwealth Scientific and Industrial Research Organization
CSO	Clonal Seed Orchard
DAO	DENR Administrative Order
DENR	Department of Environment and Natural Resources
DOST	Department of Science and Technology
EC	European Commission
EO	Executive Order
ERDB	Ecosystems Research and Development Bureau
ERDS	Ecosystems Research and Development Services
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FGR	Forest Genetic Resources

FLD	Forest & Landscape Denmark
FLAgT	Forest Land use Agreement for Tourism
FLGMA	Forest Land Grazing Management Agreement
FMB	Forest Management Bureau
FORTIP	Regional Project on Improved Productivity of Man-Made Forests Through Application of Technological Advances in Tree Breeding and Propagation
FPE	Foundation for Philippine Environment
FRA	Forest Resources Assessment
FPRDI	Forest Products Research and Development Institute
GDP	Gross Domestic Product
GEF	Global Environment Facility
GMO	Genetically Modified Organisms
GO	Government Organization
ICC	Indigenous Cultural Communities
ICRAF	The World Agroforestry Centre
IEC	Information, Education, and Communication
IFMA	Integrated Forest Management Agreement
INBAR	International Network for Bamboo and Rattan
IPA	Important Plant Area
IPB	Institute of Plant Breeding
IPRA	Indigenous Peoples' Rights Act
IPS	Important Plant Site
IRR	Implementing Rules and Regulations
ITPLA	Industrial Tree Plantation License Agreement
ITTO	International Tropical Timber Organization
IUCN	International Union for the Conservation of Nature and Natural Resources
LGU	Local government unit
MBG	Makiling Botanic Gardens
MEA	Multilateral Environmental Agreements
MIS	Management Information System
NAMRIA	National Mapping and Resources Inventory Authority
NCIP	National Commission on Indigenous People
NEDA	National Economic Development Authority
NEP	National Ecotourism Plan
NIPAS	National Integrated Protected Areas System
NIPAP	National Integrated Protected Areas Project
NGOs	Non-government Organizations
NGP	National Greening Project
NIA	National Irrigation Administration
NPC	National Power Corporation
OGAs	Other government agencies
PA	Protected Area
PACBRMA	Protected Area Community-Based Resource Management Agreement
PAMB	Protected Area Management Board
PAMP	Protected Area Management Plan
PAWB	Protected Areas and Wildlife Bureau
PCARRD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PCHM	Philippine Clearing House Mechanism for Biodiversity

PCSD	Philippine Council for Sustainable Development
PICOP	Paper Industries Corporation of the Philippines
PES	Payment for Environmental Service
PNG	Papua New Guinea
PNOC	Philippine National Oil Corporation
PSLP	Public Sector Linkage Program
PTFCF	Philippine Tropical Forest Conservation Foundation
PTFI	Provident Tree Farms, Inc.
RA	Republic Act
RDE	Research, Development, and Extension
REDD	Reducing Emissions from Deforestation and Forest Degradation
RP	Republic of the Philippines
R & D	Research and Development
SBMA	Subic Bay Metropolitan Authority
SCU	State, colleges , and universities
SIBF	Samar Island Biodiversity Foundation
SIBP	Samar Island Biodiversity Program
SIFMA	Socialized industrial Forest Management Agreement
SINP	Samar Island Natural Park
SLP	Special Land use Permit
SFM	Sustainable Forest Management
SME	Small and Medium Enterprises
SoW-FGR	State of the World's Forest Genetic Resources
SPA	Seed Production Area
SSO	Seedling Seed Orchard
SUDECOR	Surigao Development Corporation
SUSTEC	Sustainable Ecosystems International Corporation
TFLA	Tree Farm Lease Agreement
TLAs	Timber License Agreements
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
UP	University of the Philippines
UPLB	University of the Philippines Los Baňos
USD	United States Dollars
USDA	United States Department of Agriculture
WB	World Bank
WTO	World Trade Organization
WWF	World Wildlife Fund

Introduction

Forest genetic resources have long played a key role in the history of the world. Significant events in the past have seen how mankind has been intricately woven with the forests of the world and all the resources thereat. It is no wonder then that the phenomenal increase in the global population has been accompanied by the continuous diminution of the forests of the world. And with the shrinkage of the forests is the inevitable reduction or even the virtual loss of valuable genetic resources in the said areas.

In this report, forest genetic resources represent the entire "genetic variation in trees which are of potential or present benefit to humans" (FAO, 1989). The FAO, the Forest & Landscape Denmark, and the International Plant Genetic Resources Institute, now the Bioversity International (FAO, FLD, IPGRI, 2004) define forest as denoting a stand, population or landscape of trees, and typically other associated woody plants. The term genetic in the same report refers to "variation of genetic (DNA) origin, and variation of genes at different levels: (1) variation between species, (2) variation between populations within species and (3) variation between individual trees within populations. The largest variation is between species, and loss of whole species is therefore also the most dramatic loss of future options." Finally, resources refers to the "use of genetic variation—in the broad sense stated above—considered to be of potential value for humans at present or in the future." These concepts are adopted in this report.

The need to conserve forest genetic resources has long been seriously recognized. Taking the lead in the efforts to stem the tide of the continuous loss of and/or conserve the world's forest genetic resources is the Food and Agriculture Organization (FAO) of the United Nations which has organized the Panel of Experts on Forest Gene Resources or the Forest Gene Panel as early as 1967. This urgent concern was further translated into action with the FAO Commission on Genetic Resources for Food and Agriculture agreeing on the preparation of a report on "The State of the World's Forest Genetic Resources." The global report will draw from the country reports that shall be prepared by the member countries. This is the Country Report on the Forest Genetic Resources of the Philippines.

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In keeping with the guidelines, this report is an attempt to assess the state of the Philippine's forest genetic resources and their roles and values. In the assessment, "aspects

of forest biodiversity, the production systems and the environment in which these resources are used, the range of products and services which they provide, the consumption patterns and socio-cultural practices associated with them, the ecosystem functions which they sustain and their roles in achieving sustainable forest management, food security and poverty alleviation" were likewise discussed.

Researchers and technical staff of the Ecosystems Research and Development Bureau (ERDB) of the Department of Environment and Natural Resources (DENR) spearheaded the preparation of the report. Initially, an extensive literature search and retrieval of documents from research and development organizations in the country, as well as academic institutions engaged in activities on forest genetic resources conservation and management and related fields. The information collected were then consolidated and formed the bases in writing the draft of the country report. This was also referred to the DENR Regional Research Sectors nationwide for comments and improvement. A National Consultative Workshop on the State of the Philippine Forest Genetic Resources (FGR) was then convened for the purpose of validating and enriching further the contents of the draft country report. Key researchers and staff from the ERDB and other scientists whose expertise and experiences relate to FGR participated during the National Workshop. The draft country report was presented in a plenary session. Discussion groups were formed and each chapter of the draft country report was comprehensively assessed as to the contents. The country report was finalized with inputs from the national workshop.

Basic Geographic Description

Forming part of the Southeast Asian region, the Philippines is located about 1,000 kilometers from the southeast coast of the mainland of Asia. It lies between 21°20' north and 4°30' north latitude and 116°55' east and 126°36' east longitude (Fig. 1). It is bounded on the west and north by the South China Sea, on the east by the Pacific Ocean; and on the South by the Celebes Sea and the coastal waters of Borneo. The country straddles important shipping lanes both in the China Sea and the Pacific Ocean making it a strategic location for trading of goods and other commercial activities . This is the reason why the Philippines is sometimes referred to as the "Pearl of the Orient Seas."

With its total land area of 115,830 square miles (300,000 square kilometers), it constitutes two percent of the total land area of the world and is classified as a medium sized country. The entire archipelago of 7,107 islands is

Fig. 1. The location of the Philippines in Southeast Asia.

divided into three major island groups, Luzon, Visayas, and Mindanao. The largest island of Luzon is where the capital city of Manila is located. It is also the most populous among the island groups. Industrial activities are mostly concentrated in the regions surrounding Metro Manila, as well as in the central part of the Philippines, particularly in the Island of Cebu in the Visayas.

Climate and Weather Conditions

Using temperature and rainfall as bases, the climate of the country can be divided into two major seasons: (1) the rainy season, from June to November; and (2) the dry season, from December to May. The dry season may be subdivided further into (a) the cool dry season, from December to February; and (b) the hot dry season, from March to May. Based on the distribution of rainfall, four climate types are recognized. The description of each type and the prevailing types in the different regions of the country are described in Fig. 2).

Based on the average of all weather stations in the Philippines, excluding the City of Baguio, the mean annual temperature is 26.6°C. The coolest month is January with a mean temperature of 25.5°C while the warmest month occurs in May with a mean temperature of 28.3°C. Latitude is an insignificant factor in the variation of temperature while altitude shows greater contrast in temperature. The difference between the mean annual temperature of the southernmost station in Zamboanga and that of the northernmost station in Laoag City is insignificant. In other words, there is essentially no difference in the mean annual temperature of places in the island groups of Luzon, the Visayas, or Mindanao measured at or near sea level.

The Philippines has a high prevailing relative humidity throughout the year mainly due to high temperatures and the surrounding bodies of water. The average monthly relative humidity varies between 71 percent in March and 85 percent in September. The combination of warm temperature and high relative and absolute humidities give rise to high sensible temperatures throughout the archipelago. It is especially uncomfortable during March to May, when temperature and humidity attain their maximum levels.

The mean annual rainfall of the Philippines varies from 965 to 4,064 millimeters an-nually. Baguio City, eastern Samar, and eastern Surigao receive the greatest amount of rainfall while the southern portion of Cotabato receives the least amount of rain. At General Santos City in Cotabato, the average annual rainfall is only 978 millimeters.

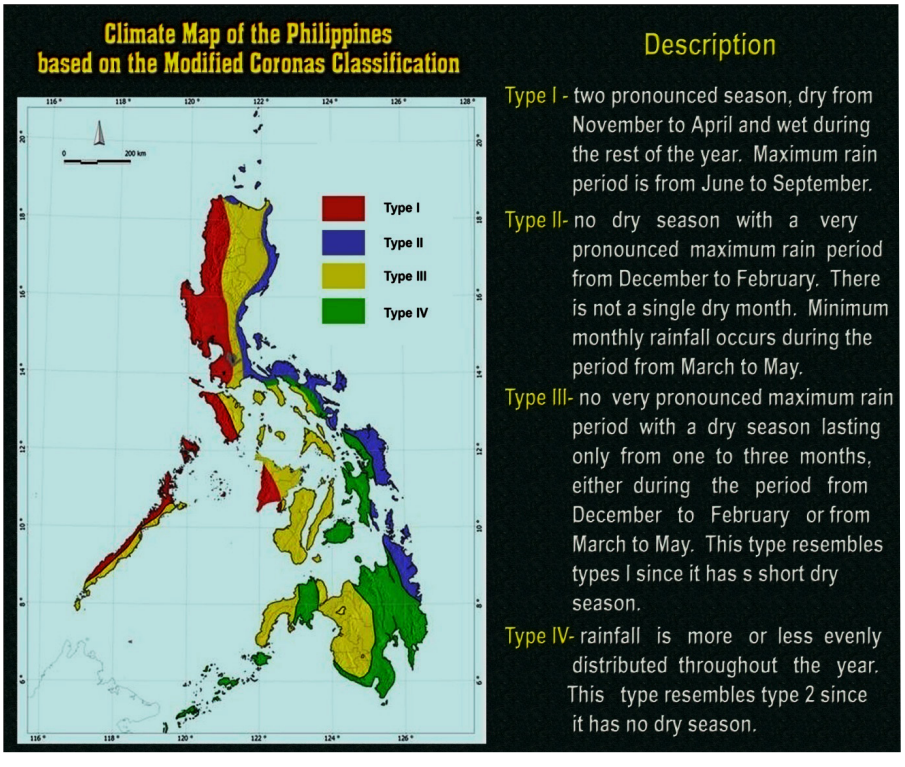

Fig. 2. Climate types in the Philippines.

The Philippines is often visited by tropical cyclones which exert a great influence on the climate and weather conditions of the country. A huge portion of the rainfall, humidity and cloudiness are due to the influence of these weather disturbances that generally originate from the east in the region of the Marianas and Caroline Islands of the Pacific Ocean which have the same latitudinal location as Mindanao. Their movements follow a northwesterly direction, sparing Mindanao from being directly hit by majority of the typhoons that cross the country.

Topographic Features

Topographically, the Philippines is broken up by the sea, which gives it one of the longest coastlines of any nation in the world. Most Filipinos live on or near the coast, where they can easily supplement their diet from approximately 2,000 species of fish. Off the coast of eastern Mindanao is the Philippines Through, which descends to a depth of 10,430 meters. The Philippines is part of a western Pacific arc system that is characterized by active volcanoes. Among the most notable peaks are Mount Mayon near Legazpi City, Taal Volcano south of Manila, and Mount Apo on Mindanao. All of the Philippine islands are prone to earthquakes. The northern Luzon highlands, or Cordillera Central, rise to between 2,500 and 2,750 meters, and, together with the Sierra Madre in the northeastern portion of Luzon and the mountains of Mindanao, boast of rain forests that provide refuge for numerous upland tribal groups. (http://en.wikipedia.org/wiki/Geography_of_the_Philippines_30 December 2011).

The country's most extensive river systems are the Pulangi River, which flows into the Mindanao River (Rio Grande de Mindanao); the Agusan, in Mindanao which flows north into the Mindanao Sea; the Cagayan in northern Luzon; and the Pampanga, which flows south from east Central Luzon into Manila Bay. Laguna de Bay, east of Manila Bay, is the largest freshwater lake in the Philippines. Several rivers have been harnessed for hydroelectric power.

Population and Economy

In the year 2008, the Philippines has a population density of 303 people km^2, and an annual population growth rate of 1.8% (FAO, 2010). It was also estimated that of the total population, 35% lives in the rural areas. In the same year, per capita GDP in the country was determined at 3, 513 USD with an annual growth rate of 3.8%.

The Philippine Forestry Sector

The Global Forest Resources Assessment of the FAO (2010) estimated that the Philippine forests cover an area of 7,665,000 hectares or 26% of the total land area of the Philippines (Table 1). Other wooded lands occupy 10,128,000 hectares or 34% of the total land mass.

From 1990 onwards, a progressive increase in forest cover has been observed (Fig. 3) from

Table 1. Philippine forest cover as of 2010 (FAO, 2010).

	Area (1,000 has.)
Total Land Area (1000 square kilometers)	29817
Total Forest Area (1000 ha)	7665
Percent Forest Cover	26
Primary Forest Cover (1000 ha)	861
Primary Forest, % total forest	11
Other wooded land (1000 ha)	10128
Other wooded land % total forest	34

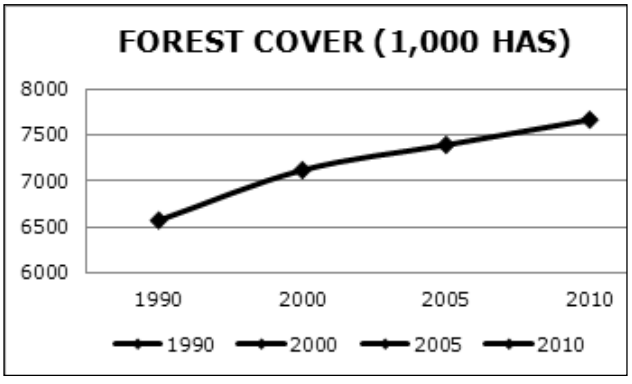

Fig. 3. Extent of forest cover in the Philippines from 1990 to 2010.

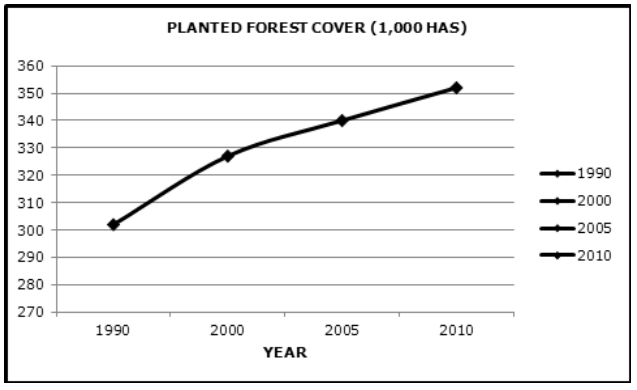

Fig. 4. Development of forest plantations in the Philippines from 1990 to 2010.

6,775,000 hectares to 7,665,000 hectares (FAO, 2010).

Naturally regenerated forests occupy the bulk (84%) of the total forest area in the country (Table 2). The old growth forests in the Philippines account for 11% of the total forest area with 861,000 hectares. The rest are established forest plantations with an area of 352,000 hectares (5% of the total forest area). The large bulk of the plantations (99%) are planted with exotic species (*Eucalyptus*, *Acacias, Paraserianthes falcataria, Gmelina arborea, and Swietennia macrophylla*). Over the years, the area of the planted forests has also increased (Fig. 4).

The FAO Global Forest Resource Assessment of 2010 also indicated that 76%, 8%, and 16% of the forests of the country are primarily devoted to production, soil and water protec-tion/ conservation, and biodiversity conserva-tion, respectively. Furthermore, 85% of the forests are publicly owned and the rest are of private ownership. Of the total forest area, 24% or 1,804,000 hectares are within protected areas and that 29% (2,250,000 hectares) are being utilized under existing fo-rest management plans, either by the government, or the private sector.

Table 2. Breakdown of Philippine forests into types (FAO, 2010).

Forest Type	Area	% Total Area
Primary forest (1000 ha / % of forest area)	861	11
Other naturally regenerated forest (1000 ha | % of forest area)	6452	84
Planted Forest (1000 ha / % of forest area)	352	5

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Chapter 1

The Current State of Philippine Forest Genetic Resources

Introduction

The Philippines lies just above the equator between 21°20' north and 4°30' north latitude and 116°55' east and 126°36' east longitude and is made up of over 7,107 islands. Of the total land area, 94% comes from the 11 largest islands. The land area is 300,000 square kilometres (sq km) or 30,000,000 hectares (ha). Water within the land occupies an area of 1,830 sq km. The coastline measures 36,289 km. The prevailing climate is tropical rain monsoon from November to April and Southwest monsoon from May to October. There are only two seasons, wet and dry as per the monsoon rains. The terrain is mostly mountainous with narrow coastal lowlands. Natural hazards include 20-22 cyclonic typhoons per year, landslides, flooding, active volcanoes, destructive earthquakes and tsunamis. Current environmental issues include uncontrolled deforestation especially in watershed areas, soil erosion, air and water pollution in major urban areas, coral reef degradation, and increasing pollution of coastal mangrove swamps that are important as fish breeding grounds.

The pressures of a growing population which has reached 101,833,938 million people (CIA, 2011) have resulted in much of these forests being cleared for shifting cultivation, cash cropping, fuelwood collection, livestock grazing, unsustainable logging and the frequent occurrences of anthropogenic fires. Rapid urbanization vis-a-vis land conversion developments has further escalated not only forest losses but also the degradation of forest genetic resources (FGR).

Types of Forest Vegetations and their Genetic Resources

Lowland evergreen rain forest

This is the most common of the tropical rain forests in the Philippines which includes the Dipterocarps and the mixed Dipterocarps. It could be found at elevations from 0 to 900 m above sea level and is well observed in sites with evenly distributed rainfall or those with short dry season. This forest type is situated along the typhoon belt. The canopy structures are diffused and allow more light penetration in the understory. These light conditions promote a dense growth of rattans, lianas, epiphytes and herbaceous plants on the forest floor and arecoid tree palms and seedlings and saplings as emergents.

Semi-evergreen rain forest

These forests are dominated by a single dipterocarp species, *Dipterocarpus grandiflorus* or *Shorea contorta*. This forest type is found in the western side of the archipelago including the provinces of Palawan and Zambales in Luzon which have seasonally dry climate.

Semi-deciduous forest

The species growing in this forest type are capable of growing in water-stressed conditions. They are often on the leeward side

of the mountains or on dry coastal hills. In western Mindoro, this forest type is dominated by *Pterocarpus indicus, Intsia bijuga, Toona calantas, Koordersiodendron pinnatum, Pometia pinnata, Dipterocarpus validus, Bischofia javanica* and *Alstonia scholaris*. *Vitex parviflora* dominates this forest type in the northwestern coastal hills of Luzon and near the East coast of Mindoro. Associated species include *Wallaceodendron celebicum, Litchi chinensis* ssp. *philippinensis, Pterocarpus indicus, Intsia bijuga, Lagerstroemia piriformis,* and *Kingiodendron alternifolium*. In Palawan, patches of this formation are still present in the Irawan Valley, Calauag and south of Roxas with the common emergents including *Pterocymbium tinctorium, Pterospermum diversifolium, Garuga floribunda* and *Intsia bijuga*.

Forest over limestone

This formation occupies low, karst limestone hills, either coastal or bordering large uplifted river valleys, which are mainly composed of crystalline covered by a shallow or very thin soil. A number of leguminous trees are dominant in this formation, namely *Afzelia rhomboidea, Sindora supa, Intsia bijuga, Albizia acle, Wallaceodendron celebicum, Pterocarpus indicus* and *Kingiodendron alternifolium*. Other dominant species include *Pterocymbium tinctorium, Zizyphus talanai, Toona calantas, Mimusops elengi, Maranthes corymbosa, Wrightia pubescens* ssp. *laniti, Lagerstroemia piriformis* and *Heritiera sylvatica* and such smaller trees as *Diospyros ferrea, Pterospermum diversifolium* and *Mallotus floribundus*. This formation is apparently similar to the so- called Molave (*Vitex parviflora*) forest.

Forest over ultramafic rocks

This forest type occurs in Palawan, Eastern Isabela and Northern Zambales in Luzon, northeastern and Southeastern Mindanao and in Dinagat Island. This forest type is found on soil high in heavy metals. Some of the ultramatic forests on Palawan are only about 2-5 m of height and contain a unique flora including among others *Planchonella* sp. and the heavy metal indicators *Scaevola micrantha, Brackenridgea palustris* and *Exocarpus latifolius*. Other tree species include *Neissosperma glomerata* and species of *Gymnostoma, Surregada, Archidendron* and *Pouteria*. The Mt. Victoria area is the largest region of ultramafic forest in Palawan and is home to the endemic tree *Embolanthera spicata* one of only two species in the genus (the other being in Indo-China). The ultramafic forests in north eastern Mindanao are taller, reaching 15 to 20 m, and include *Tristamiopsis micrantha, Sararanga philippinensis* and *Terminalia surigaoensis*. In Dinagat Island and also in the northeastern tip of Mindanao and Leyte the ultramafic forest contains the endemic tree *Xanthostemon verdugonianus*.

Beach forest

The principal species occurring in the Philippine beach forests are *Terminalia catappa, Erythrina orientalis, Barringtonia asiatica, Thespesia populneoides, Hibiscus tiliaceus, Calophyllum inophyllum, Pongamia pinnata, Tournefortia argentea, Casuarina equisetifolia* and *Scaevola frutescens*. They are usually found along the sandy beaches of seacoasts. *Terminalia catappa* may occur in small patches of pure stands. *Dendrolobium umbellatum* and *Pandanus doratissimus* also occur commonly in the beach forest. On the accreting sand there is usually a narrow strip of herbaceous vegetation dominated by *Ipomoea pescaprae*.

Mangrove forest

A total of 39 mangrove tree species has been recorded for the Philippines. The following are the common and abundant tree species: *Rhizopora apiculata, R. mucronata. Bruguierra cylindrica, B. gymnorhiza, B. parviflora, B. sexangula, Ceriops decandra, C. tagal, Avicennia marina, A. officinalis, Sonneratia alba* and *S. caseolaris*. The seaward side where the soil is generally mixed with sand or coral limestone is occupied by species of *Avicennia* and *Sonneratia. Osbornia octodonta* of Australian affinity is the associated species, which forms

almost pure thickets. *Rhizophora stylosa* also invades sandy shores and coral terraces and does not occur inland. On the inner edges of the mangrove formation the following species can be found; *Bruguierra* and *Ceriops,* as well as *Lumnitzera littorea, L. racemosa, Aegiceras corniculatum, A. floridum, Camptostemon philippinense, Scyphiphora hydrophyllacea, Excoeria agallocha, Heritiera littoralis* and *Cerbera manghas*. The following species may be rare to frequent and occur along the borders: *Glochidion littoralis, Dolichandrome spathacea, Barringtonia racemosa, Xylocarpus granatum* and *X. moluccensis*. In cut over areas and along the edges, the swamp fern *Acrostichum aureum* and two species of the spiny scandent Acanthus are prominent. On the inland edge of the mangrove and the upper tidal limit of estuaries, extensive pure stands of *Nypa fructicans* occur, especially along water courses.

Peat swamp forest

The importance of the peat swamp forests in the Philippines has just been recently appreciated with the participation of the Philippines in the ASEAN Peatlands Forests Project. (APFP) The IPAS surveys in 1991 briefly described peatland near Bunawan in the Agusan Marsh, whilst surveys during the consultation workshops for the APFP in November and December 2005 yielded more information on additional areas of peatlands in the Agusan Marsh (Caimpugan Peat Dome) and the Leyte Sab-a Basin peatland. However, these have mostly been brief studies and there has been very little or no work on the flora and fauna of the peatlands, nor their hydrology or pedology.

The ASEAN Peatlands Forests Project has reported two areas in the Philippines where substantial areas of peat have been found: the Agusan Marsh and the Leyte Sab-a Basin. The Sab-a Basin is a west-east elongated basin close to the north coast of Leyte separated from it by a metamorphic ridge. The total area is about 3,088 ha of which 44% has been reclaimed for agriculture. The remaining unutilized peatland (1,740 ha) in the eastern half of the basin consists of small remnant areas of swamp forest and sedge/grass peat swamp (ADB 2000). The two smaller peat basins in the area Daguitan (210 ha) and Kapiwaran (430 ha) have mostly been converted to agricultural land.

The Agusan Marsh holds the largest area of peatland in the Philippines. Two areas of peatland within the marsh have been confirmed – one just to the north of Bunawan, the vegetation of which has mostly been cleared and burned, and the other to the west of Caimpugan, which exhibits the characteristics of a peat dome, the forest of which is mostly intact except close to the Hibong River. This tract of forest is estimated to have an area of 5,300 hectares. There may be other areas of peat within the marsh, especially in *Terminalia copelandii/Metroxylon sagu* forests in the northwest portion of the marsh. In a recent survey led by the late Botanist Leonard Co, four generic record of plant species have been made in the Caimpugan Peat Forest. These are *Thoracostachyum* cf. *sumatranum*, *Lepironia articulate, Syzygium zeylanicum,* and *Tristaniopsis* aff. *micrantha* (http://www.aseanpeat.net/index.cfm?&menuid=38)

Freshwater swamp forest

The middle Agusan Valley and west of Pagalungan, both areas in Mindanao, as well as the Candaba and Liguasan Marshes, were cited to have freshwater swamp forests. Mineral rich fresh water from rivers and streams regularly and occasionally inundate this formation. The floristic composition of this forest type is likely that of *Metroxylon sagu* a dominant component. The freshwater swamp forest is occasionally dominated by *Terminalia copelandii* and *Nauclea orientalis*. Other co-dominants are *Albizia saponaria* and *Sesbania cannabina*. Common sedges and grasses found in the marshland include *Phragmites vallatoria, Eriochloa procera,* and *Scirpodendron ghaeri*.

Lower montane rain forest

This forest formation found at elevations ranging from 400 to 950 m and extending up to 1500 meter above sea level (masl) is dominated by *Shorea polysperma* together with oaks (*Lithocarpus*), oil fruits (*Elaeocarpus*), laurels (*Litsea*) and makaasim (*Syzygium*). The understory is composed of epiphytic ferns, herbaceous shrubs of Rubiaceae (e.g. *Psychotria*) and Acanthaceae (e.g *Strobilanthes*). *Sauraria* and species of Urticaceae including climbers such as *Freycinetia* are common in gaps and gullies. *Pinus kesiya* occurs as a fire climax tree species in pure stands in the Cordillera Mountains of Luzon. *Pinus merkusii* on the other hand, occurs on the driest sites in Western Mindoro and Luzon (Zambales and Abra).

Upper montane rain forest

This forest formation considered as mossy forest occurs in elevations greater than 1,500 m. The topograpy is rough with steep ridges and canyons. High rainfall pattern and humidity promote growth of mosses, liverworts, ferns and other epiphytes on the tree trunks. Strong winds prevent tall trees; hence, most of the trees are dwarf. Ferns and grasses occupy open areas. *Dacrydium, Dacrycarpus* and *Podocarpus* and broad leaf genera such as *Lithocarpus, Symplocos, Engelhardtia, Syzygium* and *Myrica* are the most common tree species. Additionally, species of Ericaceae (*Rhododendron, Vaccinium* and *Diplycosia*) and Melastomataceae (*Astronia, Medinilla* and *Melastoma*) are common, and so is the tree fern genus *Cyathea*.

Subalpine forest

Found in very high elevations (2,470-2,587 m asl), the vegetation of subalpine forests is generally characterized by the dominance of small, woody dicots with microphyllous-sclerophyllous leaves which form a low, dense canopy. This forest formation is found in the Mt. Halcon-Mt. Sialdang range, in Mindoro Island and some sites in Mt. Pulag in Mt. Province, and Mt. Mantalingahan in the southern portion of the Island of Palawan. The more common woody dicots in Mt. Sialdang subalpine rain forest are *Styphelia suaveolens, Rhododendron, Quadrasianum, Vaccinium myrtoides, Myrica javanica, Leptospermum flavescens, Taxus sumatrana* and *Eurya coriacea*. The plant community is quite similar to those of Mt. Kinabalu (4,101 m) in Borneo and Mt. Kerinci (3,800 m) in Sumatra).

Forest Resources

The country's forest is considered among the richest terrestrial ecosystems in terms of biological diversity. Flora in the Philippines is

Table 3. Forest ownership and area

Forest ownership	Area (ha)	% of Area
Total Land Area	30,000,000	100.00
Alienable and Disposable Land (Private)	14,194,675	47.32
Forest Land (Public)	15,805,325	52.68
Unclassified Forest Land	755,009	2.52
Classified Forest Land	15,050,316	50.17
Established Timberland	10,056,020	33.52
Established Forest Reserves	3,270,146	10.90
National parks/GRBS/WA	1,340,997	4.47
Civil Reservations	126,130	0.42
Military Reservations	165,946	0.55
Fishponds	91,077	0.30

Reference: Forest Management Bureau (DENR). 2009. Philippine Forestry Statistics.

approximately 14,000 species, which is about 5% of the world's flora. It is estimated that there are over 8,000 species of angiosperms, 33 species of gymnosperms,1,100 species of pteridophytes, 1,271 species of bryophytes, more than 3,550 species of fungi and molds, about 1,355 species of algae and 79 species of lichens. There are 26 genera of flowering plants and ferns that are endemic to the Philippines. Flowering plant endemism ranges from 45% to 60%.

About 15,900,000 ha of the country's land area are classified as forest lands. However, only 7,665,000 ha of this area are actually covered by forest as mentioned earlier. This represents 24% of the total land area or 0.1 ha of forest per capita (FAO, 2007). This proportion is the second lowest in the Southeast Asian Region, higher only to Singapore which does not really have any forest at all. The optimal forest area for the Philippines is believed to be about 12,000,000 ha, or 40% of the land area. This means that an additional 4,832,000 ha of land should be reforested.

Historically, forest tenure and ownership in the Philippines was based on the Regalian doctrine during the colonial period in allocating and managing its natural resources, including forest and forest land. The present distribution of forest ownership in the Philippines is a result of a series of decentralization from a highly regulatory and centrally controlled policies to a more participatory and people-oriented approach. Table 3 shows the present distribution and classification of forest ownership in the Philippines.

Factors Influencing the State of Forest Genetic Resources

The forestry situation in the Philippines has been shaped and continues to be shaped by a number of forces. These drivers of change do not work separately but often in combination with one another. One factor creates a situation which drives another factor to exert its pressure on the sector.

The combination of forces that had tremendous impact on the forestry sector is rapid population growth and destructive logging. Many of the population that had no place else to go in the lowlands migrated into the uplands. The influx of people in the uplands was made easier due to the presence of logging roads and logged-over areas became faster and easier to clear for agricultural purposes with the use of fire. This brought destruction to the forest and during the 1960s the rate of forest destruction reached as high as 300,000 ha annually. The Philippines, which has a population growth rate of 2.35% a year, has yet to come up with an effective population program. If the situation is not addressed, it is estimated that the population will double in 29 years. The intensity of logging activities has declined because the forest has deteriorated. The migration into the forest, however, continues. It is estimated that the population in the uplands is more than 20 million now.

The economy is also a driver of change. Since the middle of the 1990s the economy of the Philippines has been improving. This was brought about by strides in industrialization with foreign investors establishing factories and manufacturing facilities in the country. The economy has also been helped by the huge remittances of overseas Filipino workers which were reported to be more than US$18 billion in 2010. With the increase in industrialization many prime agricultural lands were converted to industrial parks and economic zones. The increased purchasing power of families of overseas workers contributed to the increase in demand for housing. Factory workers also required housing. Thus, many of the agricultural lands were also converted to real estate developments including shopping centers. However, the industries could not create enough jobs for the rapidly increasing population. Many of the displaced farmers and those who could not find employment in the urban areas migrated into the uplands.

The improved economic condition of some families allowed them time for recreation. They also became aware of the health benefits

of forests and made demands for recreational services. This also resulted in the establishment by the government of mini-parks especially in urban areas, the planting of green zones in government and school grounds and other open spaces.

Another driver of change that has great impact on the forestry sector is the energy situation. The escalating price of fossil fuel has made the Philippine Government focus its attention on the development of alternative sources of fuel. Thus, it passed the Biofuels Act of 2006 which mandates the replacement of a certain percentage of gasoline and diesel with biofuels. To supply the biofuels the government has started a program on the development of plantation of jatropha (*Jathropa curcas*) as a source of raw material for biodiesel. The government has targeted about 2 million hectares of jatropha plantations in forestlands. In response to this, the Department of Environment and Natural Resources (DENR) has allocated 375,000 ha of open forestlands for this purpose. Since this area is within forestlands, this certainly will change the vegetative structure.

The increase in prices of fossil fuel has also directed the attention of people to the use of fuelwood for cooking and for industrial uses. This will certainly aggravate the forestry situation as more communities will gather fuelwood from the forest areas. It is expected that the price of fuelwood and charcoal will consequently increase the demands for fuelwood and thus, there will be more fuelwood collection from the forests. One positive note is that the government is now contemplating the establishment of more fuelwood plantations. With increased prices of fuelwood and charcoal, the private sector may be encouraged to invest in fuelwood plantations.

It is also expected that the energy crisis will see the resurgence of biomass-to-energy systems that were tried in the late 1970s and early 1980s. These were not vigorously pursued because fossil fuel was still cheap then and the biomass-to-energy systems were inefficient and expensive to operate. Besides the biomass-to-energy technologies need improvement.

The deteriorating global environment and in particular the destruction of forest resources around the world has generated concern among governments. This has led to many conventions whose aims are to stop the destruction of biodiversity and habitats. The Philippines is partly to many of these conventions. The nature and progress of the participation of the country is described in greater detail in Chapter 7 of this report.

The commitments of the Philippines to improve the environment of the country and pursue conservation and protection of biodiversity and its habitat saw the enactment of a number of laws one of which is the National Integrated Protected Areas System (NIPAS) Act (Republic Act No. 7586) of 1992. The implementation of this law brought about the establishment of protected areas. As of July 2007 there were 77 terrestrial protected areas covering 1.85 million ha. Many more areas are lined up for proclamation as protected areas. Most if not all of the protected areas have natural second growth dipterocarp forests as components. While protected areas could provide protection and better management of the natural second growth forest within their boundaries, the proclamation of protected areas has certainly reduced the area of natural second growth forests for timber production.

Current and Emerging Technologies

Technologies are drivers of change and positive changes in the forestry sector could well be initiated and sustained by the application of production and utilization technologies. This section reviews technologies that when applied or pursued further in the field could trigger much awaited positive changes in the sector. Some technologies developed outside of the sector could also have tremendous impacts when applied in the forestry sector.

The success of plantation development often lies in the right choice of the species, the quality of seedlings or planting materials, correct planting procedures, maintenance of the planted trees including their protection and the quality of the site. To ensure sustainable supply of improved seeds, establishment of seed orchards is necessary. To ensure production of high quality planting materials, and get exact replica of the plus trees, cloning is recommended. Besides, the technology is the most appropriate alternative propagation method for species that have limited seed sources or with seeds difficult to propagate.

Fertilization is a very important component in successful plantation development. However, the use of inorganic fertilizer aside from being expensive could also deteriorate the soil and pollute water systems. Bio-N has been developed for agricultural crops particularly rice, corn and vegetables. It increases the growth of the root system of the plant by increasing its ability to absorb soil nutrients and water resulting in faster growth. Bio-N has possibilities for use in the nursery during seedling production and during plantation establishment thus reducing the cost of plantation development and faster increased in forest cover. One kilogram of Bio-N is enough to fertilize a hectare of rice field, otherwise needing 4 sacks of inorganic fertilizer for the same area.

Indigenous mycorrhizal inoculants for seedlings have been developed for reforestation and similar activities. The "Mykovam" and the "Mycogroe" which are based on mycorrhiza, a fungal association in the roots of plants have been developed and are now being mass produced. Their use however needs to be further promoted in forest development activities in the country.

Another technology that has been developed for plantation establishment is computer software that assists would-be plantation developers to identify the species suitable for various sites in the country. This serves as a guide for plantation development in the country guaranteeing the success of such and contributing to increased forest cover.

Technologies that expand the resource base promote sustainable forest management. The use of species that have not been considered commercial before has reduced pressure on the few species that have been traditionally used. Processing technologies have been developed for lesser-used species as well as small diameter logs, tree tops and branches. Non-conventional raw materials such as climbing bamboos and forest vines have been studied and technologies developed for their use in the manufacture of handicrafts. A detailed discussion on this aspect is made in Chapter 8 of this report. Similarly, the use of these raw materials will ease pressure on the use of rattan poles sourced from the natural stands. In addition to expanding the raw material base they also provide new opportunities for livelihood for upland communities through collection and sale of these raw materials.

In forest product utilization, technologies have been developed to improve efficiency in processing, consequently lessening wastages. The use of such technologies ultimately would lead to the expansion of the resource base. Use of alternative species and materials for handicrafts provides additional materials that ease pressure on the dwindling resource of traditional species. Processes that lengthen the service life of construction materials have the effect of expanding the resource base since replacement of these materials is reduced.

Several advances in biotechnology in the forestry sector could help the sector achieve its goal of increased forest cover and self-sufficiency in wood and other forest products. These are in tissue culture, cloning and organic fertilizers. Protocols for tissue culture of bamboo, rattan and a number of plantation tree species have been developed and field trials of tissue cultured seedlings have been made. Cloning is already a well developed technology for the production of high quality planting materials in the forestry sector. In fact commercial plantations have used cloned seedlings. A company has been

set up in North Central Mindanao to produce cloned *Gmelina arborea* for sale to plantation developers. The Ecosystems Research and Development Service (ERDS) of DENR Region 10 particularly the research center in Bukidnon is now selling cloned *Swietenia macrophylla* seedlings.

The challenge in this area is the wider use of these biotechnologies for the establishment of forest plantations which will reduce their development cost and increase their productivity. This depends on information campaign by the government on the use of these technologies by small farmers and large plantation developers and on the conduct of further research in these areas.

If the government embarks on a nationwide campaign based on the use of cloned seedlings and biofertilizers or the use of these technologies and appropriate plantation management in government reforestation projects, there will be higher survival rates and better quality of plantations. Furthermore, if the government provides more funds for further research on biotechnology there will be greater chances of improving the forest cover of the country.

One of the reasons the Philippines had failed in its forest protection efforts is its inability to monitor its forest resources at the site level. Monitoring has been limited to surveillance of the movement of forest products through check points and recently through a computer-based monitoring system. The use of satellite images and/or aerial photographs to monitor the changes in forest cover of tenure holders especially the Timber License Agreements (TLAs) and Integrated Forest Management Agreements (IFMAs) as well as Community-Based Forest Management Agreements (CBFMAs) and those of the military and civil reservations and other forest managers like the National Power Corporation (NPC), the Philippine National Oil Company (PNOC) and the National Irrigation Administration (NIA) has not been widely and regularly undertaken. NAMRIA regularly acquires satellite images that can be used to monitor changes in forest cover. The large tenure-holder such as the TLAs and IFMAs are required to submit to the DENR aerial photographs of their areas. These should be used to monitor forest areas and make the tenure-holders accountable for whatever unauthorized operations that result in negative impacts in their areas. The DENR should be able to institute a corresponding system of disincentives, sanctions, and penalties for those who do not protect their forest or those who abuse the use of their tenure. Failure to do this will result in further degradation of the country's forest resources.

The above technologies improve success in forest plantation development and thus, the ability to increase forest cover. They also increase the efficiency of the utilization of forest products with the effect of expanding the resource base. The overall impact is the conservation of the forest leading to sustainable forest management.

Main Value of Forest Genetic Resources

The main forest tree species actively managed for productive purposes are given in Appendix Table 1. Some of these are trees, while others are bamboos and rattans. Some are exotics while others are native to the Philippines. For their utility; some are used in pulp and paper, furniture, fuelwood, charcoal, general construction, plywood, windbreak, erosion control, tannin, matches, wooden shoes, reforestation, veneer, medicines (bark and leaves) mine props, wood carving, cabinets, basketry, fences, spear and flutes, musical instruments, cigar boxes, paper making, bamboo shoots for food, building construction and handicrafts. Appendix Table 2 shows the list of species that are commonly used either in plantation, agroforestry or enrichment planting (this includes windbreak, shelterbreak, hedge-rows, etc.).

The main forest tree species actively managed or identified for environmental services are in Appendix Table 3. They are either exotic or native to the Philippines.

In 2007, the DENR came out with DAO 2007-01 which established a national list of threatened plants (Table 4). The DAO also prohibited the collection and trade of species in this list unless a permit is granted by the DENR pursuant to the Wildlife Act. (http://chm.ph/index.php?option=com_content&view=article&id=68:forest-and-mountain-biodiversity-overview&catid=36:biodiversity-in-the-philippines&Itemid=90_30dec2011)

Table 4. Summary of number of threatened Philippine plants per category (DAO 2007-01)

Category	Number of Plant Species
Critically endangered	99
Endangered	187
Vulnerable	176
Other threatened species	64
Other wildlife species	169

Ninety nine (99) species were identified as critically endangered. Most of these belong to Family Dipterocarpaceae, Orchidaceae and Palmae species. Some critically endangered Dipterocarps are *Hopea acuminata, Shorea astylosa and Vatica pachyphylla. Genus Paphiopedilumhas* the most number of critically endangered species in the Orchidaceae Family and Genus *Hetorospathe* and *Pinanga* for Palmae. Under the category of endangered, many species belong to Family Orchidaceae, Cyatheaceae, Asclepiadaceae and Melastomataceae.

The main forest tree species considered critically endangered in the country are listed in Appendix Table 4. These include trees, orchids, ornamental plants and rattans. The trees are sources of timber, lumber and construction materials; the orchids and ornamental plants are for environmental purposes such as for landscaping/beautification.

A very rough estimate of the quantity of seeds that have been collected for use by the DENR in its current National Greening Program indicates a limited number of species yet that is being used (Table 5). Estimates of seedling production are also reflected in Table 6.

Some species are exotic such as *Acacia mangium*, and *Gmelina arborea*. The list of forest species for which genetic variability has been evaluated is shown in Appendix Table 5.

Other noteworthy projects include the following as enumerated in the following sources from the internet: (http://chm.ph/index.php?option=com_content&view=article&id=400%3Aforest-and-mountain-biodiversity-projects&catid=87&Itemid=90#0_30Dec2011)

- Samar Island Biodiversity Project (SIBP)
- Mt. Apo Natural Park Restoration and Development Cum Livelihood Project
- Cave Management and Conservation Program
- National Ecotourism Programme (NEP) Phase 1
- Mainstreaming Ecotourism in Community-based Natural and Cultural Resource Management Phase 2
- Developing Ecotourism Strategies for Biodiversity Conservation and Livelihood Opportunities
- Ethnobotanical Study of Plants in Aurora
- Ecological Analysis of the Lamao Forest Reserve as Ecotourism Site for Biodiversity Conservation
- Ecosystem Diversity Assessment of Aurora
- Comprehensive Wetland Resource Inventory and Assessment of Vascular Plants in Casiguran and Dilasag, Aurora
- Expanding and Diversifying National System Of Terrestrial Protected Areas of the Philippines (EDNSTPAP) Project
- Vulnerability Assessment of Tignoan Watershed in Real, Quezon Province
- Visayan Warty Pig (Negros Origin) Conservation Program
- Philippine Cockatoo Conservation Program
- Philippine Tarsier Conservation Program
- Philippine Spotted Deer Conservation Program
- Palawan Wildlife Rescue and Conservation Center
- Tamaraw Conservation Program
- Philippine Raptors Conservation Project

Table 5. Annual quantity of seeds produced and current state of identification of forest reproductive material of the main forest tree and other woody species in the country.

Scientific name	Native (N) or Exotic (E)	Total quantity of seeds used (Kg)	Quantity of seeds from documented sources (provenance/ delimited seed zones)
Acacia mangium	E		22
Alstonia macrophylla	N	200	300
Alstonia scholaris	N	400	500
Bauhinia malabarica	E	2	2
Bauhinia monandra	E	200	200
Cassia javanica	N	2	2
Diploknema ramiflora	N	7	7
Erythrina subumbrans	N	1	2
Eucalyptus urophylla var. *urophylla*	E		370
Eucalyptus urophylla var. *wetarensis*	E		2
Gymnacranthera paniculata	N	9	10
Kibatalia gitingensis	N	500	500
Lagerstreomia speciosa	N	3	5
Myristica elliptica	E	9	10
Oroxylum indicum	N	50	50
Pithecelobium dulce	E	4	5
Planchonella duclitan	N	5	6
Samanea saman	E	11	14
Sesbania grandiflora	N	5	5
Sterculia foetida	N	3	3

Reference: ERDB Seed Laboratory Report 2011 and Seed Production Areas of *A. mangium* and *Eucalyptus* spp.

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Baja-Lapis, A.C.; M.E. David; C.G. Reyes and B.N. Servas-Audije. 2004. ASEAN Most Precious Plants. ASEAN Regional Center for Biodiversity Conservation. 221 p.

Table 6. Annual number of seedlings (or vegetative propagules) planted and the state of identification of the reproductive material used for the main forest tree and other woody species in the country.

Scientific Name	Native (N) or Exotic (E)	Total quantity of seedlings planted	Quantity of seeds from documented sources (provenance/ delimited seed zones)	Quantity of vegetative reproductive materials used
Acacia mangium	E	4,143	4,143	
Albizia procera	N	4,728	4,728	
Alstonia macrophylla	N	2,399	2,399	
Antidesma bunius	N	4,482	4,482	
Bauhinia purpurea	N	4,055	4,055	
Cassia fistula	N	2,902	2,902	
Cassia spectabilis	N	13,469	13,469	
Cynometra ramiflora	N	120		120
Diospyros discolor	N	10		10
Dracontomelon dao	N	227	227	
Gmelina arborea	E	270	100	170
Heritierra sylvatiuca	N	304	304	
Instia bijuga	N	30		30
Kibatalia gitingensis	N	20		20
Micromelum inodorum	N	49	49	
Oroxylum indicum	N	772	772	
Parashorea malaanonan	N	350		350
Parkia timoriana	N	1,629	1,629	
Piliostigma malabaricum	N	1,500	1,500	
Pittosporum pentandrum	N	190	50	140
Polyscias florosa	N	65		65
Polyscias nodosa	N	12,191	12,191	
Ptrocarpus indicus	N	330		330
Samanea saman	N	15,749	15,749	
Sesbania grandiflora	N	3,314	3,314	
Swietinia macrophylla	E	2,901	2,901	
Syzygium nitidum	N	10		10
Syzygium polycephaloides	N	2,295	1,885	410
Terminalia microcarpa	N	1,419	1,419	
Vitex parviflora	N	312	312	

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Chapter 2
In Situ Genetic Conservation

In situ or on-site genetic conservation means the conservation and management of the species or its populations or individuals in their original or natural habitats and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

The establishment of protected forest reserves has been the main strategy of conserving forest genetic resources in many parts of the world. *In situ* is the preferable long-term genetic conservation solution for most species and especially those that are rare and endangered. This is because by dedicating the sites containing the populations to be conserved, one is also preserving, in effect, the set of ecosystems in which the selected species populations are growing. This then allows for the continuation of genotype and environment (GxE) interactions, adaptations, and evolution of the conserved populations. Thus, the *in situ* approach provides for a long-term dynamic situation wherein the populations continue to evolve in nature.

In Situ Conservation in Protected Forest Areas

In situ conservation in protected areas started in the Philippines as early as 1932, through the institution of the National Parks System. In totality, 60 national parks and 8 game refuges and bird sanctuaries were established under this system. These parks, refuges and sanctuaries became a core component of the National Integrated Protected Areas System (NIPAS) which was established in 1992 through Republic Act (RA) 7586. The objective of NIPAS is to *"integrate outstanding remarkable areas and biologically important public lands that are habitats of rare and endangered species of plants and animals, biogeographic zones and related ecosystems whether terrestrial, wetland or marine, all of which shall be designated as protected areas".*

The NIPAS is the major legal instrument for *in situ* conservation of plant biodiversity in general in the country (Catibog-Sinha 1994) and forms a significant component of the Philippine National Biodiversity Strategy and Action Plan (PAWB-UNEP 1997). It is worthy to note that the Philippines has one of the oldest national park system in South East Asia established in the early 1900s. The 4,244 ha Makiling Forest Reserve in Luzon Island is one of the earliest having been established in 1910. This and other national parks established before 1992 became the initial components of NIPAS. Currently, there are 239 of these in the NIPAS with a total area of more than 5.42 million ha, including natural parks, protected landscapes and seascapes, natural monuments or landmarks, resource reserves, wildlife sanctuaries, natural biotic areas, and marine parks and mangrove swamps. Only about 112 have, thus far, been recognized under various Presidential Proclamations while 12 has been established through legislative

acts. These cover approximately 3.54 million ha or just 11.8% of the total land area of the Philippines (Table 7). For the large majority of the protected areas in the Philippines, there are no complete inventories of their plant biodiversity or detailed information on which rare and threatened species occur in which protected area. Efforts are being pursued by the Philippine Plant Conservation Committee to address this issue.

Table 7. Summary of proclaimed protected areas in the Philippines (DENR-PAWB 2011).

Region	No.	Protected Area (ha)	Buffer Zone Area (ha)
Total	112	3,542,967.2	223,843.5
CAR	1	77,561.0	3,465.5
Region I	8	18,455.8	-
Region II	10	980,235.5	-
Region III	6	23,989.2	-
Region IVA	8	79,185.3	
Region IVB	10	588,823.4	11,677.0
Region V	10	31,108.9	-
Region VI	5	154,363.3	169.0
Region VII	9	70,823.8	788.0
Region VIII	10	450,400.0	125,400.0
Region IX	12	293,966.3	16,593.3
Region X	9	103,122.1	51,354.7
Region XI	8	102,008.9	10,035.5
Region XII	2	231,550.0	-
Region XIII	3	337,351.1	4,360.6
NCR	1	22.7	-

Although many protected areas in the Philippines, especially those identified as initial components of the NIPAS, were not determined based solely on plant biodiversity consideration, such, nonetheless, serve as de facto plant genetic resource conservation areas or genetic reserves for many commercial timber trees and other economically important species that continue to be exploited in the country. Thus, in 2000, timber harvesting in old growth forests, mossy forests, and in those located in areas over 1,000 m of elevation and with more than 50% slope was banned by the Philippine government to conserve forest genetic resources (FGR).

Some programs for the management of the protected areas in the Philippines include the Conservation of Priority Protected Areas Project (CPPAP) funded by the World Bank and the Global Environmental Facility (WB–GEF), the National Integrated Protected Areas Program (NIPAP) funded by the European Union (EU), and the Samar Island Biodiversity Project (SIBP) funded by the United Nations Development Programme (UNDP) and the Global Environmental Facility (GEF). Subsequently, other conservation projects have come into reality examples of which are the Administration and Development of the Hinulugang Taktak Protected Landscape, and Mt Apo Restoration and Development Poject to name a few. Non-government organiztions such as the Haribon Foundation, Inc., the local network of Conservation International, the Foundation for Philippine Environment, Philippine Foundation for Tropical Forests Conservation and many other smaller local organizations are actively involved in the restoration and protection work.

In situ Conservation in Production Areas

Despite the expansion of the network of protected areas in the Philippines, these remain very limited in their coverage, especially for many commercial timber trees of the lowland dipterocarp forests (Fernando, 2001). A consensus has been growing that protected areas alone will not be sufficient to effectively

conserve biodiversity and forest tree genetic resources in the Philippines. For example, the great bulk of the genetic resources of commercial timber trees (*e.g.* dipterocarps) are not found in currently declared forest reserves or protected areas. These timber species are usually restricted to the lowland rain forests where much of the large-scale commercial logging in the Philippines has been undertaken for many decades. The challenge, therefore, has been to include biodiversity conservation measures, even as timber is harvested from natural forests. Many around the world including the Philippines, have begun to develop measures to maintain biodiversity within the practice of forestry.

In the Philippines, the Sustainable Ecosystems International Corporation (SUSTEC), a non-government organization, and the Surigao Development Corporation (SUDECOR), a private logging company, in cooperation with the government's Department of Environment and Natural Resources (DENR), undertook a pioneering work in biodiversity conservation in a natural tropical rainforest. The International Tropical Timber Organization (ITTO)-funded project, although managed primarily for timber production, has shown through empirical evidence, that forest production and biodiversity conservation can go together to a large extent. A sustainable forest management plan was formulated to further improve the biodiversity conservation capacity of the forest area (ITTO and SUSTEC, 2002).

The sustainable forest management plan and the guidelines that integrate biodiversity and genetic resource conservation measures with timber production are currently being developed, specifically by SUDECOR in its timber concession areas. The plan includes, among others, very specific management strategies for the timber production zone within the logging concession. There are proposed strict standards in pre-logging inventory and tree marking (of trees to be cut) and felling. Among the specific guidelines being designed are the following:

(a) Tree marking will be governed not only by the volume, number, class-size of the trees, and replacement growth rates, but also by the species and its biodiversity and genetic resource conservation value. For instance, tree species characterized by small populations or restricted distribution (e.g. rare species) will be marked as trees to be left;
(b) Adherence to the minimum 60 cm diameter breast height requirement for trees to be cut. The Philippines follows a selective logging limiting the diameter of trees to be cut to 60 cm and above;
(c) Deviation from high grading or cutting of the largest or best trees all the time. This is to ensure that the phenotypically superior trees in the site are not completely depleted;
(d) Exclusion from marking for cutting both individual flowering and fruiting trees and those in the priority list for conservation;
(e) Directional felling to minimize damage to saplings, especially those of timber species with high commercial value or in priority list for conservation; and
(f) At least one mother tree of not less than 40 cm dbh per timber tree species per hectare will be marked as residual.

This is to guarantee that prelogging timber tree species will continue to exist in the area and at the same time promoting a better distribution of tree species across all cutting areas. This will be on top of the tree-marking goal estimated for the area (Umali-Garcia et al. 1998; Fernando and Balatibat, 1998; Fernando, 2001).

The development and implementation of a sustainable forest management using the criteria and indicators system was another step towards a more vigorous conservation effort for forest genetic resources in the country. With funding support from the International Tropical Timber Organization (ITTO), the DENR through the Forest Management Bureau implemented a project that led to the development of the Philippine C & I System.

In the Philippine C & I System, a set of criteria has been formulated that should work towards the attainment of sustainable management of the concerned forest management unit. In each criterion, a set of indicators has further been identified to help identify changes in the forest being managed. Criterion 5 in the Philippine Criteria & Indicator System specifically deals with the maintenance of biological diversity in the forest management unit.

The conservation of ecosystem diversity can best be accomplished by the establishment and management of a system of protected areas (combinations of IUCN Categories I to VI) containing representative samples of all forest types linked as far as possible by biological corridors or 'stepping stones'. This can be ensured by effective land-use policies and systems for choosing, establishing and maintaining the integrity of protected areas in consultation with and through the involvement of local communities.

The indicators include the following: (1) Protected areas containing forests; (2) Protected areas connected by biological corridors or stepping stones; (3) Existence and implementation of procedures to identify and protect endangered, rare and threatened species of forest flora and fauna; (4) Number of endangered, rare and threatened forest dependant species; (5) Measures for *in situ* and/or *ex situ* conservation of the genetic variation within commercial, endangered, rare and threatened species of forest flora and fauna; (6) Existence and implementation of procedures for protection and monitoring of biodiversity in production forests by retaining undisturbed areas, protecting rare, threatened and endangered species, protecting features of special biological interest (e.g. nesting sites, seed trees, niches, keystone species, etc), and assessing recent changes in (a) to (c), of previous page through inventories, monitoring/ assessment programs, and comparison with control areas, and; (7) Extent and percentage of production forest which has been set aside for biodiversity conservation.

Priority *In Situ* Conservation Areas

In 1988, 18 sites were identified by the Threatened Plants Unit at Kew (Cox, 1988) as centers of plant diversity in the Philippines. During the conduct of the Philippine Biodiversity Conservation Priority Setting Programme in 2002, 43 priority areas for plant conservation have been listed for the Philippines (Appendix Table 6). These are usually sites that include unique threatened habitats, exceptional botanical richness, high in species endemism, or include rare and endangered species. These are also referred as Important Plant Areas (IPAs) (Plantlife International 2004). Of the 88 conservation priority sites for plants or IPAs, only 39 sites are currently within established protected areas.

Constraints to *In Situ* Conservation

Our forest genetic resources are further threatened by over-exploitation for commercial purposes (e.g. collection of wild orchids for export), habitat destruction mainly caused by land conversion for settlement and agricultural development, logging and shifting cultivation or slash-and-burn farming, habitat fragmentation, forest fire, chemical pollution, and to some extent mining, energy projects, pests and diseases (DENR PAWB, 2006). Another constraint is the threat posed by non-invasive or alien invasive species due to the disturbed state of the forest ecosystems. The 2000 IUCN Red List included 227 species of such plants in the country. As of 2005 as earlier mentioned, the Philippine National List of Threatened Species of Plants prepared by the DENR-PAWB through the Philippine Plant Conservation Committee includes 526 species. Of these, 99 are critically endangered, 187 are in the endangered, 176 vulnerable and 64 other threatened species

Many field personnel lack the necessary knowledge and skills in identifying thousands of other plants (and even lower forms of flora, microflora animals) for conservation and in appreciating their importance. Information on inventory and actual state of these plants

is likewise limited. This is critical and could have formed part of the prescriptions during forest inventory works as part of the Philippine Selective Logging System. An actual ground demarcation of conservation (protected) areas from the production areas seldom exists. Protected areas are frequently occupied by people who practice continuously upland agriculture. Their numbers are increasing in some areas. Institutional and management limitations restrict protection in biodiversity-rich areas. Budget constraint and political will are the common causes of insufficient and inadequate forest protection programs. The National Integrated Protected Area System (NIPAS) and the Indigenous Peoples' Rights Act (IPRA) clash with each other in many respects, particularly along the issues of actual management, administration, rights of extraction and exploitation, and protection of conservation forests. Conflicts in claims and interests between major stakeholders result in stalemate in conservation programs. As the forest genetic resources hang precariously, this delicate balancing act of harmonizing interests, claims, vision, policies and programs among the major stakeholders is sorely longing for immediate and stable resolution.

With the rapid decline of its habitats, *in situ* conservation through the protected areas system in the Philippines remains as the best hope for conserving plant biodiversity and genetic resources. The protected areas, however, are still limited in their scope, often excluding lowland dipterocarp forests that harbor the majority of the commercial timber trees. The recently identified Conservation Priority Areas for Plants or Important Plant Areas not yet covered under the NIPAS must be integrated into the protected area system. Sustainable forest management systems involving integrated and careful planning of timber harvesting operations that incorporate plant genetic resource conservation measures are a promising strategy. Although there is a high diversity of plant species and habitats in the Philippines, the financial resources for plant biodiversity conservation are often limited.

Priority R & D Areas for *In Situ* Conservation

The production of planting materials for endangered, indigenous and other forest genetic resources and the development of *in situ* conservation stands shall be a primary priority. There is a need for a holistic strategy for wood production which also prevents the eminent danger of the irreversible loss of forest genetic resources. The fundamental problem to be addressed at this point is the lack of supply of improved planting materials for production purposes, and of planting materials for conservation of endangered indigenous and other forest genetic resources.

To address the abovementioned concerns, priority R & D areas for the conservation of FGR *in situ* have been identified as follows:

- Extinction of species and their respective genetic resources. That is, critical habitats of Mindoro pine (*Pinus merkusii*), Philippine teak (*Tectona philipinensis*) in Lobo and San Juan, Batangas and Occ. Mindoro where it is endemic, narek (*Hopea cagayanensis*), apitong (*Dipterocarpus grandiflorus*) in Bohol and Palawan, and other local endangered tree species need to be protected;
- Specific access and benefit-sharing from forest biodiversity development; conservation biology and demography or population studies; on threatened endemic plants,
- Research on economically important species;
- Periodic assessment of conservation status of all known Philippine plants periodically (e.g. inventory, taxonomy, database of FGR on *in situ* conservation sites);
- Ecological studies of Important Plant Sites(IPS) and Important Plant Areas (IPAs) (carbon sink, watershed and environmental services, ecotourism, genetic diversity);
- Policy assessment and formulation in support of FGRs (e.g. bio-prospecting, rescue centers) ;
- Development of a database for FGRs;

- Economic valuation studies of FGRs (for bioprospecting purposes, ecological services, etc.);
- Assessment of socio-economic and cultural practices and their impacts to FGR conservation (e.g. ethno-botany); and
- Survey, inventory and mapping of rare and endangered species.

To complement these R & D areas, important management strategies are needed as follows:

- Prevention of biological pollution;
- Ground demarcation of forest lands, e.g., production areas, protection areas, restoration areas;
- Protection of residual forests and other conservation areas which are biodiversity-rich areas;
- Harmonization of the NIPAS Act and the Indigenous People's Rights Act (IPRA);
- Habitat rehabilitation and restoration;
- Management of biodiversity in areas not declared as protected areas;
- Identification and designation Important Plant Sites (IPS) or Important Plant Areas (IPA) or i*n situ* Plant Conservation Centers;
- Development and implementation of conservation and management plan for each of the designated IPS. Such plan must include mechanisms that will ensure active participation of concerned local government units and other stakeholders; and
- Coordination, communication and networking among institutions, scientists and policy makers on FGR *in situ* conservation.
- More participation by local government units on conservation activities
- More aggressive and sustained IEC on conservation of tree genetic resources

Capacity Building Needs

The capacity-building needed to enhance FGR conservation *in situ* are as follows:

- Education & Training (e.g. skills and knowledge on species identification and inventory)
- Public Awareness (Information, Education and Communication, IEC)
- Resource mobilization to support FGR conservation activities
- Management Information System (MIS)
- Inclusion of FGR conservation in academic curriculum
- Other extension programs – demonstration farms, cross site visits
- Strategies on FGR conservation (*in situ*) and results of R & D technology
- Stakeholders' participation in FGR conservation
- Advocacy of FGR conservation – policy makers, implementers of conservation activities, e.g. forest managers, local government units and communities, academe, research and science community
- Policy issues on FGR conservation – Bioprospecting, biosafety

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Chapter 3
Ex Situ Genetic Conservation

Ex situ conservation means the conservation of species germplasm outside of its natural habitat. Such conservation stands serve to capture and maintain genetic variation in planted gene or seed banks. Most *ex situ* collections are active collections especially those that are being used for tree improvement wherein accessions are immediately available for multiplication and distribution for production, educational and research uses. Bambusetum, mangrovetum, palmetum and rattan genebank are examples of base and active collections because they serve both purposes of being conserved and preserved for future use and at the same time as immediate sources of planting materials for distribution.

Ex situ conservation efforts for forest genetic resources in the Philippines generally involve the establishment of field genebanks or genetic resources plantations, botanical gardens, and seed banks.

Field Genebanks and Plantations

The then Paper Industries Corporation of the Philippines (PICOP), a Timber License Agreement (TLA) holder in Mindanao was one of the first few logging concessionaires which established large-scale forest plantations in the Philippines to support its own pulp and paper mill in the early 1970s. The species in PICOP's plantations were *Swietenia macrophylla, Pinus caribaea, Gmelina arborea, Acacia mangium, Falcataria moluccana* and *Eucalyptus deglupta*. PICOP's industrial tree plantations in the 1980s totally covered more than 46,000 ha of mainly of the last two species (Reyes 1987). The forest plantations were supported by PICOP's own forest research and tree improvement programs such as species provenance trials, progeny testing and plus tree selection for potential mother trees. However, the company stopped operations sometime in 2008 due to some legal problems with the government. Since then, the status of the plantations has not been monitored. Undoubtedly, living collections of excellent genotypes of the different plantation species which were sources of seeds and materials for vegetative propagation have already been cut.

A collaborative effort of DENR and the New Zealand government on plantation development and management gave rise to the Bukidnon Forest Inc. (BFI). Among its significant contributions is the domestication of exotic acacias, eucalyptus and pines for planting in open grassland (*Imperata cylindrica*) sites. An extensive study on species selection and suitability of seed origin was conducted. Based on the two-year results, the most promising species were *Acacia aulacocarpa, A. auriculiformis, A. crassicarpa, A. mangium, Eucalyptus urophylla, E. camaldulensis, E. tere-ticornis, E. pellita, E. grandis, E. deglupta,* crosses *E. deglupta* × *pellita, E. grandis* × *urophylla,* and *Pinus caribaea* var. *hondurensis* and var. *bahamensis*. Information gathered from the project revealed that the BFI had adequate genetic resources of *E. urophylla, A.*

mangium and *A. crassicarpa* to establish seed production areas and seedling seed orchards (Cuevas, 1999; Crizaldo, 1999). In 1997, the BFI started a trial planting of indigenous species, such as *Shorea contorta, Anisoptera thurifera* and *Vitex parviflora* (Cuevas 1999). The plantings are being monitored by BFI staff for growth and development.

A rattan genebank has been established in a 5-ha area in the ERDB Experimental Forest in Los Baños, Laguna. It contains 444 rattan plants composed of 47 taxa of endemic and exotic species. A duplicate rattan genebank has been established in Malaybalay, Bukidnon.

In addition, bambuseta have been established in Los Baños (6 ha with 29 species), Baguio City (7 ha with 70 species) and Davao (3 ha with 32 species) to preserve indigenous and introduced bamboo species.

Mangrove species are maintained in experimental forest reserves, one of which is in Pagbilao, Quezon with 17 species (Table 8). Palms are collectively stored in a palmetum established in the Los Baños Experiment Station and being maintained in Mt. Makiling, Los Baños, Laguna. (include the location/source of the propagules)

As an *ex situ* conservation strategy, a pilot demonstration area was established in Biñan, Laguna using eight indigenous species and application of mycorrhizal isolates and compost. The species are: ipil (*Instia bijuga*), akleng parang (*Albizia procera*), batino (*Alstonia macrophylla*), dungon (*Tarrietia sylvatica*), molave (*Vitex parviflora*), narra (*Pterocarpus indicus*), bitaog (*Callophyllum inophyllum*), and malapapaya (*Polyscias nodosa*).

Botanical Gardens

The Philippines has ten botanical gardens (Table 9) with a total of 16,000 taxa (Fernando and Balatibat, 1998). Many of these are small collections of plants for public display, while others are living collections for plant genetic resource conservation research and education. Most, if not all, remain poorly-funded and under-staffed; in the greater majority there are no scientific activities and no documentation or inventory of collections.

Table 8. Species found in the Mangrove Genebank at Pagbilao.

1.	Nilad	*Scyphiphora hydrophyllacaea*
2.	Api-api	*Avicennia officinalis*
3.	Buta-buta	*Excoecaria agallocha*
4.	Tangal	*Ceriops tagal*
5.	Bakauan-lalaki	*Rhizopora apiculata*
6.	Bakauan-babae	*Rhizopora mucronata*
7.	Pagatpat	*Sonneratia alba*
8.	Piapi	*Avicennia marina* var*. rumphiana*
9.	Nipa	*Nypa fructicans*
10.	Malatangal	*Ceriops decandra*
11.	Bungalon	*Avicennia marina*
12.	Busain	*Bruguiera gymnorrhiza*
13.	Bakauan-bangkau	*Rhizopora stylosa*
14.	Pototan	*Bruguiera sexangula*
15.	Tinduk-tindukan	*Aegiceras floridum*
16.	Tabigi	*Xylocarpus granatum*
17.	Pedada	*Sonneratia caseolaris*

The Makiling Botanic Gardens (MBG) in Los Baños, Laguna is the only fully developed botanical garden in the country. It has approximately 5-ha of recreational area and arboretum and about 200 ha of natural forest. It was formally established in 1963 through RA 3523, "for the purpose of supporting professional instruction and research relating to forestry and plant sciences generally and for serving the needs of tourists as well as the educational and recreational needs of the general public". On the average it receives up to 103,000 visitors each year, more than 60% of which are primary and secondary school students and nearly 50%

Table 9. Botanic gardens in the Philippines.

Botanic Garden	Administrator	Location
Arboretum of the University of the Philippines	University of the Philippines-Diliman	Quezon City
La Union Botanical Garden	City Government of San Fernando	La Union
Makiling Botanical Gardens	University of the Philippines-Los Baños	Laguna
Manila Zoo and Botanical Garden	Public Recreation Bureau, City of Manila	Manila
Pation Botanico Garden	Philippine National Museum	Manila
Philippine Bambusetum	Department of Environment and Natural Resources	Baguio City
The Hortorium	University of the Philippines-Los Baños	Laguna
University of Santo Tomas Botanical Garden	University of Santo Tomas	Manila
Siit Arboretum Botanic Garden	Eric Hanquinet	Negros Oriental

Source: Catibog-Sinha and Heaney, 2006

come from the Metro Manila area. The Makiling Botanic Gardens maintains an arboretum of Dipterocarpaceae representing more than half of all the species known in the Philippines. It also has plantations of *Swietenia macrophylla* representing probably the earliest seed lot of this species first introduced in the Philippines in June 1913 from the Royal Botanic Gardens in Calcutta, India (Ponce, 1933). MBG's collections of commercial timber trees also include, among others, *Vitex parviflora, Pterocarpus indicus, Afzelia rhomboidea, Intsia bijuga, Sindora supa, Madhuca betis*, *Petersianthus quadrialatus, Agathis philippinensis, Tectona grandis, Tectona philippinensis, Cedrela odorata,* and *Endospermum peltatum* (Fernando, 2001).

Seed Banks, Clone Banks and *In Vitro* Genebanks

In the Philippines, there are currently no known forest tree seed banks and in vitro genebanks. While there are facilities in the ERDB for short term storage of tree seeds, these are mostly used for orthodox seeds. *In vitro* methods and tissue banks are not mainly used by ERDB as conservation strategies. Tissue banks are not viable options for the long-term conservation of forest genetic resources. Furthermore, seed storage problems especially for recalcitrant species like dipterocarps and lesser known species, including non-timber species need further research studies. The investment needed in the laboratory in terms of manpower, equipment and supplies, especially power generators for ensuring the integrity of *in vitro* collections, are reasons for their non-utilization.

The Institute of Plant Breeding (IPB) of the University of the Philippines Los Baños, through its National Plant Genetic Resources Laboratory, is maintaining a genebank for agroforestry species such as *Gliricidia sepium* and a collection of indigenous and endemic fruit tree species.

The Institute also has facilities for storing seeds and tissues for an indefinite length of time. Currently it is keeping specimens of cereals, horticultural and ornamental collections, but none yet on timber species. Nevertheless, the Institute, in collaboration with the MBG, is going to implement a program on the conservation of biodiversity of high value crops, including indigenous palms and selected forest species (Garcia, 1999).

Plant Rescue

Scientists at the National Museum in Manila have started a Plant Rescue Operation which was triggered by the recent Mt. Pinatubo eruption. No similar activities have been planned for other volcanic areas in the Philippines to prepare for future natural events (Garcia, 2000).

Clonal Propagation

Clonal propagation involves utilization of the vegetative portion of plants in producing true-to-type plants. It is used to produce high quality planting materials from outstanding/ recommended mother trees.

The Provident Tree Farms Inc. (PTFI) in southern Philippines ventured into an Industrial Tree Plantation License Agreement (ITPLA) in 1982 (Nuevo 1997). This private company included tree improvement in its long-term management strategy to meet the challenges of increasing volume and quality of logs and fibre. The company focused on *Gmelina arborea* and *Acacia mangium*. Table 10 presents the *Acacia mangium* seedlot acquisition of PTFI-SMH, in Mindoro from as early as 1982 through 1987. The table shows considerable number of various acquisitions in a span of six years. The various provenances could provide genetic base wide enough for a starting program in tree improvement. Table 10. Summary of *Acacia mangium* seeds records and acquisition by PTFI-SMH in Mindoro.

The PTFI made an extensive first generation selection of landraces of *G. arborea* throughout

Table 10. Summary of Acacia mangium seeds records and acquisition by PTFI-SMH in Mindoro

YEAR	NO. OF SEEDLOTS OR PROVENANCE
1982	87
1983	15
1984	2
1985	66
1986	45
1987	8
TOTAL	**223**

Mindanao (Southern Philippines) and a high intensity selection of *A. mangium* from the best trees among the provenances introduced from Australia and Papua New Guinea

Table 11 presents the provenances used in plantation from 1983 to 1988. Planting made in 1989 and onwards originated from seeds collected from the earlier plantations in Mindoro and finally from Talacogon.

For *G. arborea*, the journal only indicated the sources of the land races as having emanated from Nasipit, Agusan del Norte, from the local sources in the vicinity, and from Canlubang, Laguna. Similarly for *Falcata moluccana,* seeds came from local sources, Nasipit, Mindoro and PICOP area.

The PTFI also developed a technology for the cloning of terminal shoot utilizing unsterilized shoot tips and mass-growing them in unsterile rooting medium of ordinary river sand. The company's ramet multiplication garden has been able to produce in total one million stecklings, which is sufficient to fulfill its planting stock requirements with some surplus for external demands (Nuevo, 1997).

Clonal multiplication gardens composed of selected genotypes with desirable phenotypic characteristics are established near field nurseries. These are ready sources of propagules for macro and *in vitro* propagation, adding

Table 11. Provenances and Seedlots of *Acacia mangium* used in PTFI-Talacogon Plantation.

YEAR	PLANTATION STAND NOS.	PROVENANCE	SMH REGISTRATION/ SEEDLOT NO.
1983	54	PNG, Oriomo River	PH1P51830004
1984	1, 3	Australia, Olive River	PH1H518200165
	35	Australia, Olive River	PH1H518200168
1985	9	Australia, Olive River	PH1H518500165
	10, 11	Australia, Olive River	PH1H518500170
	12	PNG, Oriomo, River	PH1H518500150
1986	61, 62, 64	Australia, Olive River	PH1H518500002
1987	5, 66, 67, 68	Australia, Syndicate Road	PH1H518200052
1988	7, 8, 32, 45, 69, 70	Australia, Rex Range, Mossman	PH1H518600018
	72, 76	PNG, Oriomo River	PH1H518600050

efficiency in propagation. It eliminates the need for frequent travels to very far sources just to collect shoots for clonal propagation. Endangered indigenous tree species are collected as wildlings or seeds/seedlings and placed in the vicinity of nurseries as hedge gardens. ERDB and Regional DENR-ERDS have established hedge gardens in their nurseries, mostly of dipterocarps. Table 12 shows the dipterocarp species planted at the ERDB hedge garden. Philippine teak stockplants from Lobo, Batangas are also added, as well as molave from Dasol, Pangasinan. Selection is not practiced when it comes to conservation and not intended for tree improvement.

Research Gaps

The following R & D areas are hereby recommended for more improved *ex situ* conservation efforts in the country:

- Effects of forest fragmentation on genetic diversity, since fragmentation would affect abundance, composition and behaviour of many pollinating species; propagation of beach forest species which could be on the verge of extinction,
- Ultra-dry seed storage for orthodox species. The ultra-dry seed storage technology is based on the principle that desiccating seeds to much lower moisture contents than those generally used in standard procedures will allow seed storage for an extended period at room temperature, thereby avoiding the requirement for refrigeration facilities. The seeds are placed in hermetically sealed containers. This is very important because seeds are the most convenient form for distributing germplasm to farmers and other users.
- Storage behavior of many indigenous tree species. The orthodox and recalcitrant seeds we know in the past as the two kinds of seeds are now updated to include intermediate seeds. This kind of seed is also desiccation-sensitive, but is more tolerant than recalcitrant seeds. It is less tolerant than

Table 12. Summary of dipterocarp species planted in the ERDB hedge garden (Pollisco, 2000)

Species	Source	Date Collected	Planting Materials	Date Established	No. of Stock Plants
Almon *(Shorea almon)*	Bukidnon	1995	Wildlings	June 1997	188
Apitong *(Dipterocarpus grandiflorus)*	SBMA Forest Reserve	Oct. 1995	Wildlings	June 1996	10
Bagtikan *(Parashorea malaanonan)*	Mt. Makiling	1998	Seeds	June 1997	103
Dagang *(Anisoptera aurea)*	Mt. Makiling	1994	Seeds	June 1998	8
Dalingdingan *(Hopea foxworthyi)*	Mindoro Oriental	Feb. 1995	Wildlings	May 1996	141
Gisok-gisok *(Hopea philippinensis)*	Bislig,Surigao del Sur	Oct. 1994 Jan. 1995	Wildlings	April 1997	222
Hagakhak *(D. validus)*	Mt. Makiling	May 1999	Wildlings	Dec. 1999	17
Palosapis *(Anisoptera thurifera)*	Ipo Dam, Angat,Bulacan	1955	Seeds	May 1996	522
Panau *(D. gracilis)*	SBMA Forest Reserve	Oct. 1995	Wildlings	June 1996	180
Red lauan *(S. negrosensis)*	Peñablanca, Cagayan	Oct. 1995	Wildlings	May 1996	210
Tangile *(S. polysperma)*	SBMA Forest Reserve	1997	Seeds	August 1998	76
White lauan *(S.a contorta)*	SBMA Forest Reserv	1995	Seeds	May 1996	190
Yakal-saplungan (*Hopea plagata*)	Malaybalay	Feb. 1995	Wildlings	May1996	275

orthodox and do not conform to orthodox storage behavior. Once dried, they become particularly susceptible to injury caused by low temperature (Ellis et al., 1990; 1991). The storage life of intermediate seeds can be prolonged by this further drying but it remains impossible to achieve the long-term conservation of orthodox seeds.

- Data base for priority species and priority areas including success stories;
- Evaluation of existing Botanical Gardens;
- Establishment of new Botanical Gardens that showcase Philippine native plants;
- Role of indigenous knowledge systems;
- Provenance testing;
- Promotion of indigenous tree species;

dysgenic nature of the present selective logging system;
- Employing multiple use in upland communities; mass propagation of non-timber forest species;
- Integration of production and protection objectives in industrial tree plantations;
- Harnessing biotechnology for increased growth/development of trees and pest/disease resistance
- Establishment and maintenance of *ex situ* conservation centers of wild plants
- Establishment of new seed stands/sources, seed orchards and genebanks of important FGR
- Establishment of protocols for macro-propagation of rare and endangered species.
- Molecular genetic techniques for priority species.

Education and Training

The ASEAN Regional Centre for Biodiversity (ARCBC, now ASEAN Centre for Biodiversity or ACB) has actively conducted several trainings to upgrade the capacities of different organizations on biodiversity. Some of the training courses include a *National workshop on Understanding and Managing Biodiversity at the Provincial and Landscape Levels*, a *National Trainers' Training on Biodiversity Conservation and Sustainable Development Education at the Tertiary Level*, and a *Regional Plant Taxonomy Training*. The Protected Area and Wildlife Bureau (PAWB) has conducted training courses on techniques for plant identification and vegetation assessment. However, during the field interview related to the ITTO-funded project on forest genetic resources, many staff members of PAWB expressed the need for more training considering that only a few people were included in the previous training courses. Other government agencies, such as the Ecosystems Research and Development Bureau (ERDB), have conducted short training courses on plant collection and herbarium techniques and macro- and micro-propagation of selected premium and indigenous species. The Philippine National Museum–Plants Unit has training programs on plant conservation techniques, plant collection and identification, biodiversity assessment (flora/vegetation), curation of herbaria, and inventory and do-cumentation of ethnomedicinal plants, using of Botanical Resources and Herbarium Management System (DENR–PAWB, 2006).

Capability-building needed by institutions to promote *ex-situ* conservation and enhance FGR Conservation are as follows:

- Education and Training on plant genetic diversity and conservation of FGR
- Public Awareness (Information Education, Campaign) through improved libraries, popular and technical publications, lectures, seminars, workshops and conferences
- Resource mobilization to support FGR Conservation activities
- Management Information System (MIS)
- Inclusion of FGR Conservation in academic curriculum
- Other extension programmes – demo farms, cross site visits
- Establish a system, including websites, which will ensure a constant exchange of information on the genetic resources of Philippine plants between and among cocerned institutions and organizations, and make this information accessible to all interested parties.

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Chapter 4

The State of Use and Sustainable Management of Forest Genetic Resources

Forest genetic resources is a concept that refers to environmental, social, economic, cultural and scientific values of the heritable materials contained within and among species (Koshy et al., 2002). In sustainable forest management, Lutfi (2009) noted that a balance should be attained i.e. a balance between society's increasing demand for forest and benefits and the preservation of forest health and diversity. The balance is critical to the survival of forests and to the prosperity of forest-dependent communities.

In a paper, "Harnessing Forest Genetic Resources for Sustainable Forest Management", Garcia (1995) described measures to increase the usefulness of forest genetic resources in the Philippines. The paper touched on the following issues:

1. Enhanced information gathering and exchange for floristic surveys and forest inventory;
2. Role of indigenous knowledge systems;
3. Revitalized breeding programmes;
4. Provenance testing;
5. Promotion of indigenous tree species;
6. Dysgenic nature of the present selective logging system;
7. Employing multiple use in upland communities;
8. Mass propagation of non-timber forest products;
9. Mixed plantings;
10. Integration of production and protection objectives in industrial tree plantations;
11. Harnessing biotechnology for increased growth/development of trees and pest/disease resistance.

Utilization of Conserved Forest Genetic Resources and the Major Constraints to their Use

The conservation, protection and sustainable use of natural resources are embodied in several laws of the Philippines. The following provisions in the Philippine constitution are related to the conservation of forest resources:

1. Protection and achievement by the State of the right of all Filipino people to a balanced and healthful ecology in acordance with the rhythm and harmony of nature (Sec.16, Art.II); framework of national unity and development (Sec. 22, XI);

2. State of ownership of all natural resources and inalienability, except agricultural lands (Sec. 2, XII);

3. Full control and supervision by the State on exploration, development, and utilization of natural resources either by directly undertaking such activities or by entering into co-production, joint venture or production-sharing agreements with Filipino citizens or Filipino owned or controlled corporations or associations (Sec. 2, XIII);

4. Small scale utilization of natural resources (Sec. 2,XIII);

5. Determination by Congress of the specific limits of forest lands by marking of their boundaries on the ground (Sec.4, XII);

6. Protection of the rights of indigenous cultural communities (ICC) by the State to their ancestral lands to ensure their economic, social, and cultural well-being (Sec. 5, XII).

The above constitutional provisions as regards the use of forest genetic resources are further clearly enunciated in Section 1 of Executive Order No. 578 issued in 2006 which says that "in accordance with law, it is the policy of the state to protect, conserve and sustainably use biological diversity to ensure and secure the well-being of present and future generations of Filipinos. This state policy extends to all the components of biological diversity – ecosystems, species and genes." The same policy mandated the DENR and all other government agencies as well as all local government units to "integrate and mainstream the protection, conservation and sustainable use of biological diversity into their policies, rules and regulations, programs, projects, and development planning processes." As a matter of procedure, the EO tasked all government agencies and local government units to formulate and submit to DENR, for monitoring compliance, their respective biological programs.

The proper conservation of plant genetic resources will guarantee their availability for the use of present and future generations. Forest genetic resources can be developed to protect the environment, rehabilitate degraded lands and improve the welfare of rural communities. However, the continuous destruction of the environment poses a great threat to the availability of forest genetic resources. Destruction is mainly caused by land conversion for settlement, agricultural development, shifting cultivation, logging, forest fire, and to some extent mining, energy projects, and pest and diseases (DENR-PAWB, 2006). Fernando (2001) reported that the country's forest genetic resources are threatened by overexploitation for commercial purposes (collection of wild orchids for export), land conversion (logging and shifting cultivation) and habitat fragmentation.

The State of Forest Genetic Improvement and Breeding Program

Previous efforts and current activities on the genetic improvement and/or breeding of forest species in the Philippines are few and largely fragmented. The country doesn't have a national tree improvement program as yet, to tie in all the initiatives on forest genetic improvement including forest genetic resources conservation.

Forest genetic improvement had been conducted for several species. Some of the projects that dealt on tree breeding are the following:

1. Development of genetically superior trees in the genus Eucalyptus with funding from the now defunct PICOP. Three species of Eucalyptus (*E. deglupta, E. urophylla, and E. pellita*) were crossed. EP3 x ED1 and EP x EU excelled in height growth rate, over their mid-parents 132% and 140% respectively. The hybrids also exhibited more vigorous and homogenous seedlings heights

2. Provenance trial of *Pinus kesiya* (GOP, 10 years) – Some provenances performed better than the others in height growth. Twelve local and three foreign provenances were tested. In terms of diameter and height growth, no significant differences were noted between local and foreign provenances.

3. Provenance trial of *Pinus caribaea* (GOP, 10 years) – Differences in height and diameter growth rate was not significant; 5.25% of the experimental trees developed foxtail.

4. Provenance trial of *Eucalyptus camaldulensis* (GOP, 9 years) – Forty-nine provenances from Australia were tested. Survival, height and diameter growth rates were significantly variable.

5. Tolerance on pests and diseases of *P. caribaea, P. elliottii, P. pseudostrobus* (GOP) – Significant difference among provenances were observed.

6. Morphological evaluation *of Leucaena leucocephala* hybrids type (UPLB, 1 year) – Foreign strains as tree type compared to the native as shrub type. When crossed, the F1 hybrids are intermediate to the parents especially in leaf characters.

7. Screening of *Leucaena* for tolerance to acidic soils (UPLB, 6 months) – Fifty four accessions of local and foreign origins were screened. Accessions 68 and 19 were outstanding with 242 and 220 mg dry weight at 5 weeks after germination with growths of 35 and 30 mg per week, respectively. Tolerance to acidic soil was highly correlated with growth.

Tree Improvement

Tree improvement refers to the application of forest genetics principles within a given silvicultural system for the purpose of improving the genetic quality of the forest. Its goal is to improve the genetic value of the population while maintaining genetic diversity. Meeting this goal means that genetic improvement is aimed at the population level, rather than improvement of breeds or inbred lines. It can be attained using a short-term or a long-term approach although the latter provides the optimum genetic gains.

The short-term approach to tree improvement uses natural stands or existing land race plantations, which have already adapted to local environment conditions, although they have narrow genetic base. This approach is a temporary solution for the supply of improved planting materials until the genetically improved seeds and propagules shall have been produced by the long-term improvement output. The approach includes, but not limited to, the establishment of seed production areas in natural stands or plantations, establishment of interim seed orchards and timber stand improvement in natural forests.

The long-term approach, on the other hand, includes more advanced activities, such as species/provenance trials, progeny trials, clonal tests and hybridization.

Seed Stands provide the primary source of phenotypically superior planting materials. They serve as the direct link in the establishment of seed orchards, the advanced sources of improved planting materials. Primarily, they function as an interim source until progeny tested seeds are obtained from the seed orchards.

Successful selection of plus trees from identified seed sources of priority forest tree species throughout the country focused on forms and resistance to pests and diseases. Some of the traits considered during the selection include total height, diameter at breast height, stem straightness, forking, circularity, branch angle, branch thickness and branch persistence/pruning ability.

With the objective of selecting plus trees of several species, the UNDP and FAO funded a project called FORTIP (Regional Project on Improved Productivity of Man-made Forests through Application of Technological Advances in Tree Breeding and Propagation). The project selected more than 100 plus trees of *Swietenia macrophylla* in the Makiling Forest Reserve and the Quezon National Park, over 150 plus trees of *Pinus kesiya* in natural stands at Baguio City and Bokod Watershed Reservation area, about 30 plus trees of *Pterocarpus indicus* in the Makiling Forest Reserve and about 35 plus trees of *Gmelina arborea* in Magat, Nueva Vizcaya (Zabala, 1996).

To upgrade the quality of seed stands as source of propagules for breeding and mass propagation, provenance/progeny trials of *Pterocarpus indicus, Vitex parviflora*, and *G. arborea* were established in Quezon, Bohol and Davao, respectively by the DENR Research Sector in 2009 under its tree improvement program.

To support the continuing nationwide reforestation program with the expectation of having sustainable source of improved varieties of forest trees and genetically superior planting materials, the DENR through the Ecosystems Research and Development Bureau (ERDB) and Ecosystems Research and Development Sector (ERDS) initiated the establishment of potential seed production areas (SPA) and Seed Sources throughout the country (Appendix Table 7).

Seed Production Areas

Potential seed production areas are identified and delineated in natural stands or plantations with a high frequency of phenotypically good planting materials. The stands are upgraded and managed entirely for seed production. Undesirable trees are removed or rouged, retaining only 150-250 trees/ha, which are tall, big in diameter, with straight bole and have balanced crown.

FORTIP project reported the establishment of seed production areas of *Acacia mangium* in Puerto Azul, Ternate, Cavite in 1994. The Tree Seed Center of the Commonwealth Scientific and Industrial Research Organization of Australia (CSIRO) in cooperation with FORTIP, the Ecosystems Research and Development Bureau (ERDB), the Bukidnon Forests Incorporated (BFI) and the Forest Management Bureau (FMB) established seed production areas (SPA) of *Eucalyptus urophylla, Acacia mangium* and *A. crassicarpa* at Bansud, Mindoro, Malaybalay, Bukidnon and Baslay, Negros Oriental.

The 5.6 ha SPA for *Acacia mangium* and *Eucalyptus urophylla* has been established in Bansud, Oriental Mindoro in 1996 by ERDB in collaboration with the CSIRO Division of Forestry's Australian Tree Seed Centre (ATSC). The seedlots used in the establishment of the SPA came from provenance bulk collections of ATSC. The SPA had an initial spacing of 5.0 m x 1.5 m (or 1,333 trees/ha). Thinning/rouging was conducted in two stages with the first thinning at about two years after planting when the trees were around 6 m tall and the second thinning at age 3 when the trees averaged 9 m tall. The final stocking is 150-200 trees/ha. The SPA serves as a source of high-quality seeds and planting materials for the two species.

In 1995, the DENR, having finally realized the value of establishing a good and sustained forest genetic resources for the country's reforestation efforts, initiated through Administrative Order No. 9 the identification, establishment, maintenance, and protection of Seed Production Areas (SPAs) throughout the Philippines. The objective was to make the SPAs the primary sources of seeds for forest plantations. As embodied in the order, SPAs may be established in government tree plantations, industrial tree plantations, private forest tree plantations, and in natural forest stands. These identified plantations and natural stands should meet the following criteria: (1) for established plantation of similar species, the minimum area should not be less than 10 ha; (2) for contiguous natural stands of mixed species, the area should not be less than 10 ha; and (3) all identified mother trees shall be marked on the site, recorded in the inventory form, and plotted on a map. All established SPAs, except those on private lands, were to be delineated and proclaimed as permanent SPAs, subject to re-evaluation every 5 years. Commercial timber harvesting within the proclaimed SPA inside public forest was also to be strictly prohibited. Private landowners with at least 2 ha of forest plantation may also apply for accreditation with the DENR as seed production area (SPA).

The National Forest Tree Seed Committee of the DENR has identified potential seed production

areas all over the country. Teams conducted a country-wide survey and identified 27 candidate plantations in 10 regions. The species in the identified plantations included indigenous species (*Casuarina equisetifolia, Pterocarpus indicus* and *Vitex parviflora*) and exotics of different origins (*Swietenia macrophylla*, *Gmelina arborea, Eucalyptus camaldulensis E. deglupta, Paraserianthes falcataria, and Tectona grandis*). Unfortunately, the program did not prosper due to fear of public criticism over tree rouging.

In line with the Research and Development Projects of the National Forestation Program, a project called Establishment and Management of SPAs (Seed Production Areas) was conducted. One study under the project concentrated on the roles of seed production areas in forest plantation (Lustica et al*.,* 1999). During the 5-year study, information on the seeds and phenology of *Casuarina equisetifolia*, *C. rumphiana, Eucalyptus camaldulensis* and *Shorea macrophylla* were obtained at Dumarao, Capiz, Iloilo and Aklan. Another study under the project was national provenance trial for narra (*Pterocarpus indicus;* Favila, 1996). The five-year study compared five different provenances of *P. indicus* at two locations, the Leon National College of Agriculture (LNCA) and the Calinog Agricultural and Industrial College.

Acacias and eucalypts in Bansud, Or. Mindoro SPA produced the following seed yield: 1) *A. mangium* had an average of 399.45 g/tree, the highest of which was 765 g/tree; 2) *E. urophylla*, the average yield of 73.07 g/tree, the highest of which is 102 g/tree (Dimayuga and Pader, 2006).

As to dipterocarps, DENR has selected over 50 plus trees at the seed production area in the Experimental Forest, Bislig, Surigao del Sur and at the Forest Reserve in Subic, Olongapo, Zambales (Zabala, 1996).

Seed Orchards

Seed orchards are plantations of selected clones or progenies which are isolated or managed to avoid or reduce pollination from genetically inferior sources outside the orchard, and is intensively managed to produce frequent, abundant, and easily harvested crops of seeds.

Seed orchard represents a more advanced step than SPA. The purpose of establishing a seed orchard is not only to produce large quantities of improved seeds but can also be regarded as a breeding population as basis for further tree improvement.

A clonal seed orchard of *Gmelina arborea* of 1.5 ha with 29 clones and 161 ramets planted at 8 x 8 m spacing, and hybridizing seedling seed orchard of *A. mangium* and *A. auriculiformis* (0.75 ha) were established at Puerto Azul, Ternate, Cavite by the ERDB under the FORTIP project in 1995 and 1994, respectively. Similarly, a 1.5-ha clonal seed orchard of *Swietenia macrophylla* and a 2-ha clonal seed orchard of *Pterocarpus indicus* were established at Tayabas, Quezon in 1994–1995.

In 2007, the Public Sector Linkages Program of the Australian Government's Overseas Aid Program (PSLP of AusAID) in collaboration with the Ecosystems Research and Development Services of DENR Regions 10 and 13, funded the activities geared towards improving the productivity and profitability of trees in farms and community-managed plantations in Northern and North eastern Mindanao, and the other on the application of advanced forest tree seed technologies to improve rural wood-based economic opportunities in the tree plantation provinces of Mindanao. As a re-entry activity which was still a part of the project, a total of 6 hectares of progeny trials of *Acacia mangium* and *Swietenia macrophylla* were established in the Northern Mindanao Institute of Science and Technology (now Caraga State University) in Ampayon, Butuan City and in Mapaua Tree Farms, an IFMA holder at Mapaua, Cagayan de Oro City. Another objective for the implementation of the said project was to enhance the capabilities of the local DENR personnel with the knowledge, skills, and technologies in the application of advanced forest seed collection, processing, storage and distribution or sales

within the target provinces of Mindanao. From 2009 up to present, additional 17-ha trials of *Acacia mangium, Paraserianthes falcataria, Eucalyptus deglupta, and Gmelina arborea* were established in the Caraga Region.

Species and Provenance Trials

One of the objectives of provenance trial is to identify those provenances whose seeds will produce well-adapted and productive genetic materials for plantations. Productivity itself may not always imply rapid growth but also good survival, resistance to adverse environmental factors and pests, improved wood quality, and good seed production.

Through its regional research offices, DENR has started a number of species and provenance trials. Since as early as 1958, trial plantings of *Eucalyptus* have been conducted all over the Philippines (Lizardo, 1960). Other species trials of *Eucalyptus* provenances, obtained from the Northern Territories of Australia, Italy, Philippines, New South Wales and Brazil, have been reported by Maun (1978). Agpaoa (1980; see also Agpaoa and Tangan, 1981) claimed that *E. camaldulensis* planted in Ilocos Norte, Benguet, Nueva Ecija and Nueva Vizcaya grew and survived better than *Casuarina equisetifolia, Leucaena leucocephala, Gmelina arborea* and *Albizia procera.*

Species and provenance trials and establishment of seed orchards have long been conducted by DENR for species of *Acacia, Casuarina, Eucalyptus, Gmelina, Pterocarpus, Pinus, Swietenia, Xanthostemon* and other multipurpose species (Garcia, 1999). Many of these projects faltered due to changes in the leadership and institutional reorganizations as well as lack of sustained government support (Ordinario, 1992). Some of the provenance trial plots later formed seed sources for the younger plantations by DENR and private planters. The PICOP Resources Incorporated (PICOP), the Provident Tree Farms Incorporated (PTFI) and the Bukidnon Forests Incorporated (BFI) have been practicing *ex situ* conservation activities through provenance introduction and multiplication of phenotypically superior industrial forest plantation species such as *Paraserianthes falcataria, Gmelina arborea, Endospermum peltatum* and *Eucalyptus deglupta* (Fernando, 2001).

More provenance trials of *P. indicus* have been conducted in a volcanic ecosystem at Mt. Mayon in Albay (Matusalem, 1993), and at the Bicol National Park (Lauricio, 1997). Lauricio (1997) compared the growth of prickly *P. indicus* from Bukidnon and Camarines Sur and smooth *P. indicus* from Camarines Sur, Capiz and Quezon. The different provenances showed good growth.

Siarot and Paler (1992) did in PICOP a provenance trial of 17 seedlots of *Acacia mangium* from Sabah (Malaysia) and Queensland. The study reported no significant differences in terms of average total height, but a highly significant difference was observed in terms of average diameter at breast height after five years. The study further noted that a seedlot from Sabah was free from canker. Siarot and Paler (1992) recommended further genetic improvement to attain perfectly straight boles.

Lanting and de Chavez (2002) also reported a provenance trial of *Acacia mangium* and species trials of *A. auriculiformis, A. aulacocarpa, A. crassicarpa, A. mangium, A. mangium* × *auriculiformis* and *Gmelina arborea* at Ternate, Cavite. Seeds of *A. auriculiformis* were sourced from Queensland, whereas *G. arborea* seeds originated from Makiling Forest Reserve, Sabah Wood Industry and from Diadi, Nueva Vizcaya. The other four species came from Papua New Guinea. The study identified 150 seed trees of the different species but further noted that the seed yield from these trees was inadequate to support the national reforestation project.

A provenance trial of *Pinus caribaea* var. *hondurensis* was conducted at Jalau Reforestation project in Calinog, Iloilo by Eusebio (1983). There were nine provenances tested. Moreover, DENR has conducted provenance trials of *Pterocarpus indicus* (Matusalem, 1993; Lauricio, 1997; Favila, 1996); *Casuarina*

equisetifolia, C. junghuniana, Acacia mangium, A. auriculiformis, A. crassicarpa, A. aulacocarpa, G. arborea, A. mangium × *auriculiformis, Pinus caribaea* (Eusebio, 1983); *Eucalyptus camaldulensis* (Agpaoa and Tangan, 1981) and *Xanthostemon verdugonianus* (Nasayao and German, 1993). All these species, except for *P. indicus* and *X. verdugonianus*, are exotics.

To upgrade the quality of seed stands as source of propagules for breeding and mass propagation, provenance/progeny trials of narra (*Pterocarpus indicus),* molave (*Vitex parviflora*), and yemane (*G. arborea*) were established in Quezon, Bohol and Davao, respectively by ERDB in 2009 under its tree improvement program.

Seed Collection, Processing, Storage and Distribution

Seeds are the most economical sources of planting materials and the easiest to transport. However, most of the indigenous species are found in remote areas and produce seeds after long intervals. Added to this is the fact that most have recalcitrant seeds. Other species show some degree of dormancy or require different pre-treatments. The most recent significant seed research that was developed is the Malapapaya (*Polyscias nodosa*) seed technology by Dayan and Reaviles (2001) and has been used by MP Woods for their plantation in Gumaca, Quezon. It is the raw material for the manufacture of chopsticks, popsicle sticks, bento boxes and veneer. Seed technology of other species are published in DENR Recommends series.

A report by Tolentino et al., (2006) on the assessment of mother trees of the different species by SPA-designated stands, seed orchards, and other designated seed sources and plantations of government (DENR, SCU), corporate/private companies (timber licensees), and smallholder tree farms (CBFMA, private plantations) revealed the following results: 1) documentation of seed origin is seldom practiced; 2) the number of mother trees from where seeds are collected varies. There are those whose sources have more than 100 trees, but some smallholder tree farmers have limited number of trees (<10 trees) from which seeds are collected. Corporate or institutional (GO-based) plantations have access to a wide variety of seed sources, particularly superior ones, while resource-limited farmers do not have access to improved seeds; 3) basic policies (DENR Administrative Order 95-9 and its implementing guidelines DENR Memorandum 95-20) to insure the quality of seeds were laid out before but they have weaknesses and shortcomings that need to be addressed. The effectiveness of DAOs and memorandum circulars should also be assessed in contrast to complete tree seed legislation, i.e., a Tree Seed Law for the Philippines.

A farmer-operated association for the production, collection, processing, development and marketing of seeds was established in 1998 in Lantapan, Bukidnon. Since then the Agroforestry Tree Seed Association of Lantapan (ATSAL) has grown from the initial 15 to 60 members. The association has been instrumental in training thousands of farmers in collecting, handling and marketing of quality agroforestry seeds. The marked difference of this group with other seed vendors is that this non-formal system for seed production and distribution enabled smallholders to produce and market quality germplasm based on standardized methods, as noted by Koffa and Garrity (2001). The same authors described the approaches in maintaining diversity in germplasm sources in farming systems, namely: (a) work directly with the genetic resources which the smallholders value and conserve; (b) create and conserve protected areas; and (c) provide smallholders with genetic diversity in the form of landrace germplasm from a range of sources.

ATSAL has sold more than 5,000 kg of assorted seeds of exotic and indigenous tree species, and thousands of seedlings to buyers in Mindanao, Visayas and even in Nairobi, Kenya. Since its foundation, ATSAL has earned three million Philippine Pesos (60,000 US$). The profits were distributed among the member

farmers and used to support the organization. This example highlights the significant roles of upland farmers in contributing towards genetic conservation of important forest resources. Additionally, it emphasizes the fact that forest genetic conservation is not a monopoly of corporate or government agencies.

The Ecosystems Research and Development Services of DENR Region 13 established the Mindanao Tree Seed Center in 2008. Its establishment was made possible through the participation to the training on "advanced forest tree seed technologies to improve wood-based economic opportunities in the three plantation provinces in Mindanao", which is a part of the Public Sector Linkage Program (PSLP) of the Australian Government's Overseas Aid Program. To strengthen its implementation, DOST-PCARRD approved the implementation of different important activities of the center through the project entitled "Seed Collection and Management of Mindanao Tree Seed Center cum Production of Quality Seedlings" under the Action Program of the Establishment of ITP Action Program on the Establishment of Commercial Plantation and Efficient Utilization of Wood Products in Caraga Region. The center serves as the channel for facilitating the flow of seeds from selected sources while capturing, keeping, processing relevant information in a Seed Information System in order to improve productivity of the tree plantations. The center started dispatching industrial tree plantation (ITP) seeds in 2010 to the different DENR projects, private tree farmers and to a research organization. With its campaign message of "better plantations come from better seeds/planting materials", more private farmers and people's organizations are buying quality seeds from the center. With the implementation of National Greening Program in 2011, the center included in its identification of superior mother trees and collection of the seeds/planting materials of indigenous trees.

DENR Administrative Order No. 2010-11 issued on 05 May 2010 provides for the regulations governing forest tree seed and seedling production, collection and disposition. Among the objectives of this Order is to "ensure the continuous production of adequate supply of phenotypically and genetically-improved planting materials to meet the requirements for high quality seeds and seedlings by the government and private sectors in the establishment and development of tree plantations, tree farms, forest gardens, forestation, agroforestation projects, and rehabilitation of watersheds and coastal areas.

Research and Development

There are several R & D projects that have been conducted as regard *ex situ* efforts in the Philippines.

In a study on field performance of rooted cuttings, Pollisco (2000) reported about the destructive sampling done on three year old dipterocarp rooted cuttings and seedlings/wildlings planted at the Mt. Palay-palay National Park, Mataas na Gulod, Ternate, Cavite, to compare their root systems. The species used were white lauan (*P. contorta*), guijo (*Shorea guiso*) and palosapis (*Anisoptera thurifera*). Results showed that the root system of 3-yr old cuttings had more than one macro-root, each of which is comparable in size to the tap root of seedlings. Wildlings were found to have a major advantage of having plenty of lateral roots, presumably because of their having established initial ectomycorrhizal infection upon germination, an advantage over both seedlings and rooted cuttings. Read (1991), as cited by Becker (1983), stated that when seeds germinate, they quickly become infected by mycorrhizal fungi already established in association with the adult trees.

Initially, no major differences were found in terms of height and diameter growth of the cuttings and seedlings derived from juvenile materials. The vegetatively-derived palosapis grew more slowly in the early part than the seedlings, although the sand-rooted cuttings leveled-off with the seedlings after 11 months. Zobel (1992) also observed that rooted cuttings of sycamore (*Planatus occidentalis*) grew in the same pattern as palosapis (*Anisoptera*

thurifera), while rooted cuttings of *Bambasopsis quinata* grew faster than seedlings. Dipterocarps are commonly regarded as shade tolerant during early development and light demanders after the seedling or sapling stage (Appanah and Weinland, 1993). Many dipterocarp species either failed completely or performed poorly when planted directly on *Imperata cylindrica* grasslands. Poor performance of planted dipterocarps on open grassland was also reported by Zabala (1986). Contrary to these reports, 7-yr. old white lauan (*P. contorta*) planted in the Caliraya, Laguna field trial was found to be growing vigorously in the open (Pollisco, 2006), with bushy crown. Those planted under different nurse trees in different areas were observed to be smaller in both height and diameter increments. Dipterocarp trees under narra (*P. indicus*) in Cavite did not perform well, which may be attri-buted to the closed canopy of the nurse trees during most parts of the year (Pollisco, 2004). Dr. Zabala stated that it is intensive and may have prohibited further development of *Anisoptera marginata* saplings. The same is true with dipterocarps planted under mahogany in Malaybalay, Bukidnon wherein only occasional sunflecks penetrate the lower canopy. Even the dipterocarps planted under canopy gaps in Bislig, Surigao del Sur were smaller than those planted in the open conditions at Caliraya. Furthermore, narra shed leaves completely during summer, exposing the dipterocarps to full sunlight. Since their leaves are attuned to shade most of the year, intense sunlight during summer is stressful in addition to water deficiency resulting to lower height and smaller diameter. According to ERDS Davao, the Nabunturan, Davao del Norte field trial under eucalypts is also an exceptional trial.

Since eucalypts have small, thin leaves, it is a suitable nurse tree for dipterocarps. Appanah and Weinland (1993) noted the same for *Paraserianthes falcataria*, wherein it has a sparse foliage and flat crown high above the ground, allowing sunlight to penetrate fairly uniformly to the forest floor.

Another possible explanation may also be that, as stated by Becker (1983), plants growing under high light intensity have more abundant mycorrhizal roots than those growing in the shade. He found that under natural conditions, the number of mycorrhizal infections was higher in open areas than for seedling growing under closed canopy. Soil analysis has yet to be conducted to be able to determine the soil status of the sites. Ashton, et al. (1988) stated that distribution of dipterocarps is correlated with a number of soil factors, but primarily with magnesium and phosphorus.

Mangrove ecosystems have been another active area of research in the Philippines. For example, an inventory and assessment on mangrove biodiversity was conducted in Central Visayas. The study included research to better understand the stand structure, phenology, species composition, pests and diseases, silvicultural attributes and environmental factors which affect the survival and growth of mangrove plantation. In addition, seed sources of selected mangrove and associated species were established. Other studies on mangroves include the provenance studies of various mangrove species in Western Visayas (Malabanan, 1992), rehabilitation of the coastal areas of the National Capital Region (Esteban, 1998), and documentation and assessment of mangrove reforestation using indigenous practices in Bohol (Mantanilla and Melana, 1992).

The first work on the characterization of timber species using molecular markers in the Philippines was a dissertation produced on *Swietenia macrophylla* populations in the Luzon Island using Random Amplified Polymorphic DNA (Quimado, 2002). The study showed high polymorphism (80%) of the large leaf mahogany trees in Mt. Makiling, Laguna and in Atimonan, Quezon. Within population diversity (90%) was significantly higher than variation between populations (10%). The study also showed two major groupings and the distinctness of one population from the rest. As noted, this study is the first of its kind and more such studies are needed.

In another study, the mating system of *Pterocarpus indicus* (narra) population in a mixed planted forest at Mt Makiling, Luzon Island, was investigated using five polymorphic isozyme loci. The population was noted to have a predominantly outcrossing nature (De Guzman, 1996). Pollen competition or early selection against selfed progenies, or both, were suggested as possible reasons for the low estimates of selfing rates. The estimated outcrossing rates of the isolated trees showed that the unidentified pollinators of *P. indicus* were very efficient to ensure a high degree of cross-pollination even for spatially isolated trees. Future research to investigate the taxonomy of *P. indicus* through isozyme analysis, and studies to elucidate mating patterns of other tropical trees were suggested (De Guzman, 1996). Using isozyme analysis, *Parashorea malaanonan* was confirmed to be outcrossing (Gamboa-Lapitan & Hyun, 2005). The same study also observed biparental inbreeding in the species in some individuals in the Makiling Forest Reserve. Abasolo (2007) used a satellite marker derived from *Shorea* species to study the genetic diversity of *Parashorea malaanonan*. The results showed that diversity within sites was 64% while diversity among sites was 36%, indicating a high diversity between sites in the Makiling Forest Reserve. There was no significant correlation between genetic and geo-graphical distances in the four sites studied.

In 2009-2010, routine laboratory procedures for determining genetic variation within and among population of narra (*P. indicus*), Benguet pine (*Pinus kesiya),* molave (*V. parviflora*), limuran (*Calamus ornatus var.philippinensis)* and tagiktik (*Calamus filispadix)* were conducted using isozyme analysis.Isozyme analysis of five provenances of narra showed that Cebu has high genetic diversity thus a good source of quality seeds for plantation development. Limuran leaf samples randomly collected from Camarines Norte, Bataan and Quezon revealed low genetic variation in Quezon and those in Bataan as the most diverse, making it the most probable good source of quality seeds.

Mass Propagation of Improved Varieties

For macropropagation technique, the protocols for rooting of *Gmelina* shoot tip and nodal cuttings were developed by Umali-Garcia as early as 1990. The importance of clonal testing was demonstrated in several *Gmelina* provenances (Umali-Garcia et al*.,* 1998). The propagation of several endangered Philippine species, such as *Diospyros philippinensis* (Oporto and Umali-Garcia, 1999) and *Dracontomelon dao* (Oporto and Umali-Garcia, 1998a) has been successfully demonstrated. There are already available protocols for rooting of stem cuttings of certain species of dipterocarps (Pollisco, 1995; Dela Cruz, 1996; Oporto and Umali-Garcia, 1998c), *Paraserianthes falcataria*, (Umali-Garcia, 1989), *Eucalyptus* hybrid (Siarot 1991), *Swietenia macrophylla, Vitex parviflora* (Umali-Garcia, 1995), *Pittosporum pentandrum* (Oporto and Umali-Garcia, 1998b) and *Pinus merkusii* (Garcia, 1999).

For the last decade, macropropagation using rooted cuttings were successfully attained by ERDB for 13 dipterocarp species namely *Shorea contorta. S. contortis, S. guiso S. almon, Parashorea malaanonan, Dipterocarpus grandiflorus, D. gracilis, Hopea plagata, H. philipinnensis, H. foxworthyi, Vatica odorata, Anisoptera aurea* and *A. thurifera.* Clonal propagation was conducted on dipterocarp species because production of planting materials by seeds is difficult due to irregularity of seed production supply and short seed viability period. Indigenous species which include premium and endangered species like narek (*Hopea cagayanensis),* batikuling (*Litsea leytensis),* dangula (*Teijsmanniodendron ahernianum),* molave (*Vitex parviflora)*, toog (*Petersianthus quadrialatus),* and dungon (Heritiera *sylvatica)* were also macropropagated.

As to micropropagation, tissue culture propagation of various tree and plant species in the Philippines has been done on some forest tree species (Table 13). So far, plantlets of *Eucalyptus deglupta*, *Paraserianthes falcataria*, *Endospermum peltatum*, *Acacia mangium*, *E. camaldulensis* and *Pterocarpus indicus*

have been successfully produced in test tubes in the laboratory (Crizaldo, 1980; Capuli and Calinawan, 1999; De la Cruz, 2003). Except for *E. deglupta, P. falcataria* and *Cratoxylon sumatranum*, the clones have not found their way in the nursery. A programme on forest biotechnology based at the University of the Philippines, Los Baños (UPLB), under the College of Forestry and Natural Resources (UPLB–CFNR) focused on tissue culture of industrial plantation species such as *Acacia mangium, Gmelina arborea, Pterocarpus indicus, P. falcataria* and *Swietenia macrophylla* using explants from selected plus trees.

ERDB has successfully developed protocols for plantlet production of *Acacia mangium*, *Eucalyptus deglupta*, and *E. pellita-urophylla* using the tissue culture method. Samples of tissue cultured seedlings of *E. deglupta* were planted in the ERDB Experiment Station in Mt. Makiling, Los Banos, Laguna and in Llavac, Quezon. Two years after planting, the seedlings were observed to be exhibiting good growths and straight boles.

Tissue culture of various rattan species has also been worked on. An ongoing project on 'Research and Development Program and

Table 13. Tree species studied using tissue culture in the Philippines (adapted from Lapitan and Garcia, 1993).

Species	Status of research
Agathis philippinensis, Pseudocarpus philippinensis	Sterilization procedure and medium for callus initiation protocol developed
Paraserianthes falcataria	Plantlets developed Callus and bud formation and rooting
Pterocarpus indicus	Media identified for callus and shoot formation
Shorea contorta, Eucalyptus camaldulensis, E. deglupta, Pogostemon cablin	Nutritional requirements for callus initiation established Callus formation, shoot and root formation Plantlets acclimatized in the nursery Callus induction, plantlet regeneration, shoot formation, survival of plantlets
Citrofortunella mitis, Citrus spp.	Multiple shoot formation in defined medium
Cratoxylon sumatranum	Plantlets acclimatized under nursery condition and some were planted out in the field
Rattans:	
Daemonorops mollis, Dendrocalamus latiflorus, Calamus merrillii, C. ramulosus, C. ornatus, C. caesius, C. manilensis	Plantlets, regeneration, problem in callus maintenance protocols established
Bamboos:	
Dendrocalamus latiflorus, Bambusa blumeana, B. vulgaris, D. merrillianus, Gigantochloa levis, G. aspera	Protocol for spindle, node and ground tissue established. Species differed in nutritional requirements
Schizostachyum lumampao	Cultured clones acclimatized in nursery, established in grasslands

Capability Building on the Mass Propagation of Rattan through Tissue Culture collected seeds of different provenances of rattan from Bukidnon (Mindanao) and Aklan (Visayas), and from Makiling and Ilocos (Luzon). The project utilizes embryos and tissues from *in vitro*-germinated seeds as explants (Garcia, 2002).

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Chapter 5

The State of National Programs, Research, Education, Training and Legislation

There are several types of organizations that are known to be conducting activities on forest genetic resources conservation. These are the Department of Environment and Natural Resources through its Ecosystems Research and Development Bureau and its regional field research units (Ecosystems Research and Development Services, the academic institutions (e.g., the University of the Philippines Los Baños, other state colleges and universities, and private educational institutions), non-government organizations, and a few private wood industries in the past.

Conservation of forest genetic resources is regarded as constituting the actions and policies that assure the continued existence, evolution and availability of these resources in the future.

The Department of Environment and Natural Resources

The DENR management of forest genetic resources is anchored in its mandate as the primary government agency responsible for the conservation, management, development and proper use of the country's environment and natural resources.

Forest genetic resources management is likened to a vehicle by which a forestry project can arrive at the goal set by its management. The management (DENR) steers the vehicle to the direction it deems fit. ERDB, PAWB and FMB have proper places in the driver's seat. Fig. 5

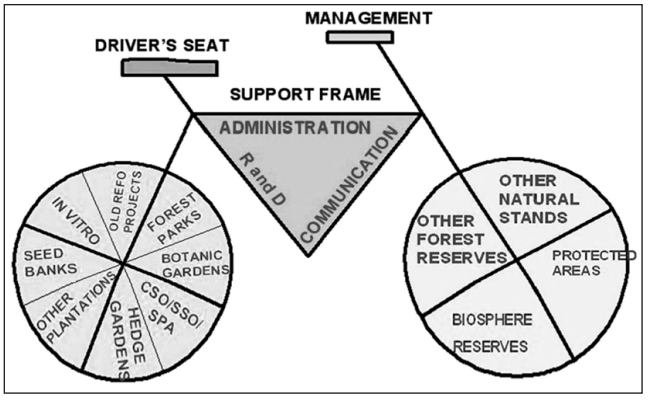

Fig. 5. Forest genetic conservation and management framework showing both the *in situ* and *ex situ* strategies (Pollisco, 2009).

shows both *in situ* and *ex situ* conservation (botanical gardens, old reforestation projects, plantations, CSOs, SSOs, SPAs, protected areas and other forest reserves) on the two wheels of the bicycle, implying equal attention to both strategies (Pollisco, 2009).

The spokes of the driving wheel become the planting stock production techniques. The support frame, supporting tree improvement, conservation, production and management, consists of research and development, administration and communication.

Funding is necessary to make the vehicle move while management has both feet planted on the pedals. Apart from funding, support and strong frames, a forest genetic resources management program also needs flexible planning, determination and capacitation from its staff in order to move towards success.

Communities, NGOs, OGAs and other stakeholders are support groups themselves who eventually become recipients of these forest genetic resources.

The overall objective is to contribute to the sustainable management and conservation of forest genetic resources for the benefit of stakeholders and end-users.

Specific objectives include the following:

1. integration of forest genetic resources conservation and management in national forestry management plans and overall development plans;

2. enhanced capabilities of manpower resources to use existing innovative technologies for propagation and conservation;

3. increased production of improved planting materials for production forests;

4. increased planting stocks for biodiversity conservation; and

5. increased planting materials, especially indigenous species for urban and highways greening

The University of the Philippines Los Baños (UPLB) through its College of Forestry and Natural Resources, the College of Agriculture, through the Institute of Plant Breeding with its National Plant Genetic Resources Laboratory and the Seed Science and Technology Division, help promote forest genetic resources conservation and management through education and extension programs. UPLB has well-equipped laboratory and field facilities and links with other research both local and abroad. They conduct research on germplasm collection, nursery propagation techniques, micropropagation, evaluation of local and exotic species for fodder production and socioeconomics.

National Programs on Forest Genetic Conservation

There are three national program that are currently being implemented in the country that have direct and indirect influences on the conservation of our forest genetic resources.

1. The National Integrated Protected Areas System (Republic Act No. 7586)

The National Integrated Protected Areas System (NIPAS) Act of 1992 is the classification and administration of all designated protected areas to maintain essential ecological processes and life-support systems, to preserve genetic diversity, to ensure sustainable use of resources found therein, and to maintain their natural conditions to the greatest extent possible. The protected areas refer to identified portions of land and water proclaimed, designated or set aside by reason of their unique physical and biological significance, managed to enhance biological diversity and protected against destructive human exploitation. These may be national parks, game refuges, bird/wildlife/fish sanctuary, wilderness areas, mangrove/strict nature reserves, watersheds, natural and historical landmarks, managed landscapes.

The NIPAS Act serves as the legal basis for the "*In Situ*" conservation of biological diversity through the appropriate management of ecologically important areas for conservation and sustainable development. It is the conservation of genetic resources of target species "on site" within the natural or original ecosystem in which they occur, or on the site previously occupied by that ecosystem; it is with the community of interacting organisms (with pollinators, seed dispersers, microbial symbionts) in its natural location.

The objective of NIPAS is to "integrate and protect outstanding remarkable areas and biologically important public lands that are habitats of rare and endangered species of plants and animals representative of biogeographic zones and related ecosystems.

According to Sinha (1994), although the NIPAS Act does not explicitly or directly mention the term "conservation of genetic resources" (or any of its variants), such conservation is not excluded from the management strategy for a protected area.

Projects for the management of the protected areas include the Conservation of Priority Protected Areas Project (CPPAP) funded by the World Bank and the Global Environmental Facility (WB–GEF), the National Integrated Protected Areas Program (NIPAP) funded by the European Union (EU), and the Samar Island Biodiversity Project (SIBP) funded by the United Nations Development Programme (UNDP) and the GEF. Subsequently, other conservation projects have come into reality: Administration and Development of Hinulugang Taktak Protected Landscape, and Mt. Apo Restoration and Development Project. Non-government organizations such as the Haribon Foundation, Inc. and the Conservation International, the Foundation for Philippine Environment, and the Philippine Tropical Forests Conservation Foundation are actively involved in the restoration and protection works.

As of 2008, there are 234 PAs under the National Integrated Protected Areas System (NIPAS) covering a total area of about 5,234 million hectares and a buffer zone of 222,634 hectares. Terrestrial PAs occupy a total of 4,092,635.87 hectares and a buffer zone of 202,922.08 hectares while marine PAs cover about 1,141,918.68 hectares and a buffer zone of about 19,712.86 hectares (DENR-PAWB, 2008). Six PAs covering a total area of 121,668 are under the jurisdiction of other government agencies, such as the National Power Corporation, Philippine National Oil Corporation, and the National Irrigation Administration. So far, only 10 have completed the process of establishment by enactment of site-specific laws. (http://chm.ph, 30dec2011).

2. The National Greening Program (Executive Order No. 26)

Issued on February 24, 2011, the National Greening Program (NGP) aims to:

- Implement sustainable management of natural resources through resource conservation, protection, and productivity enhancement
- Provide food, goods and services such as timber, fiber, non-timber forest products, aesthetic values, air enhancement values, water regulation values, and mitigate climate change by expanding forest cover that serve as carbon sink
- Promote public awareness as well as instill social and environmental consciousness on the value of forests and watersheds

The goal of the National Greening Program is to plant 1.5 billion trees in 1.5 million hectares of lands of the public domain for a period of six years from 2011 to 2016.

Premium and indigenous tree species shall be planted primarily to rehabilitate and/or restore degraded forestlands and protected areas/zones while fast-growing and production/protection forest tree species and fruit trees shall be planted in agroforestry and production areas and multiple use zones.

Among the areas targeted for planting under the program are open forest lands, mangrove and protected areas, ancestral domains, civil and military reservations, urban areas under the Greening Plan of local government units, inactive and abandoned mines and other suitable lands.

3. Tree Improvement Activities

The DENR research sector is implementing various tree improvement activities in the country which aim to upgrade and enhance the sustainable sources of quality germplasm and vegetative materials for planting stock production of some priority indigenous/

endangered species nationwide. While there is no tree improvement program as yet, the activities in general are geared towards the following:

- Establishment of clonal seed orchard, ramet/multiplication gardens and conduct provenance study from the best plus trees/ provenance of identified indigenous/endangered species;
- Development of propagation protocols (sexual or asexual) of species as guide for its mass production ;
- Conduct of monitoring and assessment of the established clonal seed orchard, ramet multiplication areas/hedge gardens, and provenance cum progeny testing in the regions; and
- Development of database for all verified seed sources, established clonal seed orchards, ramet multiplication areas and provenance/progeny testing sites of indigenous/endangered species.

To upgrade the quality of seed stands as source of propagules for breeding and mass propagation, provenance/progeny trials of narra (*Pterocarpus indicus),* molave (*Vitex parviflora*), and yemane (*G. arborea*) were established in Quezon, Bohol and Davao, respectively by ERDB in 2009 under its tree improvement program.

4. Forest and Mountain Biodiversity: Samar Island Biodiversity Project (SIBP) (http://chm.ph.,30dec2011)

The project would establish the Samar Island Natural Park (SINP), a new protected area zoned for multiple uses centering on protection, but providing for sustainable harvests of non-timber forest products, and institute a comprehensive range of ancillary conservation measures to insulate the Park from human pressures. Park management would be operationalized in partnership with forest-edge communities to conserve biodiversity and reduce poverty among the local communities. Interventions will strengthen participatory planning, process-response monitoring, surveillance and enforcement functions, enhance the conservation management capacities of communities, impart conservation values to wider Samareño society, backstop advocacy operations, and abet development of conservation-compatible village livelihoods. Implementation will be phased to nurture nascent conservation processes through to maturity.

Implementation under Phase 1 was between the Department of Environment and Natural Resources, through the Protected Areas and Wildlife Bureau and the DENR Regional Office VIII, and the Samar Island NGOs (through an umbrella organization the Samar Island Biodiversity Foundation (SIBF). Phase 2 is implemented by the DENR, through the Protected Areas and Wildlife Bureau, and the DENR Regional Office VIII through the Samar Island Natural Park-Protected Area Office.

The implementation of the project was designed to produce the following project outputs: (1) An adaptive management framework for conservation management is established and operational; (2) Conservation functions are fully operationalized; (3) A community-based conservation framework is tested and effective; (4) Broad-based awareness of conservation values and management needs is imparted to forest-edge communities and other key Samareño stakeholders; (5) Conservation objectives are internalized in sectoral development planning, budgeting and activity delivery at the provincial and municipal levels; (6) Alternative, conservation enabling livelihoods are in place, and the sustainability of wild resource use is assured, and; (7) Sustainable financing for recurrent costs of conservation activities are in place.

5. The Philippine Clearing House Mechanism for Biodiversity (CHM)

The CHM is established to facilitate the sharing of data and information on the conservation and sustainable use of biological diversity between and among the various stakeholders

in the country. This is part of the Philippine commitment to the Convention on Biological Diversity (CBD) which created the Clearing House Mechanism pursuant to Article 18.3 of the Convention. The CHM aims to contribute significantly to the implementation of the CBD by promoting and facilitating technical and scientific cooperation among Parties, other Governments and stakeholders.

Research, Education and Training

Several institutions in the Philippines provide research, education and trainings in forest genetic resources conservation. Some are government research institutions. Many are academic institutions while others are nongovernment organizations involved in environmental conservation and protection and sustainable development.

Research

The DENR administration considers Forest Genetic Resources Conservation and Management as a kind of war which needs to be fought both at the frontline and at the rearguard at the same time. In the frontline we need to meet the demand for fuelwood, construction materials for housing, furniture and a lot of other needs, and non-timber resources that serve as food, raw materials for industries and others. At the rearguard, we need to be on the lookout that the remaining forests are protected and conserved. To meet future needs for wood, the forestry sector must increase production per unit area without destroying the natural resource base. Sustainable forest management is defined in the Helsinki Process as the stewardship and use of forests and forest land in such a way, and at a rate, that maintains their biodiversity, productivity and regenerative capacity, vitality and the potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national and global levels, and that does not cause damage to other ecosystems.'

In order to alleviate the shortage of wood supply, lighten the pressure from natural forests and conserve the existing forests, fast-gro-wing and high-yielding plantations are established. The concern for species which can produce wood with desired properties requi-ring stability or strength needs should also be addressed. The production of planting materials for endangered, indigenous and other forest genetic resources shall be a primary priority.

The present need is a holistic strategy for wood production and at the same level prevents the eminent danger of the irreversible loss of forest genetic resources. The fundamental problem to be addressed at this point is the lack of supply of improved planting materials for production purposes, and of planting materials for conservation of endangered indigenous and other forest genetic resources.

The DENR research sector is currently implementing research, development and extension (RDE) projects which can address the above-mentioned issues and concerns.

1. Development of strategies for the production of good quality planting materials:

(a) for agroforestry and plantations — Innovative production strategies for the different priority species should be operationalized. The propagation populations (i.e. Seed Sources, Seed Production Areas, Seedling Seed Orchards, Clonal Seed Orchards) of the different priority species for production of improved planting materials should be maintained. Land races of exotic species that have already adapted to local conditions and endemic/indigenous species and provenances with fast-growth potential should be identified and tested. Improved planting stocks (seeds, rooted cuttings, marcots) should be promoted. Trainings at different levels/technology transfer through meetings, publications, etc. should be pursued.

(b) for restoration and rehabilitation — Seed technology and non-mist systems of propagation by rooted cuttings and the wildling recovery chamber should be

used as applicable or as needed. Hedge gardens for priority species should be esta-blished. Seed sources for abundant seed and other reproductive materials should be maintained.

(c) for urban and highways greening — Nursery-grown planting materials through seedlings, wildlings and rooted cuttings of shrubs and ornamental trees are produced for distribution to concerned entities. Technical assistance to sectors engaged in urban greening is provided if necessary. Remnants of urban vegetation in wetlands, lakes, streams and coastal areas have to be inventoried and protected. The urban populace should be educated on the role of trees and related plants in the urban ecosystem.

1. Rehabilitation and ecological restoration of marginal and degraded landscapes and seascapes.
2. Determination of carrying capacities of various areas/sites for resources conservation, ecotourism and sustainable development (e.g. PAs, CBFMAs, CEP)
3. Vulnerabililty assessment of priority watersheds in the Philippines
4. Tissue culture of genetically superior narra (*Pterocarpus indicus*)
5. Molecular level analyses of some tree species and non-wood forest species
6. Determination of growth, structure and composition of third-growth dipterocarp forest in areas under active Timber License Agreement and Industrial Forest Management Agreement
7. Tree improvement of indigenous and endangered species to upgrade and enhance the sustainable sources of quality germplasm and vegetative materials for planting stock production
8. Application of mycorrhiza and other soil amelioration measures to improve refo-restation and agroforestry in upland areas
9. Tree health assessment of important forest tree species as seed sources
10. Biosafety measures for the protection of biodiversity against the potential impacts of products of modern biotechnology or GMOs
11. Biosecurity measures for the protection of biodiversity from invasive species
12. *In situ* conservation of rare and endangered flora and fauna species in selected protected areas in the Philippines.

Likewise, academic institutions also conduct their own RDEs. The University of the Philippines Los Banos College of Forestry and Natural Resources conducts researches on seed technology, vegetative propagation and other aspects of forest production especially on indigenous trees like the dipterocarps. The Leyte State University (LSU) developed the technology on rainforestation, a strategy of forest restoration that uses indigenous tree species in combination with agricultural crops. Nueva Vizcaya State University (NVSU), in collaboration with the local Ecosystems Research and Development Sector (ERDS) in Bayombong, Nueva Vizcaya also conducts establishment of arboretum and dipterocarp plantation. Gascon (2005) reported that the Southern Luzon Polytechnic University (SLPU) is establishing the database for the Mt. Banahaw protected area, a nursery of indigenous tree species, conducts species trials using indigenous species, and are active members of the Protected Area Management Board (PAMB) of Quezon. The Misamis Oriental State College of Agriculture and Forestry (MOSCAT), the Central Visayas State College of Agriculture, Forestry and Technology (CVSCAFT), The Mindanao State University (MSU), Central Mindanao University (CMU) and even the Camarines Sur State College of Agriculture and Forestry (CSSAC), Isabela State University (ISU), DMMSU and a lot of other state universities and colleges are very active in doing different aspects of research in FGRs. The De La Salle University system is also doing work on ex situ conservation and even *in situ* conservation of Philippine teak, in collaboration with the Mindoro Biodiversity Conservation Foundation.

Education

Education on FGR is available in academic institutions through courses that are related in forestry or environment, in general. Government institutions as well as nongovernment organizations also provide training activities pertaining to FGR to a certain extent, depending on their programs/projects.

Academe

Private Schools

1. Silliman University (SU)

SU is known for its biological research activities. Biodiversity has already been integrated in most of their courses. It has the Center for Tropical Conservation Studies and the Museum of Natural History.

State Colleges and Universities

2. Southern Luzon Polytechnic University (SLPU)

SLPU's main campus is located at the foothills of Mt. Banahaw in Lucban, Quezon. It has been active in biodiversity conservation of the Mt. Banahaw-San Cristobal National Park. Many indigenous plant species have been documented in these areas with the leadership of SLPU.

3. Central Bicol State University of Agriculture (CBSUA)

Formerly the Camarines Sur State Agricultural College, CBSUA is one of the premier institutes of higher learning in the Bicol Region. Biodiversity conservation has already been integrated in some of its courses. It has formulated protocols for biodiversity research grants and developed training courses on biodiversity conservation education and research methodology.

4. Visayas State University

The programs of the Visayas State University (VSU) in instruction, research, extension and production converge and complement each other to help make Philippine agriculture globally competitive and sustainable. VSU started rainforestation as a farming technology developed by its Applied Tropical Ecology Program through a joint research project of the Philippine-German Applied Tropical Program. Realizing that reforestation failed to restore the lost forests and created a negative impact on biodiversity, VSU saw the need to restructure the ideology behind reforestation by planting native species instead of exotic ones. In addition, the Q-seedling project of CNFR VSU with support from ACIAR established field trials of combined species of dipterocarps, gmelina, mahogany, falcata and other indigenous species in five sites in Southern Mindanao and Leyte Island. The Q-seedling project research also contributed in the development of a national policy on nursery accreditation and qua-lity seedling production (DAO 2010-11 known as "Revised Regulations in Governing Forest Tree Seed and Seedling Production, Collection and Disposition)." Hands-on trainings on nursery establishment and quality seedling production were also conducted in Southern Leyte, Leyte province, Region 10 and Southern Mindanao, thereby contributing to the FGR conservation initiative of the Philippine go-vernment."

5. Mindanao State University – Iligan Institute of Technology (MSU-IIT)

MSU-IIT has conducted research projects related to the biodiversity conservation in Mt. Malindang and the Agusan Marsh in Mindanao.

6. Central Mindanao University (CMU)

CMU has a broad capacity and experience in forestry and natural resources management. Its Department of Biology conducted an inventory of all plant species in the Kitanglad

National Park under the Sustainable Agriculture and Natural Resources Management Project with the World Agroforestry Centre (ICRAF) as the principal investigator.

7. Misamis Oriental State College of Agriculture and Technology (MOSCAT)

MOSCAT's College of Agriculture has a four-year degree program on forestry. It is involved in the domestication of fruit, timber and multipurpose tree species as well as in the diversification of timber species to include indigenous ones. It has extensive field facilities for research.

8. University of the Philippines Los Baños (UPLB)

This university offers a four-year course on forestry with different specializations. It also has other courses on environment and natural resources. It has both undergraduate and graduate programs. The College of Forestry and Natural Resources offers on Forest Genetics, Forest Tree Improvement (Basic and Advanced Courses), Clonal Forestry, Conservation Biology, and a few others that have bearing on forest genetic resources conservation. Graduate programs on Forest Tree Improvement and the Master of Science in Natural Resources Conservation are curricular programs that relate directly to FGR. The College of Agriculture on the one hand has also instituted a curricular program on Plant Genetic Resources, and has for a long time already been offering courses on Plant Breeding and related sciences. It has also started a program on Agricultural Biotechnology.

Non- Government Organizations

1. Haribon Foundation, Inc.

Haribon is regarded as a pioneer of the environmental movement and one of the most active environmental organizations in the Philippines. In 1984, it was registered as a science and research foundation conducting floral and faunal studies and is accredited by the Department of Science and Technology. It is also accredited with the DENR and the United States Agency for International Development as a private voluntary organization.

In the pursuit of conservation through community-based resource management, Haribon adopts an integrated, multidisciplinary approach that is participatory and scientifically sound. Its programmes include science and research, community-based resource management, environmental defense, and membership development.

On December 21, 2005, the European Commission (EC) awarded a five-year project grant (2005-2010) to the Haribon Foundation. The project is entitled Governance and Local Development for Endangered Forests or GOLDEN Forests.

The project aims to reduce the rate of deforestation in Mts. Irid-Angelo in the provinces of Quezon, Aurora, Bulacan and Rizal; Mts. Hilong-Hilong and Diwata in Agusan, and Surigao; and Zambales mountains in Zambales, Tarlac and Pangasinan. Economic support for the marginalized forest-dependent communities living in these areas is part of the project assistance package. (www.haribon.org)

2. Soil and Water Conservation Foundation, Inc.

SWFC promotes natural and human resource development through implementation of projects and programs which are participatory, cooperative, community-building and sustainable. One of its goals is the establishment and perpetuation of comprehensive environmental ethics in individuals and communities which leads to wise use, management, and conservation of the country's resources.

3. Bantay Kalikasan

Bantay Kalikasan (Nature Watch) or BK, ABS-CBN Foundation Incorporation's environmental arm, started on July 21, 1998. It is

a media-based project supported by a multi-sector network of government agencies, private institutions, and non-government organizations. It was launched to serve as a catalyst in addressing the concern over the worsening state of the Philippine environment characterized by air and water pollution, denudation of forests, irresponsible waste disposal and their life-threatening effects.

BK was one of the prime-movers of Mt Banahaw rehabilitation and protection. It made possible the temporary suspension of visits to Mt. Banahaw because of the destruction to the area.

BK is also known for its successful rehabilitation and protection of the 2700-hectare La Mesa Watershed, the last forest of its size within Metro Manila and the source of water for over 12 million people in Metro Manila.

When BK first arrived in La Mesa, there were only about eight plant species in existence: *Acacia auriculiformis, A. mangium, Gmelina arborea,* Mahogany *(Sweitenia macrophylla)*, African tulip *(Spathodea campanulata),* Eucalyptus, and Teak *(Tectona grandis)*. Today, there are 73 different endemic species planted in the La Mesa Forest – Nature Reserve with an over-all survival rate of 92.5%, the first reforestation project in the country to plant that number of Philippine species. (http://www.bantaykalikasan.com). .

4. Agroforestry Tree Seed Association of Lantapan

ATSAL operates in Bukidnon province, southern Philippines. The association was organized in 1998 through the help of the World Agroforestry Centre (ICRAF). Farmers were trained on germplasm collection, processing and marketing of agroforestry tree seeds and seedlings. ATSAL has been marketing various tree seeds and seedlings with apparent success, and has provided training on appropriate seed collection and nursery management to farmers, government technicians, and workers from nongovernment organizations (NGOs).

5. Philippine Tropical Forest Conservation Foundation, Inc.

PTFCF was established under two bilateral agreements between the governments of the United States (US) of America and the Republic of the Philippines (RP) under the US Tropical Forest Conservation Act. These agreements, signed on September 19, 2002, leveraged a $5.5 million USG appropriate to treat $41.5 million in RP-US debt and divert $8.25 million in peso-denominated interest payments over 14 years, to the Tropical Forest Conservation Fund. The Fund is administered by an NGO-led Board comprising five representatives of the non-governmental sector appointed by the RP, two representatives of the US, two representatives of the RP.

This organization aims to, in the spirit of service and stewardship, improve the status of Philippine forests by working with communities, catalyzing local and national actions for their sustainable management.

6. BINHI Program of the Energy Development Corporation

The Energy Development Corporation launched in 2008 the BINHI Program, a forest revegetation scheme that focuses on the planting of endangered tree species. The program has four project components namely: Trees for Life, Trees for Food, Trees for the Future, and Trees for Leisure. The first component adopts the practice of rainforestation farming, giving emphasis on assisted natural regeneration with the basic intent of bridging forest gaps. The establishment of the forest bridges are being undertaken in the Northern part of the Sierra Madre Natural Park and the Mt. Kanlaon Natural Park.

The Trees for Food attempts to revegetate open and denuded lands through forest plantations and agroforestry. This is with the recognition that agroforestry brings about farm diversification and makes possible as well tree domestication. Agroforestry, likewise, can increase connectivity in patches within a fragmented

forest landscape which benefits biodiversity. Enrichment of species and genetic diversity can be achieved under this project.

The Trees for the Future concentrates on urban reforestation making use of endangered tree species. Public parks, school premises, leisure estates and residential areas, and other open spaces in urban areas are target for this reforestation scheme. Last but not the least is the Trees for Leisure project which establishes ecotourism forest parks. Focus again will be the planting of native endangered species in such areas.

7. Foundation for Philippine Environment

The Foundation for the Philippine Environment (FPE) was organized to help reverse the rapid destruction of the Philippine natural resource base through a strategic and integrated conservation program. Its mandate is to help fund the initiatives of Philippine civil society (i.e. non-governmental organizations (NGOs), people's organizations (POs) and other related sectors in conserving biodiversity and intervening to stop the further degradation of priority biodiversity sites. Over the recent 10 years, FPE continuously supported the implementation of community-based resource management (CBRM) framework in 22 site-focused projects in Mindanao, Visayas and Luzon. FPE, from time to time, engages and also funds research institutions to collaborate with civil society and local project partners. The resulting experiences, including data and information, are used by FPE to plan, decide, fund and implement present and future biodiversity projects.

Training

Institutions concerned with forest genetic resources are given opportunities for free education and training on forest genetic resources mostly offered by international organizations such as the ASEAN Centre for Biodiversity, among others. There are also local institutions that provide education and trainings in FGR.

DENR has always been involved in educating and communicating to the public the importance of biodiversity conservation. State colleges and universities, on the other hand, continue to promote programs on biodiversity conservation through instruction, research and extension. Many publications on the conservation of forest genetic resources or even the conservation publications are in technical form which prevents ordinary citizens and uneducated locals to comprehend the message. Efforts are now underway to produce information, education and communication materials in local dialects to promote a widespread education and communication of FGR conservation. Hopefully, these efforts, which are done on a national scale, will inculcate the importance of biodiversity conservation among the general public and lead to support for more in-depth studies at the species and genetic levels.

Based on an earlier assessment by Zabala (1996), there is a dearth of capable personnel to tackle the challenging task of tree breeding and improvement. Intuitively, the situation is similar for the conservation of forest genetic resources, as these two concerns are closely related. Prior to 1996, there were hardly any researcher trained either on tree improvement, or the conservation and management of forest genetic resources. After 1996, a number of graduate students have enrolled at the College of Forestry and Natural Resources and specialized in tree improvement. With a global and national concern for biodiversity conservation, the interests of younger scientists are slowly catching up with the trend to major in the conservation of forest genetic resources. The UPLB has a graduate program focusing on Plant Genetic Resources Conservation, but most of the students and faculty involved are agriculture-based.

Capability-building needed by institutions to promote and enhance FGR Conservation are as follows:

- Education and Training on plant genetic diversity and conservation of FGR

- Public Awareness (Information Education, Campaign) through improved libraries, popular and technical publications, lectures, seminars, workshops and conferences
- Resource mobilization to support FGR Conservation activities
- Management Information System (MIS)
- Inclusion of FGR Conservation in academic curriculum
- Other extension programmes – demo farms, cross site visits
- Establish a system, including websites, which will ensure a constant exchange of information on the genetic resources of Philippine plants between and among concerned institutions and organizations, and make this information accessible to all interested parties

Training obstacles and what can be done

In the report of Tolentino (2009) on the status of conservation and management practices of FGR in the Philippines, the result of the 2007 national consultative workshop on FGR identified the country's capability building needs on FGR conservation as follows:

1. Capability building:

- Education and training
- Public awareness (information, education, and communication)
- Resource mobilization to support FGR conservation activities
- Management information system
- Inclusion of FGR conservation in academic curriculum
- Other extension programs – demonstration farms, cross site visits

2. Training courses

- Strategies on FGR conservation (in situ, ex situ) and results of R&D technology
- Stakeholders' participation in FGR conservation
- Advocacy of FGR conservation – policy makers, implementers of conservation activities, e.g., forest managers, community, academe
- Product utilization, processing and marketing
- Policy issues on FGR conservation – bioprospecting, biosafety

Tolentino (2009) further enumerated the following critical gaps in research and development that were identified in the said national consultative workshop:

1. Continuing assessment of conservation status of all FGRs (e.g., inventory, taxonomy, database of FGR on *in situ* conservation sites)
2. Conservation biology (reproductive biology)
3. Ecological studies of FGRs (carbon sink, watershed and environmental services, ecotourism genetic diversity)
4. Policy assessment and formulation in support of FGRs (e.g., bio-prospecting, rescue centers)
5. Development of a guidebook for identifying FGRs
6. Valuation studies of FGRs (for bio-prospecting purposes, ecological services, etc.)
7. Assessment of socio-economic and cultural practices and their impacts to FGR conservation (e.g., ethnobotany)
8. Production technologies or silvicultural requirements for FGRs

Strategy to address education and training needs

In 2003, the Philippine Plant Conservation Committee prepared the Framework for the Philippine Plant Conservation Strategy and Action Plan to serve as the National Red List Authority of the Philippines on plants. It has been formulated in response to the Global Strategy for Plant Conservation and the country's commitment to the Convention on Biological Diversity.

In the Framework, capacity building is the focus of Objective 8 which includes physical and technological infrastructure and financial support for plant conservation. Specifically, its actions aim to:

1. Establish a roster of plant experts and agencies, research institutions and organizations involved in plant conservation in the country
2. Provide career opportunities for botanists and plant taxonomists
3. Assess the plant taxonomic needs of the Philippines
4. Develop centers of excellence on plant conservation
5. Implement technical capacity building programs on plant conservation and management (e.g., trainings on plant identification, preservation, etc., at the national, regional and local levels)
6. Identify and implement appropriate community training programs.

Legislation

The Philippines has promulgated several national policies and legislations concerning conservation, protection and proper utilization of its natural resources. The following are examples of government laws which are directly or indirectly related to the protection and conservation of forest genetic resources.

The Philippine Constitution

The Philippine constitution includes provisions related to forest resources:

(1) Protection and achievement by the State of the right of all Filipino people to a balanced and healthful ecology in accordance with the rhythm and harmony of nature (Sec. 16, Art. II); framework of national unity and development (Sec. 22, XI);

(2) State of ownership of all natural resources and inalienability, except for agricultural lands (Sec. 2, XII);

(3) Full control and supervision by the State on exploration, development, and utilization of natural resources either by directly undertaking such activities or by entering into co-production, joint venture or production-sharing agreements with Filipino citizens or Filipino owned or controlled corporations or associations (Sec. 2, XII);

(4) Small scale utilization of natural resources (Sec. 2, XIII);

(5) Determination by Congress of the specific limits of forest lands by marking of their boundaries on the ground (Sec. 4, XII);

(6) Protection of the rights of indigenous cultural communities (ICC) by the State to their ancestral lands to ensure their economic, social, and cultural well being (Sec. 5, XII).

Of the seven provisions by the Philippine constitution, Article XII of the sections 4 and 5 are relevant to the conservation of tree species.

National Legislations and Policies Affecting Genetic Resources Conservation

The growing concern for the environment and proper utilization of the natural resources for economic development have resulted in the enactment of policies which advocate the protection of the country's resource base. Specific policies and legislations and the status of their implementation are briefly listed in the following:

Act No. 315 and the Republic Act No. 826

Enacted in 1932, Act No. 315 is one of the earliest legislations related to biodiversity conservation and management. It provides for the establishment of national parks; for example, game refuges with panoramic, historical, scientific or aesthetic values for the benefit and enjoyment of the Philippine people. The law prohibits occupation of the national parks and harvesting of timber or other forest products and wildlife resources therein without permit or license. It was one of the earlier accounts on natural resources management that

consi-dered the principle of inter-generational res-ponsibilities.

Through the Republic Act No. 826, a Commission on Parks and Wildlife was created in 1952 under the supervision of the President in order to promote effective planning, development, maintenance and supervision of natio-nal parks, monuments, wildlife and game re-fuges and bird sanctuaries. The same act also promotes the establishment and conservation of provincial, city and municipal parks to comply with the fundamental purpose of national parks for the benefit and enjoyment of the future generations. It was one of the earlier accounts on natural resources management that considered the principle of inter-generational responsibilities.

Presidential Decree No. 705

This law, enacted in 1975, provides the major framework for the management, conservation and utilization of the forest resources in the country. The law mandated the Bureau of Forestry Development (BFD) with the responsibility for protection, development, management and preservation of national parks, game refuges and wildlife. The law declares the occupation of national parks and recreation and vandalism activities therein illegal.

The Philippine Forestry Code or PD 705 remains as the primary legal instrument guiding the conservation and utilization of forest resources in the country. Legal issuances cover the protection of specific areas with rich natural resources. These include RA 7611 (1991) which declared a Strategic Environmental Plan (SEP) for Palawan. The Plan calls for the conservation, utilization and development of such natural resources in tandem with the provision of optimum yield on a continuing basis. This was followed by the DENR AO 45 (1992) which declared a moratorium on all commercial logging in Palawan. Proclamation No. 926 is another conservation-oriented legal issuance establishing the Subic Watershed Forest Reserve. The DENR AO No. 25 (1991) prohibited logging from old-growth or virgin forests and declared these areas as part of the integrated protected areas systems. Likewise, large tracts of mangrove areas all over the country have been declared wilderness areas, thus, limiting the extraction of forest resources in these areas.

In 2000, the DENR AO 2000-44 allowed the sustainable use of forest resources inside multiple-use and buffer zones, except any form of logging or timber cutting involving the natural forest. Subsequently, the DENR AO 2002-02 provided an opportunity to organized tenured migrant communities and interested indigenous peoples to manage, develop, utilize, conserve and protect the resources in designated Community-based Program (CBP) area. These opportunities are subject to prior vested rights, with activities consistent with the Protected Area Management Plan (PAMP). Additional guidelines were later spelled out in the DENR AO 2004-32 which provide tenured migrant communities and interested peoples within protected areas and buffer zones tenure over established CBP areas, provided that the activities to be undertaken are consistent with PAMP.

Memorandum Circular (MC) 2004-06 of DENR adopts the so-called rainforestation technology to restore, manage and rehabilitate degraded and secondary forest in protected areas and other appropriate forest lands. Indigenous and endemic tree species are the recommended species for planting. The DENR MC 2007-02 provides the guidelines for the establishment and management of critical habitats in the country which will cover public lands (terrestrial and wetland areas) outside protected areas as well as privately-owned lands where threatened species are found.

Executive Order No. 192

Through the Executive Order No. 192, the Department of Environment and Natural Resources (DENR) is tasked with the primary res-ponsibility to promote the well-being of the Filipino people through sustainable development of natural resources, optimal utilization of forest lands, social equity and

efficiency of forest resource use and effective forest management. The Order created, among others, the Protected Area and Wildlife Board (PAWB). The aim was to consolidate governmental efforts in the conservation of natural biological resources, specifically through the institutionalization of the National Integrated Protected Areas System (NIPAS). The enactment of the NIPAS Law or Republic Act (RA) of No 7586 of 1992 was pursued by PAWB.

Republic Act No. 7586 (the NIPAS Law)

The most important piece of legislation on biodiversity in the country is the RA 7586, enacted in 1992, otherwise known as the National Integrated Protected Areas System (NIPAS) law, which mandated DENR in its implementation. It contained the twin objectives of biodiversity conservation and sustainable development.

As early as 1998, 34 protected areas were proclaimed under the NIPAS category, encompassing 1,443,000 ha. The regional offices of DENR also identified 25 old-growth and mossy forests that have been proposed for inclusion in the protected area system. In the same year, the Protected Area and Wildlife Board (PAWB) designed the Biodiversity Monitoring System (BMS) for data collection focusing on priority species and their utilization. In 2000, the BMS was institutionalized through the issuance of the Administrative Order (AO) No. 13 of DENR, entitled "Guidelines on the Implementation of the Biodiversity Monitoring System in Protected Areas". The system serves to improve the participation of communities in the protected areas and other stakeholders in the management of protected areas.

Executive Order No. 247 (the Bioprospecting Law)

The Executive Order No. 247, enacted in 1995, meant to provide a regulatory framework for bioprospecting, the exploitation of indigenous knowledge on natural resources or the search for previously unknown compounds for medi-cinal use. Also called the Bioprospecting Law, it prescribes the guidelines and establishes a regulatory framework for the bioprospecting of biological and genetic resources, their by-products and derivatives for scientific, commercial and other purposes. This law is in line with the provisions of the Convention on Biological Diversity (CBD) to which the Philippines is a signatory. The law declares:

"It shall be the policy of the State to regulate the prospecting of biological and genetic resources to the end that these resources are protected and conserved, are developed and put to the sustainable use and benefit of the national interest. Further, it shall promote the development of local capability in science and technology to achieve technological self-reliance in selected areas."

Republic Act No. 9147 (the Wildlife Resources Conservation and Protection Act)

This legislation, enacted in 2001, provides for the conservation and protection of wildlife resources in protected areas and critical habitats. It is also known as the Wildlife Resources Conservation and Protection Act. The law assigns jurisdiction over terrestrial plants and animal species to DENR and over aquatic plants and animals to the Department of Agriculture (DA). The DENR Secretary will determine whether any wildlife species or subspecies are threatened and classify them as critically endangered, endangered, vulnerable or under other categories based on scientific data and internationally accepted criteria. The act allows the collection of wildlife for scientific or breeding propagation purposes, and for the breeding or propagation of threatened species to enhance their populations in natural habitats (restoration purposes) and establishment and protection of critical habitats outside protected areas where the threatened species are found. The National List of Threatened Philippine Plants and their categories, and the List of Other Wildlife Species were established through the DENR AO 2007-01. Subsequently, the DENR AO 2007-02 was issued to provide the guidelines on the establishment and

management of critical habitat for species under the jurisdiction of DENR.

Republic Act (RA) No. 7942 or the Mining Act of 1995

This RA identified areas closed to mining operations. These include all areas expressly prohibited by RA No. 7586 and its implementing rules and regulations (DAO No. 25 series of 1992) and other laws. These areas closed to mining include old growth forests, proclaimed watershed, wilderness areas, mangrove forests, mossy forests, national parks, provincial and municipal forest, greenbelts, game refuges and bird sanctuaries among others.

Republic Act No. 7303 (the Seed Industry Development Act)

The Seed Industry Development Act of 1992 promotes and accelerates the development of seed industry and mandates the conservation, preservation and development of plant genetic resources in the Philippines. It vests the University of the Philippines, Los Baños (UPLB), with leadership in plant biotechnology activities related to plant improvement, conservation of genetic resources and *in vitro* mass production of planting materials including biotechnology.

Executive Order No. 318

Issued on June 9, 2004, this order declared the policy of government to pursue the sustainable management of forests and forestlands in watersheds. Watersheds shall be deemed as ecosystem management units and shall be managed in a holistic, scientific, rights-based manner and observing the principles of multiple-use, decentralization and devolution, and active participation of Local Government Units (LGUs), synergism of economic, ecological, social, cultural objectives, and the rational utilization of all resources found therein.

Clearly, policies are set in place to insure protection of biodiversity in the Philippines including forest genetic resources but based on field observations, the actual implementation of these policies is the big hindrance to successful conservation efforts.

Executive Order 578

Issued in the latter part of 2006, this is the policy of the state on biological diversity. It specifically states that "it is the policy of the state to protect, conserve, and sustainably use biological diversity to ensure and secure the well-being of the present and future generations of Filipinos. This state policy extends to all the components of biodiversity – ecosystem, species and genes."

Executive Order 26

Issued on February 24, 2011, the National Greening Program (NGP) aims to:

- Implement sustainable management of natural resources through resource conservation, protection, and productivity enhancement
- Provide food, goods and services such as timber, fiber, non-timber forest products, aesthetic values, air enhancement values, water regulation values, and mitigate climate change by expanding forest cover that serves as carbon sink
- Promote public awareness as well as instill social and environmental consciousness on the value of forests and watersheds

The goal of the National Greening Program is to plant 1.5 billion trees in some 1.5 million hectares of lands of the public domain for a period of six years from 2011 to 2016. In 2011, the Department of Environment and Natural Resources, other state agencies, local governments, private sector and civil society planted 83,096,223 seedlings in more than 118,939.93 hectares of land nationwide under the national greening program.

Premium and indigenous tree species shall be planted primarily to rehabilitate or restore degraded forestlands and protected areas/ zones while fast-growing and production/

protection forest tree species and fruit trees shall be planted in agroforestry and production areas and multiple use zones.

Among the areas targeted for planting under the program are forestlands, mangrove and protected areas, ancestral domains, civil and military reservations, urban area under the Greening Plan of local government units, inactive and abandoned mines and other suitable lands.

Executive Order No. 514 - The National Biosafety Framework (March 17, 2006)

The Framework prescribes its implementation guidelines, strengthening the National Committee on Biosafety of the Philippines and for other purposes. It covers all work involving genetic engineering and the importation, introduction, field release and breeding of organisms that are potentially harmful to people and environment. The departments concerned shall allocate from their present budgets such amount as may be necessary to implement the NBF, including the support in the operations of the National Committee on Biosafety of the Philippines and its secretariat.

Administrative Order No. 1 - Guidelines for Bioprospecting in the Philippines (January 14, 2005)

It is a joint order among the Department of Environment and Natural Resources (DENR), Department of Agriculture (DA), Philippine Council for Sustainable Development (PVSD), and the National Commission on Indigenous People (NCIP). The Guidelines set a uniform procedure for evaluating and granting access to biological resources and avoid the potential problem of inconsistency of bioprospecting regulations for various components of biodiversity under the management jurisdiction of different government agencies. It provides equitable sharing scheme for benefits derived from bioprospecting activities among the government and the host communities or resource providers.

DENR Administrative Order No. 2004-32 - Revised Guidelines on the Establishment and Management of Community-Based Program in Protected Areas (August 31, 2004)

It emphasizes the use of endemic and/or indigenous plant species in specific areas within the protected areas or buffer zone to return them back to the original vegetation type.

DENR Administrative Order No. 2004-15

This AO established the list of threatened species and their categories and the list of other wildlife species under the jurisdiction of the DENR pursuant to RA 9147, the Wildlife Resources Conservation and Protection Act.

DENR Memorandum Circular No. 2004-06

This MC promulgated the guidelines in the integration of rainforestation farming strategy in the development of open and denuded areas within protected areas and other appropriate forest lands (August 5, 2004).

It defines rainforestation as a concept in forest restoration, wherein only indigenous and endemic tree species are used as planting materials which include but is not limited to dipterocarp species, premium tree species, etc. it aims to preserve biodiversity and expand Philippine forests and simultaneously sustain human food production.

DENR Administrative Order No. 2003-05

This revoked Memorandum Order No. 99-29 and DAO No. 2001-03: It provides the Guidelines in the implementation of rights in tree farming.

The other policy issuances of the government in relation to the use and conservation of forest genetic resources in the country over the period 2000 -2011 appears as Appendix Table 8 of this report.

Needs for Developing Forest Genetic Resources Legislation

Although there are already existing legislations and policies affecting forest genetic resources conservation, there are still needs to further develop or strengthen forest genetic resources legislation in the country. The identified needs are given in Table 14.

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Table 14. Needs for developing forest genetic resources legislation.

Needs	Priority Level			
	Not applicable	Low	Moderate	High
Improve forest genetic resources legislation			√	
Improve reporting requirements				√
Consider sanction for non-compliance		√		
Create forest genetic resources targeted regulations			√	
Improve effectiveness of forest genetic resources regulation				√
Enhance cooperation between forest genetic resources authorities				√
Create a permanent national commission for conservation and management of forest genetic resources			√	
Others (please specify)				

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Chapter 6
The State of Regional and International Collaboration

Regional and Sub-Regional Collaboration

The DENR's Ecosystems Research and Development Bureau (ERDB) implemented the UNDP/FAO/RAS/91/004 Regional Project on Improved Productivity of Man-Made Forests through the Application of Technological Advances in Tree Breeding and Propagation (FORTIP) in 1991 which became the avenue in ERDB's international linkages regarding forest genetic resources. The country has developed linkages with CIFOR, IDRC, JICA, IPGRI, AIDAB, INBAR, ASEAN FTSC, DANIDA FSC, FORSPA, APAN, etc. The Project paved the way for the ASEAN member countries do develop/establish international linkages with the Regional/International Networks, Centers, and donor agencies.

The Philippines hosts the ASEAN Centre for Biodiversity (ACB). As an intergovernmental regional centre of excellence, ACB facilitates cooperation and coordination among the 10 ASEAN Member States (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam) and with relevant national governments, regional, and international organizations on the conservation and sustainable use of biological diversity, and the fair and equitable sharing of benefits arising from the use of such natural treasures.

Over the years since its creation as the progeny of the ASEAN Regional Centre for Biodiversity Conservation, the ACB has become and is still the primary venue for the discussion and resolution of cross-country biodiversity conservation issues. It has been the leading force in capacity development of the ASEAN Member States, for policy development and coordination through education on key biodiversity-related multilateral environment agreements, as well as increased knowledge and skills to assess regional/national situations and develop appropriate response mechanisms. ACB also aims to enhance competence of Protected Area managers of the ASEAN Member States through the conduct of capacity building series workshops and conferences with partner institutions.

In collaboration with CSIRO Division of Forestry's Australian Tree Seed Centre (ATSC) in 1996-1998, ERDB was able to establish seed production areas (SPAs) and seedling seed orchard (SSO) of *Acacia mangium* and *Eucalyptus urophylla* as follows: 1.5 ha *A. mangium* SPA (ATSC seedlots); 1.5 ha *E. urophylla* var *wetarensis* SPA (ATSC seedlots); 1.125 ha *E. urophylla* var. *urophylla* SPA (ATSC seedlots); 1.5 ha *A. mangium* SPA (MSBFI seedlots); and 3.5 ha *A. mangium* SSO (ATSC seedlots) in Oriental Mindoro. The initial phase of the project was completed in December 2000. It covered site selection and delineation, production of planting stocks, plantation site preparation/establishment, plantation protection and maintenance, and monitoring of early growth performance. All activities such as assessments, thinning and other management operations were accomplished in the duration

of the study. From the selected parent trees, seeds were collected and 9.5 kg were provided to ATSC for establishing genetic gain trials of both species.

The country's involvement in the conservation and management of bamboo and rattan resources is governed by its membership at the International Network for Bamboo and Rattan (INBAR) which is an inter-governmental organization established in 1997 with head-quarters in Beijing, China and regional offices in Asia, Africa, Latin America and Europe. It is dedicated to improving the social, economic, and environmental benefits of bamboo and rattan. INBAR connects a global network of partners from the government, research institutions, NGOs, rural communities, private, and not-for-profit sectors in over 50 countries to define and implement a global agenda for sustainable development through bamboo and rattan. Among its environmental goals related to forest genetic resources is to identify threatened bamboo and rattan species and take actions to foster their conservation. With its partners it intends to explore and demonstrate new ways to reverse the depletion of the world's rattan resources, while encouraging their sustainable use in poverty alleviation. It has undertaken development projects and provided trainings to member countries such as the Philippines on the conservation, diversity, ecogeography, germplasm, resource utilization and taxonomy of bamboo and rattan.

The ERDB also implemented the International Tropical Timber Organization funded project "Demonstration and Application of Production and Utilization Technologies for Rattan Sustainable Development in the ASEAN Member Countries (ITTO) [ITTO PD 334/05 Rev 2 (1)] in 2005-2010. The project aimed to strengthen ASEAN collaboration that would promote the sustainability of rattan resources through demonstration and application of rattan production and utilization technologies to uplift the socio-economic status of local communities. Twenty training programs were conducted separately in the different areas of the Philippines, Vietnam, Lao PDR, and Cambodia. A total of 220 hectares of rattan plantations were established and maintained by the respective participating countries.

With the ITTO, the Philippines through the Forest Management Bureau of the DENR implemented the project "Development of Criteria and Indicators (C&I) for Sustainable Forest Management (SFM) in the Philippines" (PD 225/03 Rev. 1) from 2002 to 2003. It aimed to promote sustainable management of the tropical resources in the Philippines in accordance with the year 2000 objective through the formulation of criteria and indicators for sustainable forest management at the national and forest management unit levels, including appropriate monitoring, assessment and reporting systems. The project has produced some useful documents including the baseline report on C&I in 2003 and the first progress report in 2005. It also has developed a GIS-compatible database system for C&I, which will allow for the easy management of data, reporting, updating, retrieval and analysis to determine progress towards SFM.

The Association of Southeast Asian Nations (ASEAN) at which the Philippines is a member, the policy coordination and decision-making on regional cooperation in the forestry sector is the task of the ASEAN Senior Officials on Forestry (ASOF) guided by the ASEAN Ministers on Agriculture and Forestry (AMAF). In the Blueprint for the ASEAN Socio-Cultural Community (ASCC), ensuring environmental sustainability is a major area. This includes, among others, intensified regional cooperation on global environmental issues, conservation of biological diversity, as well as promotion of sustainable forest management (SFM) and eradication of unsustainable practices including combating illegal logging and its associated trade.

International Collaborations

The Philippines collaborates with the International Plant Genetic Resources Institute (IPGRI) now the Bioversity International in the

management of its forest genetic resources. It backs the IPGRI's mission to encourage, support and undertake activities to improve the management of genetic resources worldwide so as to help eradicate poverty, increase food security and protect the environment. IPGRI focuses on the conservation and use of plant genetic resources important to developing countries and has an explicit commitment to specific crops. The country is an active partner in undertaking research and training, and the provision of scientific and technical advice and information.

The Philippines is also a party to a number of multilateral environmental agreements (MEAs) which aims to conserve and sustainably use biological diversity. These include the United Nations Environment Programme (UNEP) Convention on Biological Diversity (CBD), the Cartagena Protocol on Biosafety, and the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES). With all these MEAs the Philippines is mandated to comply with all the provisions to ensure the conservation of the country's biodiversity resources within and outside the PAs.

The International Union for the Conservation of Nature and Natural Resources(IUCN) with which the Philippines is a member since 1968, is a union of sovereign states, government agencies and NGO's with the initiation and promotion of scientifically-based action that will ensure the perpetuation of man's natural environment. It maintains close working relations with many inter-governmental organizations and it maintains close working relations with the World Wide Fund for Nature (WWF). Its mission is to provide international leadership for the conservation and management of living resources. The Philippines has prior involvement with the IUCN dating back in the mid-60s. The agency extended consultancy assistance to the country in the survey of national parks and other equivalent reserves of the then Parks and Wildlife Office. IUCN member countries submit data on the status of endangered species and on traffic in wildlife through the union's specialized monitoring centers based in the United Kingdom.

The ERDB together with the University of the Philippines Los Baños (UPLB) and the Forest Products Research and Development Institute (FPRDI) under the Department of Science and Technology (DOST) is a member of the International Union of Forest Research Organizations (IUFRO). Its mission is to promote global cooperation in forest-related research and to enhance the understanding of the ecological, economic and social aspects of forests and trees; as well as to disseminate scientific knowledge to stakeholders and decision-makers and to contribute to forest policy and on-the-ground forest. IUFRO attains its objectives by networking activities including the generation, exchange and dissemination of scientific knowledge, the provision of access to relevant information, and the assistance to scientists and institutions to strengthen their research capacities.

The Asia Pacific Association of Forestry Research Institutions (APAFRI) is an independent non-profit body, which aims to enhance research and technology development capabilities in support of conservation and management of forest resources in the Asia-Pacific region. The member agencies in the Philippines are the Philippine Council for Agriculture, Forestry and Natural Resources Development (PCARRD, FPRDI, ERDB, the University of the Philippines Los Baños-College of Forestry and Natural Resources (UPLB-CFNR), and the University of the Northern Philippines (UNP).

The establishment of APAFRI was prompted by the need to provide a viable institutional framework for research collaboration in the region. Since 1991, the Forestry Research Support Programme for Asia and the Pacific (FORSPA) has been fulfilling the networking function. APAFRI, a follow-up of FORSPA, is an outcome of the desire of the countries in the region and the donor community to develop a more self-reliant and sustainable mechanism to strengthen research networking. It was

launched during the meeting of the Heads of Forestry Research Organizations in the Asia-Pacific held in Bogor, 20-23 February 1995.

The International Union of Forest Research Organizations (IUFRO) has recognized APAFRI as its Asia-Pacific chap-ter. APAFRI has been collaborating closely with the IUFRO Special Programme for Developing Countries (SPDC) in strengthening research in the Asia-Pacific region.

The Philippines became a collaborator of the International Neem Network which was coordinated by the Food and Agriculture Organization of the United Nations (FAO) in 1993 with the long-term objective to conserve genetic resources and to improve the genetic quality, adaptability, and utilization of the species. Provenance trials were established in San Manuel, Pangasinan and Bansud, Oriental Mindoro on August 1996 and November 1996 respectively.

Since the latter part of the last century, the Philippines has been involved with the ASEAN Peatland Forests Project (APFP) which aims to demonstrate, implement and scale up the sustainable management and rehabilitation of peatland forests in Southeast Asia. The Pro-ject focuses on strengthening institutional capacity and frameworks, reducing the rate of degradation on peatlands in Southeast Asia, demonstrating integrated management and rehabilitation of peatlands at target sites, and engaging the private sector and local communities in sustainable peatland management. It fits within the framework of the ASEAN Peatland Management Initiative (APMI), and directly supports the ASEAN Peatland Management Strategy (APMS), and associated National Action Plans on Peatlands. Together with the Philippines, the other Southeast Asian nations participating in the project are Malaysia, Thailand, and Vietnam. So far, ground surveys have been undertaken in two areas in the Philippines, namely, in the Leyte Sab-a Basin and the Peatland Forests of the Agusan Marsh in the Island of Mindanao.

Needs and Priorities for Future

International Collaboration

The following tables shows the country's needs and priorities for future international collaboration (Table 15). There is a clear perceived need for advanced knowledge and skills on both the methodologies of *in-situ* and *ex-situ* conservation of forest genetic resources in the Philippines. The establishment and maintenance of seed banks and *in vitro* banks for forest species will be top priorities as these are completely lacking in the country. Training is also deemed as a priority to enhance the conduct of research on the various aspects of FGR, as well as ways to further the awareness on the value, conservation and sustainable use of FGR among the public.

Table 15. Needs and priorities of the Philippines for international collaboration on forest genetic resources.

Needs and Priorities	Priority Level			
	Not applicable	Low	Medium	High
Understanding the state of diversity			√	
Enhancing *in situ* management and conservation				√
Enhancing *ex situ* management and conservation				√
Enhancing use of forest genetic resources			√	
Enhancing research				√
Enhancing education and training				√
Enhancing legislation			√	
Enhancing information management and early warning systems for forest genetic resources			√	
Enhancing public awareness				√

Chapter 7
Access to Forest Genetic Resources and Sharing of Benefits Arising from their Use

The 1987 Constitution of the Philippines provides that access to natural resources including forest (and genetic resources) can only be done through joint venture (with the government), co-production, or production sharing agreements. In 1993, DENR established the Industrial Forest Management (IFM) Program that issued the Industrial Forest Management Agreement (IFMA) as the tenure instrument under DAO No. 60 series of 1995. This is a production sharing agreement that grants tenure holders the privilege to harvest second growth natural forest and requires them to help in the development and protection of forest areas. The provisions of the DAO have undergone several revisions and amendments and its final form is contained in DAO No. 99-53. The tenure has a duration of 25 years renewable for another 25 years. The maximum area granted under this agreement is 40,000 ha. A grantee can have more than one IFMA area as long as the combined area does not exceed 40,000 ha. The minimum area that may be granted is 500 ha.

For the medium investors and small farmers, the Socialized Industrial Forest Management Agreement (SIFMA) was instituted (DAO No. 24, 1996). The area that may be granted is as low as 1 ha for individuals or families to a maximum of 500 ha for cooperatives and associations. The responsibilities given to the IFMA holder of developing, managing and protecting the forest are also mandated to the SIFMA holder.

In 1998, the Philippine government through the DENR, established the Community-Based Forest Management Program (CBFM), which can provide the mechanism for improving access to sustainable use of forest genetic resources in the Philippine uplands. The CBFM is an application of the principle of "People first and sustainable forestry will follow." The program seeks to promote among other things the sustainable management of forest resources, social justice and improved well-being of local communities, and strong partnership among local communities and the Department of Environment and Natural Resources. CBFM is implemented in all areas classified as forest lands, including allowable zones within protected areas not covered by prior vested rights. The implementation further seeks to integrate and unify all people-oriented forestry activities of the Integrated Social Forestry Program, Community Forestry Program, Coastal Environment Program, and Recognition of Ancestral Domains.

The access to and sharing of benefits in the use of FGR are incorporated in the following key features of the CBFM namely: security of tenure, social equity, and market linkage. The Community-Based Forest Management Agreement (CBFMA) entitles forest communities to use and develop the forestland and resources for a duration of 25 years. Furthermore, the Program grants forest communities the comprehensive rights to use and develop forest resources. Finally, the DENR and the LGUs provide technical assistance

to CBFM participants to help them attain sustainable forest management in addition to proving help to the communities in terms of accessing investment capital, identifying markets, and building marketing capabilities.

International Agreements

Over the past 10 years, the country subscribed to many international agreements relevant to access to forest genetic resources, transfer and sharing of benefit arising from their use. The Philippines is a signatory to the World Trade Organization (WTO) that intends to supervise and liberalize international trade and provides a framework for negotiating and formalizing trade agreements, and a dispute resolution process. The agreements include provisions on the trade of environmental goods and services, standards and certification procedures with possible implications on forest genetic resources. Some environmental goods require forest genetic resources as raw materials such as timber and non-timber forest products. These goods may also require forest genetic resources as components or inputs in manufacturing.

The Philippines is also a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), The Kyoto Protocol (COP3) and succeeding Conferences of the Parties (Since 1992 and on-going). With the objective of the treaty to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, it provides that credit would be granted for broad activities that absorb carbon from the atmosphere or store it, including forest and cropland management, and re-vegetation, with no over-all cap on the amount of credit that a country could claim for carbon sink activities. Hence, depending on eligible projects, national priorities, and forest management policies and decisions, this will entangle with the management and conservation of forest genetic resources. Development of forest plantations as carbon sink will enhance forest genetic conservation, not just on the aspect of trees but the adjoining vegetation during the plantation development. However, such endeavors should not solely consider commercial production. The biological objective of such plantation development activities should take into serious consideration the enrichment of the genetic structure of the species that will be used.

The Convention on Biological Diversity (CBD) is another international agreement which the Philippines subscribes to and supports since its inception. Here, the Conference of the Parties (COP) adopted the Bonn Guidelines to facilitate the implementation of the Access and Benefit Sharing System (ABS). The ABS is similarly applicable to traditional knowledge of indigenous and local communities associated to genetic resources. The Philippines, being one of the countries in the world with diverse traditional knowledge systems that are in many cases based on forest genetic resources has much stake in the provisions of the agreement to protect said resources.

The Cartagena Protocol on Biosafety under the CBD also known as the Biosafety Protocol was adopted in January 2000. The Biosafety Protocol seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology. Since most of the country's biological diversity rests on forest areas and its genetic resources, the country has many wide areas of specific concerns on Biosafety. The Philippines has since developed its Biosafety Framework and created its Biosafety Committee that looks on the possible implications of the products of modern genetic technologies not just on the agricultural domain but also on forest genetic resources.

Since 2003, the Philippines has been participating in the ASEAN Free Trade Area (AFTA) organized by the Association of Southeast Asian Nations. The AFTA is meant to increase ASEAN's competitive edge as a production base in the world market through the elimination, within ASEAN, of tariffs and non-tariff barriers, Such should attract more foreign direct

investments to ASEAN. It includes provisions on the change of tariffs on wood-based products that in one way or another will have effects on the utilization of forest biological resources.

National Legislations and Policies

The country has also promulgated national legislations and policies in terms of access to forest genetic resources and sharing of benefits arising out of their use. Although enacted much earlier, the country observes the provisions of Presidential Decree No. 1151 (Philippine Environmental Policy) and subsequently, the Department of Environment and Natural Resources Administrative Order 2003-30 (Detailed Guidelines and Procedures in the Implementation of the Philippine EIS System) which requires all agencies and instrumentalities of the national government, including government-owned or controlled corporations, as well as private corporations, firms and entities to make a detailed statement on environmental impacts of any proposed undertaking which significantly affects the environment. Hence, forestry and thus forest genetic resources are covered by this law in the sense that areas declared by law as a national park, watershed, reserve, wildlife preserves or sanctuary, areas which constitute the habitat for any endangered or threatened species of indigenous Philippine wildlife (flora and fauna), and mangrove areas, among others, are declared as Environmentally Critical Projects (ECP). Utilization and exploitation of these have critical environmental impacts and therefore need to undergo environmental impact assessments and need to acquire Environmental Compliance Certificates (ECC) prior to implementation. This law in many ways can provide for the conservation of forest genetic resources in the country if properly and judiciously implemented.

Another old law, the Presidential Decree No. 705 Revised Forestry Code of the Philippines still governs the forest management system in the country. Presidential Decree No. 705 or the Revised Forestry Code of the Philippines emphasizes proper classification and survey of all lands of the public domain, management and utilization, as well as the protection, development and rehabilitation of forest lands to ensure continuity of productive condition. Presidential Decree No. 1433 (Promulgating the Plant Quarantine Law of 1978, Thereby Revising and Consolidating Existing Plant Quarantine Laws to Further Improve and Strengthen the Plant Quarantine Service of the Bureau Of Plant Industry) restricts the importation and/or introduction into the Philippines of plants, plant products, soil, packing materials of plant origin capable of harboring and are a source of medium of infection/infestation of plant pests subject to such quarantine orders, rules and regulations as may be promulgated, from time to time.

Executive Order 23 (February 1, 2011) declares a moratorium on the cutting and harvesting of timber in the natural and residual forests and creating the anti-illegal logging task force, among others. The DENR is prohibited from issuing logging contracts/agreements in all natural and residual forests, such as Integrated Forest Management Agreements (IFMA), Socialized Integrated Forest Management Agreements (SIFMA), Community-Based Forest Management Agreement (CBFMA) and other agreements/contracts with logging components in natural and residual forests.

One policy issuance with direct implication on access to forest genetic resources is Executive Order No. 247 (May 18, 1995) and its Implementing Rules and Regulations (DENR DAO 96-20). It prescribes guidelines and establishes a regulatory framework for the prospecting of biological and genetic resources, their by-products and derivatives, for scientific and commercial purposes; and for other purposes. Prospecting of biological and genetic resources shall be allowed within the ancestral lands and domains of indigenous cultural communities only with the prior informed consent of such communities obtained in accordance with the customary laws of the concerned community.

The prospecting of biological and genetic resources shall be allowed when the person, entity or corporation, foreign or domestic, undertaking such activities, on recommendation of the Inter-Agency Committee on Biological and Genetic Resources executes a Research Agreement. If the research and collection of biological and genetic resources is intended, directly or indirectly, for commercial purposes, the agreement must be a Commercial Research Agreement. If the prospecting of biological and genetic materials is intended primarily for academic purposes, the agreement shall be an Academic Research Agreement.

Republic Act No. 7586 enacted in July 1991, An Act Providing for the Establishment and Management of National Integrated Protected Areas System, Defining Its Scope and Coverage, and for Other Purposes provides that hunting, destroying, disturbing, or mere possession of any plant or animal or products derived there from without a permit from the Management Board is prohibited (Section 20). Executive Order 578 November 8, 2006 established the National Policy on Biological Diversity and prescribed its implementation throughout the country, particularly in the Sulu Sulawesi Marine Ecosystem and the Verde Island Passage Marine Corridor. The EO provides that the DENR shall, in accordance with law and subject to public consultations, develop and promulgate rules, and regulations for the establishment of critical habitats within key biodiversity areas which are known to harbor habitats and ecosystems critical for the survival of threatened, restricted-range, and congregatory species, and provide the guidelines for their management and protection. Biodiversity impact assessment shall be integrated into the Environmental Impact Assessment and the Environmental Risk Assessment Processes, taking into consideration guidelines adopted under the United Nations Convention on Biological Diversity (Section 3).

Republic Act No. 8371 (An Act to Recognize, Protect and Promote the Rights of Indigenous Cultural Communities (ICC) / Indigenous People (IP), Creating a National Commission of Indigenous People, Establishing Implementing Mechanisms, Appropriating Funds Therefore, and for Other Purposes) recognizes, promotes and protects the rights of ICCs/ IPs to their ancestral domains, autonomy and self determination and cultural integrity. It further recognizes full ownership, control and protection of their cultural and intellectual property - including special measures to control, develop and protect their sciences, technologies and cultural manifestations, including human and other genetic resources, seeds, medicines, indigenous knowledge system and practices, knowledge of the properties of fauna and flora, oral traditions, literature, designs, visual and performing arts and the right to the protection of their traditional medicines and health practices, the protection of vital medicinal plants, animals and minerals.

In July 31, 2001, the country enacted Republic Act No. 9147 or the Wildlife Act (An Act Providing for the Conservation and Protection of Wildlife Resources and Their Habitats, Appropriating Funds Therefore and for Other Purposes). Among other provisions, local transport of wildlife, by-products and derivatives collected or possessed through any other means shall be authorized unless the same is prejudicial to the wildlife and public health. Wildlife species may be exported to or imported from another country as may be authorized by the Secretary or the designated representative, subject to strict compliance with the provisions of this Act and rules and regulations promulgated pursuant thereto: *Provided*, that the recipient of the wildlife is technically and financially capable to maintain it. Bio-prospecting shall be allowed upon execution of an undertaking by any proponent, stipulating therein its compliance with and commitment(s) to reasonable terms and conditions that may be imposed by the Secretary which are necessary to protect biological diversity.

Germplasm exchange rules are defined in Article 42, Section 5 of the Implementing Rules

and Regulations (IRR) of Republic Act No. 7308, otherwise known as the Seed Industry Development Act of 1992. This applies more on agricultural plant genetic resources but the general purpose is to conserve, preserve, and develop the plant genetic resources of the nation. Access to forest genetic resources over the past ten years has been defined by strict laws and regulations. Difficulty depends on the nature of gaining access and the purpose for obtaining said resources. There are reasons to believe that the country encountered difficulty in maintaining or enhancing access to forest genetic resources located outside the country considering that these countries too, made parallel legislations and rules of access with reference to CBD.

The Philippines may not really depend on access to forest genetic resources outside the country considering its rich source of indigenous genetic materials. Forest development goals of the country can be attained using local sources.

Chapter 8
The Contribution of Forest Genetic Resources to Food and Health Security, Poverty Alleviation, and Sustainable Development

The Philippine forests, particularly the genetic resources, remain an important element of the natural environment that performs invaluable ecological services vital to the survival of the Filipino people. Clean water, good soil, and fresh air are some of the major services provided by the forests. Thus, the Philippine government is committed to protecting and sustainably managing its remaining forest genetic resources.

While the contribution of the forest sector to GDP is dwindling, it remains significant, especially if looked at in tandem with the agriculture and fisheries sectors. From 2004-2009, the agriculture, fisheries and forestry (AFF) sector accounted for 18.7 percent of total GDP[1]. Ironically, lack of protection and improper use over the years brought about the deterioration of the natural ecosystems, resulted in the decline of the AFF contribution to GDP by 1.5% during the same period (NEDA 2011).

The poor state of the country's forest resources is felt most intensely by the poor, especially the rural communities which remain the poorest in the country[2]. The strong link between poverty and forest degradation cannot be denied as continuous degradation of this important resource poses a threat to life itself.

1 Average AFF contribution to GDP from 2004-2009. Source: NSCB

2 2006 Poverty incidence identified fisherfolks and farmers as the poorest

There are approximately 20 million people living in upland and forest areas, half of whom are dependent on shifting cultivation for their livelihood (Cruz and Zosa-Feranil, 1998 as cited by NEDA 2011). Inequitable land distribution, insecure tenure and rural poverty are often cited as causes of deforestation and forest degradation in the Philippines, which is linked to increases in rural populations both as a result of fertility and in-migration (Kummer, 1992; Liché, 1997 as cited by NEDA 2011).

FGR Contribution to Food and Health Security, Poverty Alleviation, and Sustainable Development

With the rich diversity in terms of species that the Philippine forests has, it is no wonder that they yield plants, plant parts, exudates, and plant derivatives that have proven to be of immense value to Philippine society. Philippine customs and traditions are interwoven with FGR which more than highlight the biological and economic importance of FGR to the Filipino way of life. This part of the report provides the highlights for the multifarious contributions that FGR have been providing to the well being of the Filipinos.

Philippine Wild Food Plants

The Philippine forest has a rich reserve of wild and semi-wild food plants, which many of the country's indigenous groups depend on for subsistence, and to some extent, as source of additional income.

Some of these wildfood plants can be eaten raw, while some need cooking. Others can be processed as delicacies or made into preserves that could be stocked for future needs. The cultivation of these wildfood plants as alternative to agricultural crops can help provide livelihood options to many upland and forest dwelling Filipinos (Polinag, 2003; Dichoso, 2010). In the northern region of the Philippines, over 49 wild species have been recorded in the 11 municipalities of Cordillera and the young shoots, tops, stalks, flowers, leaves, bulbs and fruit reported to be eaten as vegetables. Many of these belong to the Asteraceae (Compostitae), Solanaceae, Amaranthaceae and Brassicaceae families. *Gagattang* is the local name for several thistle-like species - including *Sonchus oleraceus L* (common sow thistle) and *S. arvensis* (perennial sow thistle) - which, although rather bitter, are consumed by local communities. The plants are high in flavonoids and are also used to treat indigestion, fever and asthma. *Puriket* (*Bidens pilosa*), another popular wild plant, is rich in iodine and is reported to prevent goitre (enlarged thyroid). The young roots are also used to cure rheumatism and treat wounds and, in some areas, *puriket* is used in the preparation of sake (rice wine).
(http://www.new-ag.info)

A list of these wildfood plants with their corresponding food values is in Appendix Table 9.

Contribution to Health and Security

The Philippine forests also abound with medicinal plants. Many have been proven to be fast and relatively inexpensive cures to common physical ailments and entails simple preparation either as concoctions for skin diseases or taken as tea. There are quite a number of these species whose air dried leaves are pounded and encapsulated and are being sold in the local market. An example is akapulko (*Cassia alata*), a shrub known to be a diuretic, sudorific and purgative. The medicinal uses of akapulko are to treat fungal infection of the skin and for the treatment of ringworms. Then there is the banaba (*Lagerstroemia speciosa*), a tree found throughout the Philippines whose leaves, roots, fruit and flowers a have medicinal uses. The species is used in the treatment of diabetes and other ailments. It is also a purgative and a diuretic.

There are also herbal products from the forests that include natural products for food that are processed with natural raw material ingredients, additives, and processing supplements to protect the sensory qualities of food. Herbal products for personal care or 'cosmeceuticals' contain natural ingredients from plant, animal or mineral sources that have been minimally processed for soap, lotion and other beauty care.

Forest-based Industries/Activities Supporting Poverty Alleviation

Furniture Industry. Philippine furniture ranks among the world's best, earning for the country the honor of being the "Milan of Asia" for elegance and high quality craftsmanship. The wooden furniture manufacturers in the Philippines used to export only sanded items and parts, but have now penetrated the global market with finished products that showcase local skills in carving, marquetry and inlaying. Philippine-made wooden pieces were previously reproduction or period pieces. However, several firms are now producing modern and contemporary style furniture. Other manufacturers have also ventured into the use of particleboards and medium density fiberboards for panel furniture (http://philexport.ph/furniture.html).

An estimated 15,000 local furniture companies are actively supporting the industry and providing employment to a total of 481,500 direct workers and 300,000 from sub-contractors. Only 2% of these establishments are considered large companies. The remaining 98% are classified as small and medium size enterprises. Notably, Small and Medium Enterprises (SME) make up much of the 2,500 furniture companies engaged in exports.

The three main centers of furniture production in the country are Metro Manila, Pampanga and Cebu. The Southern Tagalog Region, Iloilo and Mindanao (i.e. Davao, Cagayan de Oro City and Butuan City) are becoming furniture centers too. The largest-sized rattan, stonecraft and metal furniture manufacturers are located in Cebu. Lately however, several rattan factories in Cebu have shifted to wood furniture production.

Handicrafts-Making. The industry produces an assortment of wares such as basketwork, shell craft articles, ceramics, metal wares, textiles, stone wares, wood crafts, hand made paper products, biojewels, and others. Most of the new and smaller handicraft firms use manual production while a few of the larger and progressive firms are already mechanized. The industry requires minimal capital investment wherein the bulk of investment is in working capital for raw materials and labor. Raw materials used are mostly locally sourced and usually from areas around the production centers. Raw materials such as natural fiber, agricultural wastes, and indigenous plants are spread around the country.

Majority of the handicraft manufacturers in the Philippines are small and medium enterprises (SMEs), with a capitalization of less than PhP1 M and less than 20 employees. The employees are often family members, relatives and neighbors. These handicrafts include baskets, holiday decors, body wearables like earrings, food and ash trays, and many other novelty items. A list of these species which are used as raw materials for such handicraft products is shown in Appendix Table 10.

The basketware sub-sector of the handicrafts industry is 90% labor intensive. At present, there are more than 5,000 firms who are into basket production. Seventy-one firms are registered with the BOI, 150 are large-scale, while the remaining firms are micro and small-scale companies. This sub-sector provides direct employment to about 40,000 workers. An additional one million workers are indirectly employed, spread out over the major basket producing regions. Majority of basket producers are into sub-contracting arrangement with other firms. On the average, a major manufacturer subcontracts 50% of its production, and an exporter has three major subcontractors. Subcontracting in the basketry sub-sector provides employment to about 100,000 individuals. Examples of these species are Bulakan (*Merremia peltata* (L.) Merr.), Hinggiw kalabaw (*Streptocaulon baumii* Decne.), Lukmoy (*Rhaphidophora monticola* Krause), Malagayaman (*Pothos scandens* L.), and Silong pugo (*Pericampylus glaucus* (Lam) Merr.).

Majority of the basket manufacturers and subcontractors are found in the provinces of Quezon, Ilocos, Albay, Pangasinan, Pampanga, Cagayan, Cebu, Bohol, and Negros, where raw materials are readily available. Other areas have specialized basket products depending on the materials available. Central Visayas is known for baskets made of bamboo, coco midrib and buri. Producers in the Bicol region are known for their abaca products.

The wooden toy sub-sector is more capital-intensive. While most firms utilize a number of machinery and equipment, at least 50% of the total number of equipment of the industry is imported. Production workers vary from as few as three workers to as many as 200 workers, 90% of whom are women. The number excludes subcontractors who are summoned when there are big volume orders (http://tradeline phil.dti.gov.ph/betp/toys). The main materials for the wooden toy sub-sector include kiln dried mahogany (*Swietennia macrophylla),* and soft solid wood such as almaciga (*Agathis* spp.).

The handmade paper subsector is another handicraft industry with barely 10 years in existence. Although young, the yearly average value of exports, within a period of five years from 1995 to 1999, amounted to FOB US$120.22 M for HMP sheets and converted items. Except for the biggest one, the mills operate on micro- and small scale, with production capacity range of 1,000–30,000

sheets of varied sizes and 100-50,000 pieces of converted items per month. The industry consists of about 100 firms, each employing some five to more than a hundred workers, mostly underemployed and out-of-school youths in the community. The industry is faced with problems on slow production, high cost of labor, materials and machines, low qualities of paper, inadequate promotion and marketing of products, among others. Main raw materials for handmade production include agricultural fibers like abaca fibers, cogon grasses, salago, banana fibers, etc.

Non-wood forest products. As mentioned above, they are also valuable sources of essential oils, dyestuffs, tannins, and animal products such as honey and beeswax. These include resins and exudates, palm and palm by-products, fibers, natural dyes and colorants, natural herbals, tannins, medicinal plants (leaves, roots, barks).

Resins and resinoids produced from almaciga (*Agathis* spp.) known as Manila copal, is processed for paints, varnishes and lacquers. Another exudate, Manila elemi, comes from *Canarium* species and processed similarly as Manila copal.

Palm products and by products are extracted from kaong (*Arenga pinnata*) and sago (*Metroxylon sagu*) fruits, specialty wine from nipa (*Nypa fruticans)* and fibers, raffia and buntal from buri (*Corypha utan* syn. *Corypha elata*).

Bast fibers from salago (*Wikstroemia* spp.) forests are used in the manufacture of bank notes and special types of paper products. These fibers can likewise be used for fishlines and nets, clotheslines, sacks, and woven in intricate designs for bags, wallets and hats.

Wood fuels can come from the forest, wooded lands, agricultural lands, and homesteads. The World Bank/ESMAP Philippine Household Energy Strategy Study in 1991 showed that the share of forest and non-forest land supplied fuelwood is about 14% and 86%, respectively. This indicates that the non-forest lands are the important woodfuel supply source in the Philippines, particularly the household use.

The main process of woodfuel conversion is resizing where wood is cut and split into sizes that are easy to handle and transport, and drying before being used directly as fuel wood. Woodfuel could also undergo the following processes: carbonization, gasification, densification, liquid fuel production, and combustion. Charcoal briquette is being promoted to use low quality biomass fuel into a high-density fuel. Wood chipping technologies are available but are not yet widely used in the country. Charcoal briquettes produced from twigs, saw dusts and other biomass are comparable if not better than the heating values of coconut shell indicating the potential of charcoal briquettes to supplement woodfuels in satisfying the demand.

The distribution and marketing system of woodfuels is performed by two distinct groups of traders: the rural and urban groups. The rural traders are the persons responsible for bringing woodfuels from the rural areas to the urban users. They are composed of transporters and dealers. This group of traders may procure woodfuel directly from the source, i. e., from fuelwood gatherers and charcoal makers, from sawmill operators and from local agents or assemblers of woodfuels in a particular area. Rural traders can also be fuelwood gatherers and charcoal makers who market their goods by themselves.

Urban traders, on the other hand, are sellers of woodfuel operating in the city. This category includes the wholesaler-assembler, wholesaler-assembler-retailer, wholesaler-retailer, and retailer. A wholesaler sells fuelwood in large quantities at a time. An assembler is involved in gathering or bringing together woodfuel from different sources to accumulate large volumes. A retailer on the other hand, sells woodfuel in small quantities directly to consumers.

For many of the poor rural households with limited sources of income opportunities, the urban woodfuel trade is a vital component of

their household economy. UNDP/WB ESMAP disclosed that there are 536,000 households dependent on gathering and selling wood, 158,000 households are charcoal makers, 40,000 households act as traders in rural areas, and an additional estimated 100,000 households are urban traders. The traders are mainly storeowners or market stall operators selling fuelwood and or charcoal as part of the range of goods offered for sale.

In the Philippines, about 86% of the rural households were reported to be predominantly using fuel wood as source of energy. The amount of wood-based energy consumed by households depends on the household size and income, type of energy applications being used, efficiencies and cost of devices, and accessibility to wood-based fuels.

The industrial sector, on the other hand, accounts for about one-third of all biomass fuel consumption in the Philippines with most of its usage accounted for by bakeries, sugar factories, tobacco curing barn, eateries, brick, pots and ceramics making, and lime factory. Demand is concentrated in urban and semi-urban areas as well as in the rural areas with large concentration of rural industries (i.e. brick, pots and ceramic making, lime factory and the like). With the distance between production/conversion area to consumption, charcoal is preferred in terms of transportation cost and ease of handling compared to fuel wood. Wood-based fuels are used as compliments for conventional sources of energy. Urban users have the propensity to substitute wood-based fuels with conventional fuel sources as their income increases.

Initiatives Towards Sustainable Development and People-Oriented Forest Management Programs

Sustainable development has always been the overarching policy of the Philippine government in the management of the country's forest resources. This policy ensures that in addition to ensuring economic viability, forest resources management initiatives also factor in the social equity and ecological stability considerations.

These initiatives are incorporated in most of the recent forest resource management programs and projects of the Philippines. While the programs are primarily designed to increase both in quantity and quality of timber production to support the forest-based industries, the programs also contain strategies that will accelerate rehabilitation of degraded forest ecosystem and at the same time help uplift the socio-economic condition of the upland/forest occupants.

These strategies center on maximizing the involvement of upland communities and other forest resource-dependent families in the implementation forest management projects not only as laborer but also as key implementer as well.

***The Community-Based Forest Management Program (CBFM)*.** Executive Order 263 issued in 1995 adopts CBFM as a major strategy for sustainable management of the Philippine resources (EO 263). This was further reiterated in EO 318 "promoting Sustainable Forest Management in the Philippines".

CBFM integrates and unifies all people-oriented forestry programs including the Integrated Social Forestry Program, Upland Development Project, Community Forestry Program, Low-Income Upland Community Project and the Forestry Sector Project. In accord with the intent and purpose of the people-oriented forestry programs, the CBFM also aims to improve the socio-economic conditions of the upland communities through the promotion of social justice, equitable access to and sustainable development of forestlands resources.

Under CBFM, organized communities or people's organization can enter into a production sharing agreement (CBFMA) with the DENR to give them the right to occupy posses, develop and utilize resources within a designated CBFMA area for a period of

25 years renewable for another 25 years. EOs 263 and 318 likewise call on various relevant instrumentalities of the government including the LGUs, civil society organizations and private business entities to assist in the implementation of CBFM.

In 2008, the DENR has already entered into CBFM Agreement with 1, 783 POs covering an area of about 1,622,404 has. About 321,638 households have been benefitting from this program.

Integrated Forest Management Program (IFMP). The declining supply of the raw materials for the wood industries of the country has compelled the government to promote the establishment of Industrial Tree plantations. In, 1999, the DENR has issued Administrative Order No. 99-53 providing the regulations for the implementation of IFMP. From a mere forest tree plantation, IFMP expands the scope and coverage and introduces other strategies to encourage participation of the industry sectors as well as the support of the communities.

Under the guidelines, qualified applicants may enter into a production sharing contract with the DENR wherein he/she (the qualified applicant) will be granted the right to develop, manage, protect and utilize a specified area of forestland and forest resources therein for a period of 25 years and may be renewed for another 25-year period.

Other provisions that are explicitly stated in the IFMP regulation include the requirement to plant principally timber-producing species compatible with the ecological and biophysical characteristics of the area, including rubber, durian and/or non-timber species like rattan and bamboo. The program also allows the use of not more than 10% of the area for agricultural purposes to supplement income or food requirements of the plantation workers.

However, the number of IFMA holders has been declining from as high as 188 in its initial year covering to a low of 146 in 2008. On the other hand, the area under IFMA has continued to increase from a low of 508,000 hectares to as high as 833,000 hectares in 2007. In 2008, the area has gone down to about 767,094 ha.

Socialized Industrial Forest Management Program (SIFMP). Pursuant to the forest management principle of ensuring equitable opportunities and access to forest resources, the DENR has implemented the Socialized Industrial Forest Management Program. This is to allow upland individual/family and community association/cooperatives to participate in the establishment of industrial forest plantation.

Under this program, the qualified individual family, community associations/cooperatives may enter into an agreement (SIFMA) with the DENR wherein the latter grants to the former the right to develop, utilize and manage a small tract of forestland consistent with the principle of sustainable development (DENR Administrative Order No. 96-24). In 2008, about 35,587 hectares have been placed under 1,803 SIFMA.

National Greening Program. In the face of the worsening problem on forest denudation, the President of the Philippines has issued EO 23 declaring a moratorium on the cutting and harvesting of timber in the natural and residual forests of the entire country. The EO aims to protect the remaining forest cover areas not only to prevent damages to life and properties due to natural calamities such as flashfloods and land/mudslides, but also to preserve biodiversity by protecting the habitats and sanctuaries of endangered and rare species, and to allow for the natural regeneration of residual forests and the development of plantation forests.

The National Greening Program is one of the priority strategies specified under EO 23, series of 2011. This is intended to address the government's goal of poverty reduction, food security, and climate change adaptation and mitigation. The EO has likewise mandated the various government agencies with specific tasks in support to the effective implementation

of the NGP. Among others, the EO directed the Department of Education and the Commission on Higher Education (to initiate the necessary educational drive campaign), the Department of Interior and Local Government (to help in establishing communal tree farms for firewood and other purposes), the Department of Social Welfare and Development (to identify the upland farmers covered by the NGP as priority beneficiaries of the conditional cash transfer program), the Department of Budget and Management (to provide the funds for the production of quality seedlings for reforestation programs from available funds of the government), and the private sector and other concerned agencies and institutions (to raise funds and resources for tree planting activities).

The NGP aims to plant 1.5 billion trees in 1.5 million hectares over a period of 6 years starting 2011. This is quite a gargantuan task. In order to establish a standard for its effective and efficient implementation of the programs, the DENR has issued Memorandum Circular No. 2011-01. The Circular provides the scope and coverage of the program. It also enumerates the priority areas for reforestation and rehabilitation that includes forestlands, mangrove, ancestral lands, military reservations, abandoned mining area, urban parks and open spaces and other suitable public lands such as river banks and stream banks.

NGP is comprised of the seven components including the production of seedling materials; development of upland farms through agro-forestry; reforestation of marginal lands and rehabilitation of mangrove areas in community-managed forestlands; rehabilitation of de-graded areas in priority watershed and protected areas; rehabilitation of river and streambanks; development of forest/tree parks and greenbelts in suitable sites in urban areas; and, maintenance and protection of planted trees and established plantations by partner implementers.

It should be emphasized that NGP recognizes the use of quality planting materials for the reforestation and rehabilitation component of the project. As such, it mandated all the participating/partner agencies to conform with the guidelines on the collection, production and disposition of forest tree seeds and seedlings as provided for under Administrative Order no. 2010-11.

Likewise, the Program also requires the use of premium and indigenous tree species in the reforestation and rehabilitation of degraded forestlands and protected areas. In line with this requirement, the DENR taps its clonal nursery nationwide as a major source of planting materials.

Confronting Tenurial Problem. In addition to the above people-oriented programs and to help address the tenurial problem in the uplands, approximately 11.6 million ha of forestlands are now covered by some form of tenurial instruments under various government programs that somehow provided security to upland occupants (Table 16).

Other specific strategies being implemented to protect the remaining forest genetic resources are the following:

a. Transform open, denuded and degraded areas into protection forests and/or economically-productive asset.
b. Encourage communities to develop multi-purpose forests in on open, denuded and degraded areas including into protection forests and economically-productive asset;
c. Develop a portfolio approach for forest investment in collaboration with the LGUs and NCIP. They shall jointly prepare a forest land use plan identifying areas for protection and areas for investment and provide all necessary permits and clearances prior to development
d. Ensure that CDM/REDD plus programs truly benefit Filipinos and reduce CO_2 in the atmosphere.
e. Encourage communities to enhance protection and sustain productivity of reforestation and upland areas for livelihood and poverty alleviation

Table 16. Various forest tenurial instruments implemented, as of 2010 (NEDA, 2011).

No.	LTI Type	Number	Area (has)
1	Timber License Agreement (TLA)	4	252,510.00
2	Integrated Forest Management Agreement (IFMA)	145	1,017,654.76
3	Socialized Industrial Forest Management Agreement (SIFMA)	1,822	36,941.08
4	Agroforestry Farm Lease Agreements (AF-FLA)	17	4,776.00
5	Tree Farm Lease Agreement (TFLA)	88	9,742.00
6	Forestland Grazing Management Agreement (FLGMA & FLGA)	364	97,019.00
7	Special Land Use Permit (SLP)	198	2,063.02
8	Special Land Use Lease Agreement (SPLU-LA)	18	98.51
9	Forest Land Use Agreements for Tourism Purposes (FLAgT)	31	967.89
10	Special Forest Land Use Agreement (FLAg)	11	2,580.39
11	Community-Based Forest Management Program (CBFMP)		
12	CBFM Agreement	1,790	1,633,892.11
13	Other CBFM Tenure (CSC, FLMA, CFSA, CFP, etc)	3,314	3,200,024.02
14	Approved CADT and CALT	414	4,276,639.25
15	PACBRMA	58	22,240.03
16	Areas under Management Arrangements		
17	Philippine National Oil Corporation (PNOC)		266,326.00
18	National Power Corporation (NPC)		337,721.00
19	National Irrigation Administration		22,243.00
20	Co-Management Agreement with LGUs	153	485,536.65
	TOTAL	8,427	11,668,974.71
	Total forestland		15,805,325.00
	Tenured		11,668,974.71
	Untenured		4,136,350.29

f. Undertake completion of forestland boundary delineation and assessment and push for the enactment of bills, and placing all untenured /open access area under management regime
g. Carry out collaborative watershed management planning *cum* vulnerability assessment and implementation among DENR, LGUs and other watershed stakeholders towards responsible forest management.
h. Manage, protect, and develop natural forest, established plantation, and economically important non timber forest products and species
i. Conduct Monitoring and Evaluation using Criteria and Indicators, Third Party Monitoring, and Forest Certification, among others.
j. Strengthen Decision Support System

through Inventory of forest resources, Baseline Data generation & GIS mapping and Forest valuation & natural resource accounting

k. Integrate the Conservation Farming Village approach in the development of upland farming communities in the Philippines

Issues and Challenges

The aforementioned discussions have brought to the fore the multifarious benefits that can be derived from the country's forest genetic resources. Obvious is the fact that there is strong appreciation of these uses and benefits. But there is more that we can get when such genetic resources are managed on a sustainable basis. Tangible goods are only half of the benefits derived from FGR. The other half are the environmental services that the sustainable use of FGR can bring about. The potential of this other half has just begun to be understood, and the methods to realize such potential is just starting to evolve.

The full ecological and environmental values of FGR is now again brought into the limelight with the new program on Reducing Emissions from Deforestation and Forest Degradation which is recognized as an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. With the huge outflows of funds from industrialized countries to the less developed ones, there can really be meaningful emission reduction efforts with the conservation of biodiversity and securing vital ecosystem services as indirect results.

In relation to REDD+ providing a boost to FGR conservation, another evolving approach is the Payment for Environmental Services (PES) which now being regarded as an indispensable sustainable development mechanism. PES will inevitably make efforts towards conservation of FGR very attractive. Developments in the methodologies for valuing FGR will certainly go a long way in promoting the conservation and sustainable of FGR in the Philippines.

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Appendix Tables

Appendix Table 1. Forest species in the Philippines with economic importance and/or uses.

Scientific Name	Tree (T) or other species (O)	Native (N) or Exotic (E)	Reasons for Priority
Trees			
Acacia auriculiformis A. Cunn. Ex Benth.	T	E	used in pulp and paper, furniture, fuelwood, charcoal
Acacia mangium Willd.	T	E	used in general construction and furniture industry
Anthocephalus chinensis (Lamb) A. Rich. Ex Walp.	T	N	for plywood, pulp and paper
Casuarina equisitifolia L.	T	N	firewood, windbreak, erosion control, tannin, pulp
Endospermum peltatum Merr.	T	N	important source of lightweight hardwood; wood is especially used for matches, various kinds of sticks and wooden shoes; used in reforestation
Eucalyptus deglupta Blume	T	N	used for pulp and paper, lumber, poles, boxes, furniture, mine timber
Gmelina arborea Roxb.	T	E	pulp, veneer, light construction lumber, fuelwood, furniture, posts, particle board, poles, plywood
Paraserianthes falcataria (L.) Nielsen	T	E	used in pulp, blackboard, fuelwood, corestock, furniture, toys, handicrafts
Pinus kesiya Royle ex Gordon	T	N	long-fibers for quality paper production, mine props, wood construction

Pterocarpus indicus Willd.	T	N	used as structural timber for light to heavy construction, considered among the best for furniture, panelling, musical instruments, high grade cabinet work, decorative flooring, and novelties
Samanea saman (Jacq.) Merr	T	E	furniture and panelling, cabinet, wood, construction, veneer, plywood, wood carving
Swietenia macrophylla King	T	E	regarded as the world's finest timber for high-class furniture and cabinet work
Tectona grandis L. f.	T	E	construction, wood carving
Toona calantas Merr. & Rolfe	T	N	used especially for furniture, musical instruments, cigar boxes and plywood; the wood has a pleasant smell, bark and flower are used in local medicine
Bamboo			
Bambusa blumeana J.A. Schultes & J.H. Schultes	O	E	culms are used in building construction, manufacture of furniture, produces excellent pulp for paper making, and common source of shoots
Dendrocalamus asper (Schultes f.) Backer ex Heyne	O	E	used in house construction, pulp and paper making, bamboo plywood and tiles, produces one of the best shoots
Gigantochloa levis (Blanco) Merr.	O	E	culms used in building construction, basketry and furniture
Schizostachyum lumampao (Blanco) Merr.	O	E	used for making bamboo mats or sawali, plyboo, basket, fences, spears and flutes
Rattan			
Calamus dimorphacanthus Becc.	O	N	used for baskets, bags, for home industries
Calamus manillensis (Mart.) H. Wendl.	O	N	good source of material for weaving
Calamus merrillii Becc.	O	N	utilized in furniture making
Calamus mindorensis Becc.	O	N	furniture, basketry and cordage
Calamus ornatus Becc. var. *philippinensis* Becc.	O	N	furniture, cane, handles for implements and flooring, leaves and roots as medicine, fruits occasionally eaten

Calamus ornatus Blume var. *Philippinensis* Becc.	O	N	good source of material for furniture industry and the stem is cut into strips for handicraft purposes
Calamus siphonospathus Mart. var. *dransfieldii* Baja-Lapis	O	N	basketry and tying
Calamus symphysipus Mart.	O	N	chairs, pack saddles for animals
Daemonorops ochrolepis Becc.	O	N	furniture, baskets, bags, for home industries and local commercial use
Daemonorops pedicelaris Becc.	O	N	Handicrafts

Appendix Table 2. Forest species used for plantation, agroforestry or enrichment planting in natural forests.

Scientific Name	Native (N) or Exotic (E)	Current Uses*	If managed, type of management system
Trees			
Acacia auriculiformis A. Cunn. Ex Benth.	E	1, 2, 3	plantation
Acacia mangium Willd.	E	1, 2, 3	plantation
Anthocephalus chinensis (Lamk.) A. Rich. Ex Walp	N	1, 2	plantation
Artocarpus blancoi (Elmer) Merr.	N	1, 4	agroforestry
Callophylum inophyllum L.	N	1, 3	natural forest
Casuarina equisitifolia L.	N	2, 3, 4, 5	plantation
Dipterocarpus grandiflorus Blanco	N	1	natural forest
Endospermum peltatum Merr.	N	1	natural forest
Eucalyptus camaldulensis Dehnh.	E	1, 2, 3	plantation
Eucalyptus deglupta Blume	N	1, 2	plantation
Gliricidia sepium (Jacq.) Kunth ex Walp.	E	1, 3, 4, 5	agroforestry
Gmelina arborea Roxb.	E	1, 2	plantation
Hevea brasiliensis (HBK.) Muell.-Arg.	E	1, 4	plantation
Leucaena leucocephala (Lam.) de Wit	E	1, 4, 5	plantation, agroforestry
Litsea perrottetii	N	1, 4	agroforestry

Mangifera indica L.	N	1, 4, 5	plantation, agroforestry
Octomelis sumatrana Miq.	N	1	natural forest
Palaquium luzoniense (F.-Vill) Vidal	N	1	natural forest
Paraserianthes falcataria (L.) Nielsen	N	1, 2	plantation
Parashorea malaanonan (Blanco) Merr.	N	1	natural forest
Petersianthus quadrialatus (Merr.) Merr.	N	1, 2	plantation
Pinus kesiya Royle ex Gordon	N	1, 2	plantation, reforestation
*Pterocarpus indicus*Willd.	N	1	plantation, natural forest
Samanea saman (Jacq.) Merr	E	1	plantation, open areas, ornamental
Shorea almon Foxw.	N	1	natural forest
Shorea contorta Vidal	N	1	natural forest
Shorea negrosensis Foxw.	N	1	natural forest
Shorea polysperma (Blanco) Merr.	N	1	natural forest
Shorea squamata (Blanco) Merr.	N	1	natural forest
Swietenia macrophylla King	E	1	plantation, natural forest, ornamental
Tectona grandis L. f.	E	1	plantation, natural forest
Shrub			
Vitex negundo L.	N	4, 5	plantation/agroforestry
Bamboo			
Bambusa blumeana J.A. Schultes & J.H. Schultes	E	2, 4, 6	plantation
Bambusa philippinensis (Gamble) McClure	N	2, 4 ,6	plantation
Bambusa vulgaris Schrader ex Wendl.	E	2, 4 ,6	natural forest
Dendrocalamus asper (Schultes f.) Backer ex Heyne	E	2, 4, 6	plantation
Gigantochloa atter (Hassk.) Kurz	E	2, 4 ,6	plantation
Gigantochloa levis Merr.	N	2, 4 ,6	plantation
Schizostachyum lumampao (Blanco) Merr.	N	2, 4 ,6	natural forest

Palm			
Cocos nucifera L.	E	1,3, 4, 5	plantation/agroforestry
Corypha elata Roxb.	N	4, 5	natural forest
Metroxylon sagu Rottb.	N	1, 4, 5	natural forest
Arenga pinnata (Wurmb) Merr.		1, 4	plantation/agroforestry
Rattan			
Calamus caesius Blume	N	6	natural forest
Calamus dimorphacanthus Becc.	N	6	natural forest
Calamus filispadix Becc.	N	6	natural forest
Calamus javensis Blume	N	6	natural forest
Calamus manillensis (Mart.) H.A. Wendl.	N	6	natural forest
Calamus merrillii Becc.	N	6	natural forest
Calamus microcarpus Becc. var. m*icrocarpus*	N	6	natural forest
Calamus microsphaerion Becc.	N	6	natural forest
Calamus mindorensis Becc.	N	6	natural forest
Calamus ornatus Becc. var. *philippinensis* Becc.	N	6	natural forest
Calamus ramolosus Becc.	N	6	natural forest
Calamus scipionum Lour.	N	6	natural forest
Daemonorops mollis (Blanco) Merr.	N	6	natural forest
Daemonorops pedicellaris Becc.	N	6	natural forest

* Currrent Use:

1 Solid wood products
2 Pulp and paper
3 Energy (fuel)
4 Non wood forest products (food, fodder, medicine, etc.)
5 Used in agroforestry systems
6 Others

Appendix Table 3. Main tree and other woody forest species providing environmental services or social values.

Scientific Name	Native (N) or Exotic (E)	Environmental Service or Social Value*
Trees		
Agathis philippinensis Warb.	N	6
Alnus nepalensis D. Don	E	1
Alstonia scholaris R. Br.	N	5
Amherstia nobilis Wall.	E	5
Calliandra calothyrsus Meissner	E	1, 2
Cananga odorata (Lamk) Hook.f & Thomson	N	5, 6
Cassia fistula L.	E	5
Casuarina equisitifolia L.	N	1, 2
Cynometra ramiflora L.	N	5
Desmodium gyroides DC. Home	N	1
Elaeis guineensis Jacq.	E	5 , 7
*Flemengia macrophylla (*Willd.) Merr.	N	1, 2
Leucaena diversifolia Benth.	E	1, 2
Leucaena leucocephalla (Lam.) de Wit	E	1
Muntingia calabura L.	N	5
Piliostigma malabaricum (Roxb.) Benth.	N	1
Pinus kesiya Royle ex Gordon	N	1, 5
Pinus merkusii Jung 7 de Vriese	N	1, 5
Pithecelobium dulce (Roxb.) Benth.	E	2,7
Psidium guajava L.	E	2,7
Samanea saman (Jacq.) Merr	E	5
Saraca declinata Miq.	E	5
Saraca thaipengensis Prain	E	5
Senna siamea (Lam.) Irwin et Barneby	N	2
Sesbania grandiflora (L.) Poiret	E	1
Syzygium cumini (L.) Skeels	N	5
Gliricidia sepium (Jacq.) Walp.	E	1
Bamboo		
Bambusa blumeana J.A. Schultes & J.H. Schultes	E	1, 2, 3
Gigantochloa atroviolaceae Widjaja	E	5
Bambusa vulgaris var. *striata* Schrad. Ex Wendl. cv. *vitata* Mcll.	E	5

Schizostachyum brachycladum (Kurz)	E	5
Palm		
Livistonia rotundifolia (Lam.) Mart.	E	5
Licuala grandis H. Wendl.	E	5
Roystonia regia (HBK) O.F. Cook	E	5
Cryptostachys renda Bl.	E	5
Mascarena lagenicaulis L.H. Bailey	E	5

* Services and values include:

1 Soil and water conservation including watershed management
2 Soil fertility
3 Biodiversity conservation
4 Cultural values
5 Aesthetic values
6 Religious values
7 Food

Appendix Table 4. List of tree and other woody forest species considered to be critically endangered in all or part of their range from genetic conservation point of view.

Scientific Name	Family	Distribution in the country: Widespread (W), Rare (R) or Local (L)	Type of Threat*	Threat Category**
Kibatalia longifolia Merr.	Apocynaceae	Rare	1,2,6,7	Critically Endangered
Cyathea microchlamys Holtt.	Cyatheaceae	Rare	1,2,6,7	Critically Endangered
Hopea acuminata Merr.	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Hopea basilanica (Foxw.) Slooten	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Hopea cagayanensis (Foxw.) Slooten	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Hopea foxworthyi Elmer	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Hopea malibato Foxw.	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Hopea mindanensis Foxw.	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered

Hopea philppinensis Dyer	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Hopea quisumbingiana Gutierrez	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Hopea samarensis Gutierrez	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Shorea astylosa Foxw.	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Shorea malibato Foxw.	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Vatica elliptica Foxw.	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Vatica pachyphylla Merr.	Dipterocarpaceae	Rare	1,2,6,7	Critically Endangered
Ctenitis paleolata Copel.	Dryopteridaceae	Rare	1,2,6,7	Critically Endangered
Diospyros blancoi A DC.	Ebenaceae	Rare	1,2,6,7	Critically Endangered
Diospyros brideliifolia Elmer	Ebenaceae	Rare	1,2,6,7	Critically Endangered
Diospyros ceulifom Blume	Ebenaceae	Rare	1,2,6,7	Critically Endangered
Diospyros poncei Merr.	Ebenaceae	Rare	1,2,6,7	Critically Endangered
Rhododendron javenicum (Blume) Benn. var. *schadenbergii* (Warb.) Sleum.	Ericaceae	Rare	1,2,6,7	Critically Endangered
Rhododendron kochii Stein	Ericaceae	Rare	1,2,6,7	Critically Endangered
Rhododendron taxifolium Merr.	Ericaceae	Rare	1,2,6,7	Critically Endangered
Reutealis trisperma (Blanco) Airy Shaw	Euphorbiaceae	Rare	1,2,6,7	Critically Endangered
Hypericum pulogense Merr	Hypericaceae	Rare	1,2,6,7	Critically Endangered
lsoetes philippinensis Merr. & Peny	Isoetaceae	Rare	1,2,6,7	Critically Endangered
Cinnamomum cebuense Kosterrn.	Lauraceae	Rare	1,2,6,7	Critically Endangered
Pterocarpus indicus Willd. forma indicus	Fabaceae	Rare	1,2,6,7	Critically Endangered

Pterocarpus indicus Willd. forma echinatus (Pers.) Rojo	Fabaceae	Rare	1,2,6,7	Critically Endangered
Thaumasianthes amplifolia (Merr.) Danser	Loranthaceae	Rare	1,2,6,7	Critically Endangered
Aglaia pyriformis Merr.	Meliaceae	Rare	1,2,6,7	Critically Endangered
Toona calantas Merr. & Rolfe	Meliaceae	Rare	1,2,6,7	Critically Endangered
Syzygium nitidum Benth.	Myrtaceae	Rare	1,2,6,7	Critically Endangered
Tristaniopsis decorticata (Merr.) Peter G. Wilson & Waterhouse	Myrtaceae	Rare	1,2,6,7	Critically Endangered
Xanthostemon bracteatus Merr.	Myrtaceae	Rare	1,2,6,7	Critically Endangered
Xanthostemon philippinensis Merr.	Myrtaceae	Rare	1,2,6,7	Critically Endangered
Nepenthes argentii M. Jebb & M Cheek	Nepenthaceae	Rare	1,2,6,7	Critically Endangered
Nepenthes memilliana Macfarlane	Nepenthaceae	Rare	1,2,6,7	Critically Endangered
Nepenthes sibuyanensis J Nerz	Nepenthaceae	Rare	1,2,6,7	Critically Endangered
Chionanthus clementis (Quisumb. & Merr.) Kiew	Oleaceae	Rare	1,2,6,7	Critically Endangered
Chionanthus remotinervius (Merr.) Kiew	Oleaceae	Rare	1,2,6,7	Critically Endangered
Olea palawanensis Kiew	Oleaceae	Rare	1,2,6,7	Critically Endangered
Amesiella monticola J. Cootes & DP Banks	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Ascoglossum calopterum (Reichb. f.) Schlecter	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Ceratocentron fesseli Senghas	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Dendrobium schuetzei Rolfe	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Euanthe sanderiana (Reichb. f) Schltr.	Orchidaceae	Rare	1,2,6,7	Critically Endangered

Gastrochilus calceolaris (Buch.- Ham. ex J.E. Sm.) D.Do	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum acrnodontum Schoser ex MW Wood	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum adductum Asher	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum anitum Golamco	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum argus (ReichbX) Stein	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum fowliei Birk	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum haynaldianum (Reich b. f.) Stein	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum hennisianum (MW Wood) Fowlie	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum randii Fowlie	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum urbanianum Fowlie	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Paphiopedilum usitanum O Gruss & J Roeth	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Phalaenopsis micholitzi Rolfe	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Phmgmorchls teretffolia LO Williams	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Vanda lamellata Lindl. var. *calayan* Valmayor & D. Tiu	Orchidaceae	Rare	1,2,6,7	Critically Endangered
Areca parens Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Calamus batanensis (Becc.) Baja-Lapls	Arecaceae	Rare	1,2,6,7	Critically Endangered
Calamus jenningsianus Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Calamus vinosus Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Daemonorops affinis Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered

Daemonorops oligolepis Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Daemonorops pannosus Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Heterospathe calihons Fernando	Arecaceae	Rare	1,2,6,7	Critically Endangered
Heterospathe dransfieldii Fernando	Arecaceae	Rare	1,2,6,7	Critically Endangered
Heterospathe scitula Fernando	Arecaceae	Rare	1,2,6,7	Critically Endangered
Heterospathe sibuyanensis Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Heterospathe trispatha Fernando	Arecaceae	Rare	1,2,6,7	Critically Endangered
Pinanga batanensis Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Pinanga bicolana Fernando	Arecaceae	Rare	1,2,6,7	Critically Endangered
Pinanga samarana Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Pinanga sclerophylla Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Pinanga sibuyanensis Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Plectocomia elmeri Becc.	Arecaceae	Rare	1,2,6,7	Critically Endangered
Peranema cyatheoides D. Don var. *luzonicum* (Copel.) Ching & S. H. Wu	Peranemaceae	Rare	1,2,6,7	Critically Endangered
Platycerium coronarium (Koenig ex Miller) Desv.	Polypodiaceae	Rare	1,2,6,7	Critically Endangered
Platycerium grande (Fee) Kunze	Polypodiaceae	Rare	1,2,6,7	Critically Endangered
Podosorus angustatus Holtt.	Polypodiaceae	Rare	1,2,6,7	Critically Endangered
Pteris calocarpa (Copel.) M. G. Price	Pteridaceae	Rare	1,2,6,7	Critically Endangered
Pteris pachysora (Copel.) M. G. Price	Pteridaceae	Rare	1,2,6,7	Critically Endangered
Rafflesia manillana Teschem.	Rafflesiaceae	Rare	1,2,6,7	Critically Endangered
Rafflesia speciosa Barcelona B Fernando	Rafflesiaceae	Rare	1,2,6,7	Critically Endangered

Rafflesia schadenbergiana Goppert ex Hieron	Rafflesiaceae	Rare	1,2,6,7	Critically Endangered
Greeniopsis pubescens Merr.	Rubiaceae	Rare	1,2,6,7	Critically Endangered
Villaria acutifolia (Elmer) Merr.	Rubiaceae	Rare	1,2,6,7	Critically Endangered
Swinglea glutinosa (Blanco) Merr	Rutaceae	Rare	1,2,6,7	Critically Endangered
Gongrospermum philippinense Radlk.	Sapindaceae	Rare	1,2,6,7	Critically Endangered
Guioa palawanica Welzen	Sapindaceae	Rare	1,2,6,7	Critically Endangered
Guioa parvifoliola Merr.	Sapindaceae	Rare	1,2,6,7	Critically Endangered
Guioa reticulata Radlk.	Sapindaceae	Rare	1,2,6,7	Critically Endangered
Coryphopteris borealis Holtt.	Thelypteridaceae	Rare	1,2,6,7	Critically Endangered
Clerodendrum guadriloculare (Blanco) Merr.	Lamiaceae	Rare	1,2,6,7	Critically Endangered
Tectona philippiinensis Benth. B Hook. f.	Lamiaceae	Rare	1,2,6,7	Critically Endangered

* Type of threat:

1 Forest cover reduction and degradation
2 Forest ecosystem diversity reduction and degradation
3 Unsustainable logging
4 Management intensification
5 Competition for land use
6 Urbanization
7 Habitat fragmentation
8 Uncontrolled introduction of alien species
9 Acidification of soil and water
10 Pollutant emissions
11 Pests and diseases
12 Forest fires
13 Drought and desertification
14 Rising sea level
15 Others

**Threat categories are based on DENR Administrative Order No. 2007-01.

Appendix Table 5. List of forest species whose genetic variability has been evaluated.

Scientific Name	Native (N) or Exotic (E)	Morphological Traits	Adaptive and Production Characters Assessed	Molecular Characterization
Swietenia macrophylla King	E	large tree, reaching a height of 30-40 m and girth of 3-4 m; trunk straight, cylindrical, with a buttressed base; bark rough, flaking off in small patches	Young leaves	Random Amplified Polymorphic
Calamus merrillii Becc.	N	large-diameter, clustering, dioecious; dense sheath spines, fibrous brown to black; leaves alternate, grows up to 50-100 m	Young leaves and shoots	Isozyme analysis
Calamus ornatus Becc.	N	Dull green sheaths, densely spiny, brown; stems 4-7 cm diameter, 20 m tall; canes 2-4 cm diameter; leaves coarse 3 m long, horizontal and recurved, alternatingly scattered	Young leaves and shoots	Isozyme analysis
Pinus kesiya Royle ex Gordon	N	large tree up to 45 m tall with a bole free of branches for 15-20 m and up to 100 cm in diameter, a thick, reticulately and deeply fissured bark; needles in bundles of (2-)3(-4), very slender and flexible	Young needles	DNA (microsatellite analysis)
Pterocarpus indicus Willd.	N	big tree, growing to 33 m in height and 2 m diameter; trunks usually fluted and buttressed to 7-m diameter at the base; crowns are large and bear many long branches; leaves are compound-pinnate, bearing about 12 alternate leaflets; leaflets are rather large, 7 x 3.5 to 11 x 55 cm and ovate to elliptic in shape	Young leaves from seedlings Young leaves from trees	Isozyme analysis Isozyme analysis

	N		Leaves	Isozyme analysis
Parashorea malaanonan (Blanco) Merr.		A very large tree to 45 m tall; stem to 2 m in diameter, with large plank-like buttresses to 4 m high, spreading to over 2.5 m., outer bark fissured; inner bark reddish. Leaves simple, elliptical or ovate, 8-16 x 3-12 cm, sometimes plicate, glabrous on both sides, the lower surface distinctly glaucous. Flowers white, in terminal or axillary racemes, the petals falling off separately. Fruit winged, the wings (calyx lobes) much longer than the nut, three longer wings 9-16 x 0.7-1.7 cm, the two shorter wings to 10 cm long; the nut ellipsoid or ovoid, 1.7 x 1.4 cm, finely pubescent.	Mature leaves	DNA (microsatellite) analysis

Reference: Abasolo (2007), Abasolo et al. (2009), Delos Reyes et al. (2010), Gamboa-Lapitan and Jo. (2005), Quimado (2002) and Quimado et al. (2011).

Appendix Table 6. Priority areas for plant conservation (*Important Plant Areas* or *Important Plant Sites* (DENR–PAWB, CI, & UP–CIDS 2002).

Island & important plant area	Province
Batanes Islands	
Batanes Islands Protected Landscape & Seascape	
Luzon	
Peaks of Central Cordillera (1000 m a.s.l.)	Abra, Mt Province, Benguet, Ifugao, and Ilocos Sur Provinces
Mt Arayat National Park	Tarlac, Pampanga and Nueva Ecija
Bataan Natural Park & Subic Bay Forest Reserve	Bataan and Zambales
Mt Makiling Forest Reserve	Batangas and Laguna
Mt Palaypalay – Mt Mataas na Gulod National Park	Cavite and Batangas
Mt Isarog National Park	Camarines Sur
Isabela – Sierra Madre	Isabela
Aurora –Sierra Madre	Aurora
Mt Tapulao	Zambales
Northern Quezon (Central Sierra Madre)	Quezon
Southern Quezon (Central Sierra Madre)	Quezon
Bicol National Park – Mt Labo	Camarines Sur
Mindoro	
Mt Halcon	Mindoro Occidental and Mindoro Oriental
Naujan Lake National Park	Mindoro Oriental
Sibuyan Island	
Sibuyan Island	Romblon
Panay	
Central Panay Mountains: Madjaas–Baloi Complex	Aklan, Capiz, Antique, and Iloilo
Negros	
Mt Canlaon National Park	Negros Occidental and Negros Oriental
Cuernos de Negros Region	Negros Oriental

Samar	
Mt Cabalantian – Mt Capotoan Complex	Samar, Eastern Samar and Northern Samar
Sohoton – Loquilocon area	Eastern and Western Samar
Mindanao	
Dinagat (Mt Kambinlio & Mt Redondo)	Surigao del Norte
Mimbilisan Protected Landscape	Misamis Oriental
North Diwata (Bislig, Mt Agtuuganon – Mt Pasian)	Agusan Del Sur, Compostela Valley, Davao Oriental, and Surigao del Sur
Mt Kaluayan – Kinabalian (Kimangkil Ridge), Bukidnon – Agusan del Norte border	Misamis Oriental, Bukidnon, Davao, Davao del Sur, Agusan del Norte and Agusan del Sur
Mt Kitanglad	Bukidnon
Mt Kalatungan Range	Misamis Oriental, Bukidnon, Lanao del Norte and Lanao del Sur
Munai Tambo Complex (Kolambugan uplands & associated mountains	Lanao del Norte and Lanao del Sur
Lake Lanao	Lanao del Sur
Mt Piagayungan (Ragang) Complex	Bukidnon, North Cotabato, Lanao del Sur and Maguindanao
Mt Butig / Lake Butig National Park	Lanao del Sur and Maguindanao
Marilog Forest Reserve, Bukidnon – Davao boundary	Davao and Davao del Sur
Mt Apo Range	North Cotabato and Davao del Sur
Mt Matutum	Davao del Sur, Sarangani, and South Cotabato
Mt Latian Complex (Sarangani Mountains)	Davao del Sur and Sarangani
Mt Malindang & Lake Duminagat	Misamis Occidental and Zamboanga del Norte
Calamian Islands	
Calamianes	Palawan
Palawan	
Northern Palawan	
Central Palawan	Palawan

Southern Palawan, including Balabac Group of Islands	Palawan
Leyte	
Mt Pangasugan & Anonang – Lobi Range	
Camiguin Island	
Mt Hibok-hibok	Misamis Oriental
Tawi-tawi	
Tawi-tawi	

Appendix Table 7. Potential seed production areas/Seed Sources by region.

Region	Province	Town/City	Location/Barangay	Species	No. of Candidate Plus Trees
CAR	Benguet	Bokod	Yapes Community Watershed/Bobok	*Pinus kesiya*	30
	Benguet	Tuba	Camp 4	*Pterocarpus indicus*	26
	Benguet	Itogon	Binga	*Eucapyptus camaldulensis*	30
	Benguet	Baguio City	Busol Watershed	*P. kesiya*	30
	Benguet	Baguio City	Forbes Park	*P. kesiya*	35
	Benguet	Baguio City	Camp John Hay	*P. kesiya*	27
R-1	Ilocos Norte	Pasuquin	PFDPIN, Tadao	*Red gum*	8
	Ilocos Norte	Marcos		*Gmelina arborea*	12
	Ilocos Norte	Nueva Era	Nueva Era Refo Project/ Poblacion	*Swietenia macrophylla*	25
	Ilocos Sur	Bantay	Refo Project/Caniaw	*P. indicus*	12
	Pangasinan	Mangatarem	Manleluag Spring Protected Landscape/ Malabobo	*Dipterocarpus grandiflorus*	2
	Pangasinan	Mangatarem	Manleluag Spring Protected Landscape/ Malabobo	*Pentacme contorta*	4
	Pangasinan	Mangatarem	Manleluag Spring Protected Landscape/ Malabobo	*Anisoptera thurifera*	6
	Pangasinan	Mangatarem	Manleluag Spring Protected Landscape/ Malabobo	*P. indicus*	20
R-2	Cagayan	Solana	Maquirig	*G. arborea*	55
	Cagayan	Peñablanca	Callao	*S. macrophylla*	75
	Cagayan	Claveria	Claveria Experimental Forest/Kikiling	*Mixed Dipterocarps*	202
	Nueva Vizcaya	Bambang	Salinas	*S. macrophylla*	64
	Nueva Vizcaya	San Luis	Lower Magat Forest Reserve/Diadi	*G. arborea*	67
	Nueva Vizcaya	San Luis	Lower Magat Forest Reserve/Diadi	*S. macrophylla*	108
	Quirino	Nagtipunan	Dipantan	*G. arborea*	54

Region	Province	Town/City	Location/Barangay	Species	No. of Candidate Plus Trees
R-3	Bataan	Mariveles	Mariveles Refo Project/ Alas-asin	*Acacia auriculiformis*	30
	Nueva Ecija	Carranglan	Puncan	*P. indicus*	24
	Pampanga	Arayat	Mt. Arayat National Park/ San Juna Banio	*Vitex parviflora*	13
	Pampanga	Angeles City	Airforce City, Clarkfield	*V. parviflora*	60
	Tarlac	Mayantoc	Calao/San Jose	*S. macrophylla*	36
	Tarlac	Mayantoc	Calao/San Jose	*G. arborea*	105
R-4A	Batangas	San Juan	Imelda	*V. parviflora*	100
	Batangas	Lobo	Sawang	*Teak*	76
	Cavite	Ternate	Mt. Palaypalay National Park/ Malauyas, Sapang	*G. arborea*	25
	Cavite	Ternate	Mt. Palaypalay National Park/ Malauyas, Sapang	*A. auriculiformis*	117
	Cavite	Ternate	Mt. Palaypalay National Park/ Malauyas, Sapang	*A. mangium*	5
	Quezon	Dolores	Kinabuhayan	*S. macrophylla*	95
	Quezon	Lucban	Palola	*S. macrophylla*	31
	Quezon	Lucban	Palola	*P. indicus*	37
	Quezon	Pagbilao	Quezon National Park/ Malicboy	*S. macrophylla*	109
	Quezon	Lucena	Quan's Worth Farm/ Silangan Mayao	*V. parviflora*	20
R-4B	Occ. Mindoro	Mamburao	Tagum/ San Luis	*P. indicus*	29
	Occ. Mindoro	Sta. Cruz	Tagbungan	*Pinus merkusii*	33
R-5	Albay	Guinobatan	Agpay	*Polyscias nodosa*	16
R-6	Aklan	Tangalan	Jawili	*Casuarina equi-setifolia*	35
	Iloilo	Dingle	Bulabog Putian Nat. Park	*V. parviflora*	11
	Iloilo	Dingle	Bulabog Putian Nat. Park	*S. macrophylla*	8

Region	Province	Town/City	Location/Barangay	Species	No. of Candidate Plus Trees
	Iloilo	Dingle	Bulabog Putian Nat. Park	*G. arborea*	10
	Iloilo	Leon	Omambong	*P. indicus*	34
	Iloilo	Lemery	San Jose	*Pittrosporum pentandrum*	23
	Negros Occ.	Bacolod City	Bacolod Tree Park/ Alangilan	*C. equisetifolia*	30
R-7	Cebu	Minglanilla	Camp 7	*S. macrophylla*	250
	Cebu	Minglanilla	Camp 7	*P. indicus*	30
	Cebu	Minglanilla	Camp 7	*Dipterocarp species*	25
	Cebu	Talisay City	Juanay	*C. equisetifolia*	28
	Cebu	Talisay City	Juanay	*E. deglupta*	43
	Cebu	Tabuelan	Danison,Tigbawan	*C. equisetifolia*	3
	Cebu	Tabuelan	Danison,Tigbawan	*E. deglupta*	4
	Cebu	Cebu City	Cantipla	*A. mangium*	29
	Negros Oriental	Mabinay	Bulwang	*G. arborea*	26
	Siquijor	Bogo		*V. parviflora*	31
	Siquijor	Maria	Umpas Liloan	*V. parviflora*	29
R-8	Leyte	Baybay	VSU Forest Reservation Area	*Diospyrus philipinensis*	5
	Eastern Samar	Quinapon-dan	Buenavista	*D. grandiflorus*	4
	Eastern Samar	Quinapon-dan	Buenavista	*P. indicus*	4
	Eastern Samar	Quinapon-dan	Buenavista	*P. falcataria*	302
	Eastern Samar	Quinapon-dan	Buenavista	*S. macrophylla*	53
R-9	Zamboanga City	Zamboanga City	Pasonanca Park	*P. plicata*	9
	Zamboanga City	Zamboanga City	Pasonanca Park	*S. macrophylla*	7
	Zamboanga City	Zamboanga City	Pasonanca Park	*P. indicus*	25

Region	Province	Town/City	Location/Barangay	Species	No. of Candidate Plus Trees
	Zamboanga City	Zamboanga City	Zamboanga City Water District (ZCWD)/P. indicus Outpost, Upper Dulian	*P. plicata*	2
R-10	Bukidnon	Impasugong	Impalutao Refo Project	*S. macrophylla*	50
	Bukidnon	Impasugong	Impalutao Refo Project	*P. contorta*	48
	Bukidnon	Impasugong	Impalutao Refo Project	*Agathis philippinensis*	32
	Bukidnon	Kitaotao	East Poblacion	*V. parviflora*	88
	Camiguin	Guinsiliban	So. Kibila, Cantaan	*V. parviflora*	60
R-11	Compostela Valley	Nabunturan		*G. arborea*	25
	Compostela Valley	Nabunturan		*S. macrophylla*	25
	Compostela Valley	Nabunturan		*E. deglupta*	22
	Compostela Valley	Mawab	Sta. Ana	*P. contorta*	23
	Compostela Valley	Mawab	Sta. Ana	*A. mangium*	13
	Davao del Norte	Davao City	New Loon, Mintal	*S. macrophylla*	23
	Davao del Norte	Davao City	New Loon, Mintal	*Tectona grandis*	28
	Davao del Norte	Davao City	New Loon, Mintal	*P. indicus*	23
	Davao del Norte	Davao City	New Loon, Mintal	*P. Contorta*	47
R-13	Surigao del Sur	Bislig City	PICOP Resources/ Maharlika	*P. falcataria*	28
	Surigao del Sur	Bislig City	PICOP Resources/ Maharlika	*E. deglupta*	17
	Surigao del Sur	Bislig City	PICOP Resources/ Maharlika	*P. contorta*	10
	Agusan del Sur	Butuan City	Mandakpan	*P. falcataria*	30

Reference: Development and Management of Forest Plantations in the Philippines: A guidebook. ERDB-DENR. 2010

Appendix Table 8. Policy issuances related to forest genetic resources conservation and sustainable use promulgated by the Philippine government

Policy	Nature of Policy
DENR Administrative Order (DAO) No. 2011-10	Declaring Cabusao Wetland Area Situated in Barangays Pandan and Biong in the Municipality of Cabusao, Camarines Sur as Critical Habitat pursuant to Section 25 of Republic Act No. 9147, otherwise known as the "Wildlife Resources Conservation and Protection Act", Rules 25.1-25.5 of Joint DENR-DA-PCSD Administrative Order No. 01, Series of 2004; and DENR Memorandum Circular No. 2 Series of 2007 "Guidelines on the Establishment and Management of Critical Habitat", and in order to protect the habitat and population of the endemic and threatened *Anas luzonica* (Philippine duck) along with other species of wild fauna and flora, Cabusao Wetland Area situated in Barangays Pandan and Biong in the Municipality of Cabusao, Camarines Sur is hereby declared as Critical Habitat and shall be known as the "CABUSAO WETLAND CRITICAL HABITAT".
Executive Order (EO) No. 23 February 01, 2011	Declaring a Moratorium on the Cutting and Harvesting of Timber in the Natural and Residual Forests and Creating the Anti-illegal Logging Task Force
Presidential Proclamation (PP) No.2011-139	Declaring Aliwagwag as as protected area under the category of protected landscape and its peripheral areas as buffer zone situated in the municipalities of Boston and Cateel, province of Davao Oriental and in the municipality of Compostela, Province of Compostela Valley and in the municipalities of Boston and Cateel, province of Davao Oriental pursuant to R.A. 7586 (NIPAS ACT of 1992
DENR Administrative Order No. 2010-03	Implementing Rules and Regulations of Republic Act No. 9237 or "The Mount Apo Protected Area (MAPA) Act of 2003" Pursuant to Section 28 of Republic Act No. 9237, otherwise known as the Mount Apo Protected Area Act of 2003, this Administrative Order setting forth the rules and regulations governing the implementation of the Act is hereby promulgated
DENR Administrative Order No. 2010-04	Implementing Rules and Regulations of Republic Act No. 9154 Pursuant to Section 23 of Republic Act No. 9154, otherwise known as the Mount Kanlaon Natural Park Act of 2001, this Administrative Order sets the rules and regulations governing the implementation of RA
DAO 2010-11	Revised Regulations Governing Forest Tree Seed and Seedling Production, Collection and Disposition
DAO 2010-16	Establishing the "Adopt-A-Wildlife Species Program" and Providing the Guidelines Governing the Implementation Thereof" Pursuant to the provisions of R. A. No. 9147, otherwise known as the Wildlife Resources Conservation and Protection Act, particularly on its avowed policy to conserve and protect wildlife species and their habitats to promote ecological balance and enhance biological diversity, and in order to provide additional avenues for the Local Government Units (LGUs), the private sector, Non-Government Organizations (NGOs), Peoples' Organizations (POs), civil society groups and other interested individuals to participate in the government's campaign to conserve biodiversity and prevent species extinction

DAO 2010-20	Revising the Technical Description of the Boundaries of Central Cebu Protected Landscape (CCPL) and Designating its Buffer Zones pursuant to Section 4 of RA No 9486 otherwise known as the Central Cebu Protected Landscape Act of 2007 and Section 10(d) of RA 7586 or the National Integrated Protected Areas System Act of 1992 and its Revised Implementing Rules and Regulations, and in line with Resolution No. 2010-05-01 of the CCPL Management Board, the following is hereby promulgated and adopted to set the final limits of the CCPL
DAO No. 2009-01	Guidelines in Establishing the Wild Fauna Marking and Identification System Pursuant to the objectives of Republic Act 9147, otherwise known as the Wildlife Resources Conservation and Protection Act of 2001, and its Joint DENR-DA-PCSD Administrative Order No. 01, the Implementing Rules and Regulations of RA 9147, and in compliance to Article VI of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), a wild fauna marking and identification system is hereby established
DAO No. 2009-09	Standard Design and Specification of Signs, Buildings, Facilities and Other Infrastructure That May Be Installed and/or Constructed Within Protected Areas Pursuant to Section 10 (l) and (m) of Republic Act No. 7586, otherwise known as the NIPAS Act of 1992 and its Implementing Rules and Regulations, and Executive Order No. 111, "Establishing the Guidelines for Ecotourism Development in the Philippines," and all other laws/decrees, and to provide guidelines on the design and specification of signs, buildings, facilities
PP No. 2009-1815	Designating Mt. Mantalingahan Mountain Range as Protected Landscape Area Upon recommendation of the Secretary of the Department of Environment and Natural Resources (DENR) and the Palawan Council for Sustainable Development (PCSD) hereby set aside and designate Mt. Mantalingahan Mountain Range situated in the Municipalities of Bataraza, Brooke's Point, Sofronio Española, Quezon and Rizal, all in the Province of Palawan as "Protected Area under NIPAS and shall be known as Mt. Mantalingahan Protected Landscape, subject to prior rights and without prejudice to the rights of indigenous peoples as provided for in RA 8371, DENR Administrative Order No. 93-02 and other related rules and regulations
DAO 2008-08	Guidelines on Self-Regulation of the Floriculture Industry for the Sustainable Management of Philippine Wild Flora Pursuant to Republic Act No. 9147, otherwise known as the "Wildlife Resources Conservation and Protection Act", its implementing rules and regulations, the Philippine Plant Conservation Strategy and Action Plan, and the Philippine commitments under the Convention on Biological Diversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), promulgated to encourage and support the floriculture industry to adopt self-regulation for the conservation and sustainable utilization of the Philippine wild flora.

DAO 2008-17	Amending Section 10 of DAO No. 25 Series of 1992 and Providing Criteria in the Identification and Procedures in the Delineation and/or Demarcation of Management Zones within Protected Areas Pursuant to Republic Act No. 7586 otherwise known as the National Integrated Protected Areas System Act (NIPAS Act) and its Implementing Rules and Regulations, and to rationalize the designation of management zones within protected areas, Section 10 of DAO 25, series of 1992
DAO 2008-18	Amending Section 8 of DENR Administrative Order No. 200445 - In order to further streamline the procedure for the issuance of Wild-life export/import-export clearance for non-CITES species, second sentence of paragraph 2, Section 8. 'Exportation and Importation of Wildlife" of DENR Administrative Order (DAO) No. 2004-55
DAO 2008-21	Amending DENR Administrative Order No. 2002-08 "Strengthening the Coastal Environment Program (CEP) through the Establishment of the Coastal and Marine Management Office (CMMO) - Pursuant to Executive Order No. 192 and consistent with the Integrated Coastal Management Strategy provided under Executive Order No. 533, the coastal and marine management functions of the CMMO pursuant to DENR A0 2002-08 are hereby transferred to the Protected Areas and Wildlife Bureau (PAWB)
DAO 2008-24	Guidelines for the Assessment and Delineation of Boundaries Between Forestlands, National Parks and Agricultural Lands - Pursuant to the provisions of Section 4, Article XII of the 1987 Philippine Constitution, Executive Order No. 192, Republic Act No. 3092, Republic Act No. 7586 and Presidential Decree No. 705, as amended, Executive Order No. 318, DENR Administrative Order No. 2000-24 and other pertinent laws, rules and regulations
DAO 2008-26	Revised Implementing Rules and Regulations of RA No. 7586 or the NIPAS Act of 1992 - Pursuant to Section 10(d) of the NIPAS Act and consistent with the Wildlife Resources Conservation and Protection Act (R.A. No. 9147), Caves and Cave Resources Management and Protection Act (R.A. No. 9072), Philippine Mining Act of 1995 (R.A. No. 7942), and other laws establishing the specific components of the NIPAS, DENR Administrative Order 25, Series of 1992 which is the Implementing Rules and Regulations of the NIPAS Act
DAO 2007-01	Establishing the National List of Threatened Philippine Plants and their Categories, and the List of Other Wildlife Species - Pursuant to Section 22 of Republic Act No. 9147, otherwise known as the "Wildlife Resources Conservation and Protection Act", the National List of Threatened Philippine Plants and their categories
DAO 2007-17	Rules and Regulations Governing Special Uses Within Protected Areas - Pursuant to RA 7586 otherwise known as the National Integrated Protected Areas System (NIPAS) Act of 1992 and its Implementing Rules and Regulations

DAO 2007-24	Amending DAO 2007-01, "Establishing the National List of Threatened Philippine Plants and their Categories, and the List of Other Wildlife Species" - In order to ensure effective implementation of the provisions of DAO 2007-0 1
DAO 2007-34	Guidelines on Treasure Hunting in Caves Pursuant to Section 14 of the National Caves and Cave Resources Management and Protection Act (Republic Act No. 90723 and Sections 12, 13, 14 and 15 of its Implementing Rules and Regulations
DMC 2007-02	Guidelines on the Establishment and Management of Critical Habitat - Pursuant to Sections 4 and 25 of Republic Act No. 9147, otherwise known as the "Wildlife Resources Conservation and Protection Act", Rules 25.1-25.5 of Joint DENR DA-PCSD Administrative Order No. 01, Series of 2004, and Executive Order No. 578 of 2006
DMC 2007-04	Procedure in Cave Classification - Pursuant to Republic Act No. 9072, otherwise known as the National Caves and Cave Resources Management and Protection Act of 2001, and Sections 10, 12 and 13 of its lmplementing Rules and Regulations, (DAO 2003-29), a Manual on Cave Classification is prescribed and adopted for all caves within public domain and private lands, including those found within protected areas for the guidance of all concerned
Republic Act (RA) No. 9486	Central Cebu Protected Landscape Act of 2007 An act establishing Buhisan Watershed Forest Reserve, the Mananga Watershed Forest Reserve, the Sudlon National Park, the Central Cebu National Park and the Kotkot Lusaran Watershed Forest Reserve into one protected area to be known as the Central Cebu Protected Landscape and for other purposes
EO 2006-533	Adopting Integrated Coastal Management as a National Strategy to Ensure the Sustainable Development of the Country's Coastal and Marine Environment and Resources and Establishing Supporting Mechanisms for its Implementation
EO 2006-578	Establishing the National Policy on Biological Diversity, Prescribing its Implementation Throughout the Country, Particularly in the Sulu Sulawesi Marine Ecosystem and the Verde Island Passage Marine Corridor
RA No. 9494	Mimbilisan Protected Landscape Act - An act declaring the Mimbilisan Watershed as a protected area under the category of protected landscape, providing for its management and for other purposes
DAO 2005-21	Revised Guidelines on the Establishment and Management of Integrated Protected Areas Fund (IPAF) - Pursuant to Section 10 of RA 7586 otherwise known as the National Integrated Protected Areas System (NIPAS) Act of 1992 and its Implementing Rules and Regulations and in order to provide flexibility in accessing the IPAF
DAO 2005-24	Guidelines on the Grant of Coastal Area Special Use Agreement - Pursuant to Executive Order No. 192 and pertinent provision of Republic Act No. 9 147(Wildlife Resources Act)

Joint DENR-DA-PCSD-NCIP AO No. 2005-01	Guidelines for Bioprospecting Activities in the Philippines 10/20/2009 Pursuant to the obligations of the Philippines under the Convention on Biological Diversity and other relevant international agreements, the provisions of Executive Order No. 247 (1995) as amended by Section 14 of the Wildlife Act (Republic Act No. 9147) and Section 35 of IPRA (Republic Act No. 8371), in relation to the NIPAS Act (Republic Act No.7586), the Local Government Code (Republic Act No. 7160), the SEP for Palawan Act (Republic Act No. 7611), the Fisheries Code (Republic Act No. 8550), the Seed Industry Development Act (Republic Act No. 7308), the Traditional and Alternative Medicine Act (Republic Act No. 8423) and other relevant laws
DAO 2004-01	Implementing Rules and Regulations (IRR) Pursuant to Republic Act No. 9147 otherwise known as the Wildlife Resources Conservation and Protection Act of 2001.
DAO No. 2004-15	Establishing the List of Terrestrial Threatened Species and Other Wildlife Species - Pursuant to Sections 5 22 of Republic Act No. 9147 otherwise known as the "Wildlife Conservation and Protection Act
DAO No. 2004-17	Determining and Delineating the Actual Metes and Bounds of the Samar 10/05/2009 Specifying the Guidelines and Reference Points In Determining and Delineating the Actual Metes and Bounds of the Samar Island Natural Park (SINP), as established under Presidential Proclamation 442 date d August 13,2003
DAO No. 2004-32	Revised Guidelines on the Establishment and Management of Community-Based Program in Protected Areas - Pursuant to Republic Act No. 7586 (National Integrated Protected Areas System (NIPAS) Act of 1992), DENR Administrative Order No. 25, Series of 1992 (Implementing Rules and Regulations of NIPAS Act) and Executive Order No. 263 (Adopting Community-Based Forest Management as the National Strategy to Ensure the Sustainable Development of the Country's Forestlands Resources and Providing Mechanisms for its Implementation), and to facilitate the implementation of the Community Based Program (CBP) in Protected Areas, DAO 2002-02 (Guidelines on the Establishment and Management of Community-Based Program in Protected Areas) is revised
DAO No. 2004-55	DENR Streamlining/Procedural Guidelines Pursuant to RA 9147 ; Pursuant to the provisions of the Joint DENR-DA-PCSD Administrative Order No. 01 Series of 2004
DAO No. 2004-62	Prescribing Fees and Other Guidelines on the Implementation of DENR A. O. Nos. 2004-55 and 2004-58
DAO No. 2004-65	Waiving Certain Provisions of DENR Administrative Order (DAO) No. 2004-62 - Promulgated to give zoo owners, hobbyist, pet owners and private wildlife collectors the opportunity to have their wildlife stock and facilities registered with the DENR, the corresponding fees for the registration of threatened, non-threatend and exotic faunal species, as provided for under Section 3 of the DAO 2004-62

DENR Memorandum Circular (DMC) 2004-06	Guidelines in the Integration of Rainforestation Farming Strategy Pursuant to the provisions of Executive Order No. 192 and in line with our commitment to the UN Convention on Biological Diversity, the Framework Convention on Climate Change, the UN Convention to Combat Desertification and the United Nations Forum on Forests, and to the principle of Sustainable Forest Management, the following guidelines for the integration of rainforestation farming strategy in the development of open areas and denuded forests to promote biodiversity conservation and sustainable development in protected areas and other appropriate forest lands
DMC 2004-09	Amending DMC 35, Series of 1993 - Pursuant to Republic Act No. 7586 or the NIPAS Act and in order to provide a more appropriate criteria that will suit the present biophysical and socio-economic conditions of protected areas in the country, the criteria and guidelines for the categorization of protected areas under NIPAS as provided under Annex A of DMC35 Series of 1993 is hereby amended
DAO No. 2003-29	Implementing Rules and Regulations of the Republic Act No. 9072 Pursuant to Section 11 of Republic Act No. 9072 otherwise known as the "National Caves and Cave Resources Management and Protection Act", this Administrative Order setting forth the rules and regulations governing the implementation of this Act
DMC 2003-01	Harmonization IPRA and ENR Laws and Policies - issued in order to address the issues affecting the rights of the Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs)in relation to the implementation of the IPRA and ENR laws and policies
PP 2003-426	Amending Proclamation No. 2152 Which Declared Parts of the Country as Mangrove Swamp Forest Reserves; by segregating there from certain portions of the Island of Panglao, Province of Bohol and reserving the same as a protected area pursuant to Republic Act No.7586 (NIPAS Act of 1992) to be known as Panglao Island Protected Seascape, under the administration of the Department of Environment and Natural Resources, subject to valid private rights, if any there be, and actual ground survey.
PP 2003-441	Central Cebu Protected Landscape - set aside, declare and consolidate the aforecited five reservations into one protected area, located in the Cities of Cebu, Talisay, Toledo and Danao and in the Municipalities of Minglanilla, Consolacion, Liloan, Compostela and Balamban, Province of Cebu, as Protected Area under the category as Protected Landscape, subject to private rights and without prejudice to the rights of the Indigenous People as provided for in R.A. 8371, DENR Administrative Order No. 93-46902 and other rules and regulations if any
PP 2003-442	Declaring the Samar Island Forest Reserve as a Protected Area and its Peripheral Area as a Buffer Zone

PP 2003-484	Amending Proclamation No. 416 and Re-naming as the "Peñablanca Protected Landscape and Seascape" - amends ProclamationNo.416 dated 29 June 1994 which established the "Peñablanca Protected Landscape" by expanding its coverage to include certain parcels of lands of the public domain situated in the Municipality of Peñablanca, Province of Cagayan, embracing the forest, agricultural, caves and coastal ecosystems therein. and renaming the same as "Peñablanca Protected Landscape and Seascape", subject to existing recognized, and valid private rights and without prejudice to the rights of the indigenous people as provided for in RA 8371, DENR Administrative Order No. 93-02, and other relevant rules and regulations
RA No. 9237	Mount Apo Protected Area Act of 2003 - act establishing Mount Apo as a protected area under the category of natural park and its peripheral areas as buffer zones, providing for its management, and for other purposes
DAO 2002-31	Amending DENR Administrative Order No. 2000-83 - Pursuant to the Department's thrust on the sustainable development of our natural resources and to generate revenues from the operation of the existing establishments in the form of fees and charges, DENR Administrative Order No. 2000-83 "Guidelines for the Management and Development of Small Islands, Including its Coastal Areas" is amended
DAO No. 2002-02	Establishment and Management of Community-Based Program in Protected Areas - Pursuant to Republic Act No. 7586, otherwise known as the National Integrated Protected Areas Act (NIPAS Act) as implemented by DAO No. 25 series 1992, requiring a management planning strategy of protected areas and providing protection to qualified tenured migrant communities and interested indigenous people; and, EO No. 263 entitled "Adopting Community-Based Forest Management as the National Strategy to Ensure the Sustainable Development of the Country's Forestlands Resources and Providing Mechanisms for its Implementation," this Administrative Order is promulgated
DAO No. 2001-02	Amending Relevant Provisions of DAO 2000-68 - issued to effectively implement the coastal and marine environment and biodiversity conservation programs and projects of the Department of Environment and Natural Resources (DENR) the relevant provisions of the aforementioned Department Orders are hereby amended and other related programs/ projects and activities, be placed within the Protected Areas and Wildlife Bureau
DMO 2001-06	Adoption of Prescribed Methods in Monitoring Biodiversity - All concerned Offices, officials, and personnel are directed to adopt the methods prescribed in the attached Biodiversity Monitoring System Manual in monitoring biodiversity in terrestrial and wetlands (freshwater and marine). The Manual was jointly prepared by Protected Areas and Wildlife Bureau and the WB-Technical Assistance for Improving Biodiversity Conservation in Protected Areas of the Philippines Project through NORDECO.

DMC 2001-11	Status of Biodiversity Monitoring System (BMS) Implementation and Results - prescribed the standard format which shall be used by PAWB and the Regional Offices, specifically PAWD, in the quarterly monitoring and evaluation of BMS implementation and results. The Regional Offices shall submit the accomplished forms to PAWB
RA No. 9125	Northern Sierra Madre Natural Park (NSMNP) Act of 2001 - An act establishing the northern sierra madre mountain range within the province of isabela as a protected area and its peripheral areas as buffer zones providing for its management and for other purposes
RA No. 9154	Mt. Kanlaon Natural Park Act of 2001 - An act establishing Mt. Kanlaon as a protected area and a peripheral area as a buffer zone providing for its management, and for other purposes
DAO 2000-13	Guidelines on the Implementation of the Biodiversity Monitoring System (BMS) in Protected Areas - promulgated pursuant to Republic Act No. 7586 (NIPAS Act) and its Implementing Rules and Regulations, in line with the Philippine commitment to the Convention on Biological Diversity, and in order to provide up-to-date and comparable information on resources as basis for the management of protected areas
DAO 2000-44	Provisions of DAO 96-29 and Guidelines for Community-Based Projects Within Protected Areas - issued pursuant to the action agenda of consolidating all forestry programs into an over-arching Sustainable Forest Management Program, DAO 96-29, the Rules and Regulations for the implementation of Executive Order No. 263, otherwise known as the Community-Based Forest Management Strategy, is hereby amended to align it with the provisions of Republic Act 7586, otherwise known as the National Integrated Protected Areas Systems (NIPAS) Act of 1192, and specifically to provide the following guidelines on the establishment and management of Community-Based Projects (CBP) within protected areas
DAO 2000-51	Determining Fees for Access to and Sustainable Use of Resources in Protected Area - promulgated pursuant to the, provisions of Republic Act 7586 otherwise known as the National Integrated Protected Areas System (NIPAS). Act of 1992 and its Implementing Rules and Regulations, and in order to provide guidelines and principles in accessing and sustainably using resources in protected areas
DAO 2000-89	Amending Sections 7, 8.2 and 9 of DAO No. 97-36, Series of 1997 Pursuant to Section 4 of E.O. 192, Series of 1987 of which the DENR is mandated to provide nature conservation awareness for the protection of the natural resources and in order to further strengthen the Dalaw-Turo capability, Sections 7,8.2 and 9 of DAO 97-36 dated December 15, 1997 is amended
RA No. 8978	Mt. Katinglad Range Protected Area Act of 2000 - An act declaring that Mt. Kitanglad Range in the province of Bukidnon as a protected area and its peripheral areas as buffer zones, providing for its management and for other purposes

RA No. 8991	Batanes Protected Area Act of 2000 - An act to establish the Batanes Group of Islands and Islets as a protected area, and its peripheral waters as buffer zones, providing for its management and for other purposes
RA No. 9106	Sagay Marine Reserve Law - An act for the establishment and management of sagay marine reserve, defining its scope coverage, and for other purposes

Appendix Table 9. Wildfood plants in the Philippines forest

Wildfood Plant Species	Scientific Name	Specific Food Value
1. Lubigan	*Acorus calamus L.*	Powdered rhizomes used as condiments
2. Biga	*Alocasia macrorrhiza* (L.)	Stems and corms are eaten after roasting or boiling. Heating helps in destroying the harmful substance raphides.
3. Langkauas	*Alpinia pyramidata* Blanco	The rhizome is used as a condiment. Its flavor is similar to ginger, but much less pungent. It is also cooked with the sap of sugar cane or with honey and water produce an antitoxicating beverage. The young rhizome and tender underdeveloped shoots are eaten, as are also the flower and flowers buds.
4. Kulitis	*Amaranthus tricolor*	Young leaves and stems are boiled and eaten as vegetables. It is also used as a substitute for spinach.
5. Pongapong	*Amorphophallus campanulatus* (Roxb) Bl. ex Decne	The petioles of young, unexpanded leaves are edible, when thoroughly cooked. When food is scarce, the corm is sometimes eaten. The leaves and corms are common feed for hogs.
6. Bignai	*Antidesma bunius* (L.) Spreng	The fruits are seldom utilized in the Philippines and are left to be eaten by birds. However, they may be eaten out of the hand or made into an excellent wine and refreshing drink. They are also sometimes used in the preparation of various dishes as a substitute for tomato as vinegar. Leaves are eaten with rice when young.

7. Aunasin	*Ardisia pyramidalis* (Cav.) Pers.	The young leaf tips are used as greens, or cooked with meat or fish and eaten as vegetable. The flowers and fruits are cooked as flavoring for fish, as salad, the young leaves are blanched, then mixed with onions, tomatoes, garlic and salt. The young leaves are eaten by deer and the fruits by monkeys, wild pigs and birds.
8. Kaliso	*Areca caliso* Becc.	Bud is cooked and eaten as vegetables. Sap for inferior beverage. Fruits substitute for betel nut.
9. Kaong	*Arenga pinnata* (Wurmb) Merr.	Kaong seeds are edible. The fleshy kernels of the right stage of endosperm are coked and eaten or made into sweets. The buds are eaten raw as an excellent salad or cooked as vegetables. The sweet sap is used in the production of sugar starch, vinegar and "tuba" (a native drink).
10. Gumayaka	*Arenga tremula*	Peduncles tapped for sap known as "tuba". Buds eaten in large quantities cause profound sleep.
11. Zamboangita	*Asystasia gangetica*	Leaves and flowers are pot herbs, adjunct to fish and meat stew.
12. Api-api	*Avicennia officinalis*	The fruits or leaves are eaten raw or cooked.
13. Kawayan tinik	*Bambusa blumeana* Schultes	The young shoots are fairly tender are used for food. Bamboo shoots or *labong* are source of calcium and iron. It can also be cooked into *dinengdeng* together with *saluyot* or jute.
14. Botong	*Barringtonia asiatica* (L.) Kurz	The young shoots of this plant are eaten fresh. It is however slightly astringent.
15. Alibangbang parang	*Bauhinia malabarica* Roxb.	The leaves of this species are sour, and are used considerably by the Filipinos for flavoring meats and fish. Young leaves are eaten raw as a side dish to rice or cook with soups and stews.
16. Puriket	*Bidens pilosa*	Seeds are used in making Igorot wine called "sinitsit". In the Mt. Province it is considered as vegetable.

17. Tuai	*Bischofia javanica* Blume.	The young soft leaves are cooked and eaten as vegetables.
18. Busaing	*Bruguiera gymnorrhiza* (L.) Lam.	Fruits boiled in water twice, the whole fruit, the second with its outer covering removed and eaten. Hypocotyl of germinating seed is edible.
19. Himbabao	*Allaenthus luzonicus* (Blanco) F. Vill	The young leaves and male inflorescence of Himbabao are cooked and eaten as vegetable. It could be cooked solely or in mixture with other vegetables such as eggplant, bitter melon, cabbage, sweet potatoes, etc., and seasoned with fish and tomatoes. Flowers are blanched and make a good salad. Alukon flowers can be mixed with moist and vegetable recipes. It tastes best when used in nilagang baboy, manok or baka, pinakbet and stir-fries with either meat or fish.
20. Limuran	*Calamus ornatus*	This palm species is a source of raw materials for the manufacture of furniture, basketry, fishtrap, hats, fans, and hats.
21. Pugahan	*Caryota cumingii* Lodd.	The seed of this species is used as a substitute for chewing. The sap is a source of "tuba" or palm wine. The bud is collected and used as vegetable. It is cooked with coconut milk or sometimes sauted with fish and meat.
22. Takip-kuhol	*Centella asiatica*	Eaten whole, raw or steamed, as salad, for stew or potherb and soup. Widely used as food because of high vitamin and mineral content in addition to carbohydrates and proteins.
23. San Francisco	*Codiaeum variegatum*	Young leaves are blanched for salad. It has a nutty flavor especially the yellow ones.
24. Adlai/Tigbi	*Coix lacryma-jobi*	The hulled grain analyses about the same as wheat but with a somewhat higher face content. It may be eaten like rice, and cracked as oatmeal. The flour mixed with one-third to one half wheat flour makes good bread, biscuits and hotcakes. It is considered as reserves for food in times of scarcity.
25. Alikbangon	*Commelina bengha-lensis*	Young leaves are cooked and eaten as vegetables.

26. Saluyot	*Corchorus olitorius*	Cooked into *dinendeng, pakbet* or *adobo*. In Bengal it is very common to add a few leaves of the plant to the daily diet with rice, as it is considered to be tonic. Slaves from India made much use of it as vegetable. When cooked they are very mucilaginous and slimy. The flavor is very good.
27. Buri	*Corypha elata* Roxb.	Starch is obtained from the trunk like sago palm, sugar, syrup, vinegar and wine from the sap of the tender inflorescence, and excellent preserves are made from the immature seeds boiled in sugar.
28. Pitogo	*Cycas circinalis* L.	Young rolled leaves are cooked and eaten as a vegetable. Ripe seeds are crushed and soaked in several changes of water to remove the poisonous substance and died flour-like product is cooked into small cakes or as porridge.
29. Katmon	*Dillenia philippinensis* Rolfe.	The fruit is rounded and contains soft, fleshy, green pulp, with a flavor resembling that of the apple. It used for flavouring fish and it makes an excellent sauce or jam. It can also be eaten raw.
30. Balubo/Balobo	*Diplodiscus paniculatus* Turcz.	The seeds are starchy and eaten boiled like lima beans.
31. Paco	*Diplazium esculentum*	The young fronds are much desired and are eaten in all parts of the Islands, either raw or cooked. They are used as leafy vegetable or as an ingredient of stew or even pickled. Young fiddle heads are eaten as salad.
32. Apulid	*Eleocharis dulcis*	The tuber of this species are dark-colored, 2 to 3 cm in diameter and are boiled and eaten as a vegetable.
33. Tibig	*Ficus nota* (Blanco) Merr.	The young leaves are cooked as vegetables and the fruits are eaten raw when ripe. The sap of the freshly cut stems also yields drinkable water. The fresh of the cyconium fruits are used for ice cream flavour.
34. Balete	*Ficus balete* Merr.	The young folded leaves are cooked as vegetables. Seeds are roasted and used as substitute for coffee.
35. Pakiling	*Ficus ororata* (Blanco) Merr.	The fleshy portion of the fruit and seed are eaten raw.

36. Niog-niogan	*Ficus pseudopalma* Blanco	Young leaves are cooked and eaten as vegetable with coconut milk, meat or fish.
37. Bitongol	*Flacourtia rukam* Zoll. & Mor. (Flac.)	Bitongol is eaten off-head when fully ripe. It also make a good jam, pies and preserve and is popular in making pickle.
38. Kakawate	*Gliricidia sepium* (Jacq.)	Leaves used as adjunct to Filipino dish, adobo.
39. Bago	*Gnetum gnemon* L.	Young leaves, flowers and fruits are cooked with sea foods, an excellent side-dish. Ripe fruits are roasted and while hot, pounded into thin round cakes. These are cooked in boiling oil where they puff into a porous, crisp cake called " Krupuk".
40. Gumamela	*Hibiscus rosa-sinensis*	Pickles from the petals of the flowers and torta. Flower buds and leaves for salad, omelet and potherb.
41. Roselle/Red sorrel	*Hibiscus sabdariffa*	Young leaves may be used as substitute for spinach, or may be cooked with fish for meat in making *sinigang*. The calyx which is thick, fleshy and sour makes excellent jelly. The unripe fruit is adapted for pickles and a refreshing beverage is made from it. Roselle is used for making tarts, jellies, wine and a variety of other products.
42. Anahau	*Livistona rotundifolia* (Lam.) Mart.	The soft endosperm of this species is eaten raw or is made into preserves. The buds are cooked and eaten as vegetables with coconut milk.
43. Binunga	*Macaranga tanarius* (L.) Muell-Arg.	The bark, leaves and fruit are used in fermenting drink known as "basi". The fruit is sometimes used for the same purpose.
44. Gabing-uak, upi-upi	*Monochoria vaginalis*	Tubers are eaten in the mountain of Luzon. In Malaysia the leaves are eaten raw or cooked.
45. Bangkoro	*Morinda citrifolia*	The fruit of this plant is eaten raw young leaves may leaves may serve as vegetable.
46. Pulau/Lauas	*Nymphaea nouchaii*	Seeds are eaten raw, petiole and corm cooked and eaten as a vegetable salad with various dressing, or as ingredients of stews.
47. Nipa	*Nypha fruticans*	The flesh of the young nuts makes good desserts or may be eaten raw. Sap is a source of vinegar and sugar. Heat cabbage (bud).

48. Beach pandan, screw pine	*Pandanus tectorius* Soland.	Fleshy portion of lower part of mature fruit eaten raw.
49. Pansit-pansitan	*Peperomia pellucida*	Eaten as green salad
50. Iba	*Phyllanthus acida*	The fruit is about as large as a small grape, ribbed, pale green. Excellent for jelly and varying preserves and makes a good "ade".
51. Maluko/kolis	*Pisonia grandis*	The tender leaves make good greens, boiled, eaten with meat, butter and vinegar, when they resemble spinach, sometimes cooked with coconut milk.
52. Kiapo or Quiapo	*Pistia stratiotes* L.	Young leaves are eaten as vegetables. It is boiled to destroy the stinging crystals or raphides which are very abundant in the leaves. This is a famine food in India, while the Chinese eat the young leaves cooked.
53. Hanapol	*Poikilospermum suaveolens*	Freshly cut stem exude water for drinking and cooking.
54. Golasiman, olasiman	*Portulaca oleracea*	Young leaves and stems are used as adjuncts to stews, meat and fish sinigang. It can be eaten as salad. The fatty or slimy quality of purslane is sometimes objectionable, but by chopping the cooked tip and then baking with bread crumbs and beaten egg, their disagreeable quality is entirely disguised.
55. Alagau	*Premna odorata* Blanco	Young leaves mixed with "hito", a fresh water fish, when cooked with coconut milk.
56. Tangolon	*Quisqualis indica*	The tender shoots are cooked and eaten.
57. Sundang hari	*Rhoeo spathacea*	Young leaves potherb
58. Bakauan-babae	*Rhizophora mucronata* Lam.	Young leaves for potherb. Bark is used for flovouring of local wine "tuba".
59. Atibulnak	*Rubus pectinelllus*	The fleshy pulp of the riped fruit is eaten raw by man, birds and deers.
60. Bikal	*Schizostachyum diffusum*	Freshly cut stems gives water for drinking
61. Malabulak	*Salmalia malabarica* Schott & Endl.	Buds, young pods and roots of seedlings are cooked and eaten.

62. Balatong aso, mongo-mongohan, andasasi	*Senna tora*	Young leaves for potherb and roasted seeds for coffee substitute.
63. Katuray	*Sesbania grandiflora* (L.) Pers.	The flowers and pods can be eaten raw or cooked in steam and prepared as an excellent salad.
64. Dampalit	*Sesuvium portulacastrum*	The stems and leaves when boiled are eaten as a vegetable. It is mixed with fish or meat. The leaves give a sour flavouring in the mixture. It could also be blanched and served as a salad dish with sliced tomatoes and fish sauce or salt.
65. Talong-talongan, tarumbulo	*Solanum cuminggi* Dun.	The unripe fruits are cooked with either fish or meat and eaten as vegetable. No analysis has been made so far on the constituents of its edible parts.
66. Kunti	*Solanum nigrum*	The riped fruits are picked and eaten raw. It is also prepared into jams and pies in the rural areas. The leaves and young shoots are cooked and eaten as vegetables like spinach.
67. Pagatpat	*Sonneratia alba* J. Sm.	The fruit is used for food and also for making vinegar.
68. Pedada	*Sonneratia caseolaris* (L.) Engl.	The fruits are cooked and eaten and are also a source of vinegar.
69. Malunggay-hapon	*Souropus androgynus*	Leaves for stew or salad.
70. Kandi-kandilaan	*Stachytarfetta jamaicensis*	Leaves are for stew or omelette. The dried leaves are made to Brazilian tea.
71. Tuhod-manok	*Synedrella nodiflora*	Young shoots are eaten raw as salad or cooked.
72. Kalubkob	*Syzygium calubcob* (C.B. Rob) Merr.	The fruit when ripe is delicious and are eaten raw.
73. Lipote	*Syzygium polycephaloides* (C.B. Rob) Merr.	The edible part of this species is the fleshy portion of the fruit which is eaten raw. Fruits are mixed with wine for flavouring *lambanog* in Quezon.

74. Yabyaban	*Maranta arundinaceae*	Corm and rhizomes are baked. Starch should be washed several times to eliminate bitter substance in the corm. Tacca flour or starch formed an agreeable food when eaten with sugar. And that mixed with white wine flour it is used in making bread. In preparing the flour, rub the tubers under water with rough stone, allow the starch to settle, pour out the water, and then dry the product.
75. Talinum	*Talinum triangulare*	Young leaves or stems are used as adjuncts to stews, meat and fish sinigang. It can be eaten as salad.
76. Kalumpit	*Terminalia microcarpa* Decne.	The fruit is eaten raw when ripe (violet-black color) and because of its fleshy and acidic characteristics, they are good for preserves. The ripe fruit are boiled and cooked with sugar, oftentimes fruits are sun-dried for longer storage. They can also be dehydrated or made into wine.
77. Toston	*Trianthema portulcastrum*	The plant is eaten as a leafy vegetable.
78. Gabi-gabihan, gabing nuno	*Typhonium trilobatum*	Rootstocks boiled, are eaten alone or with stems.
79. Hilagok, susong kalabau	*Uvaria rufa*	Fruits are eaten raw or cooked as vegetables.
80. Lagundi	*Vitex negundo*	Seeds are boiled and eaten.
81. Ambung	*Arenga ambong* Becc.	Buds are edible and can be eaten as salad.
82. Anahaw	*Livistonia rotundifolia* (Lam.) Mart	Anahaw buds are highly esteemed as a vegetable. Nuts are eaten when young and green. The rind is tasty when ripe.
83. Anibong	*Oncosperma gracilipes*	The young shoot buds (ubud) are edible.
84. Buri	*Corypha elata* Roxb.	Buri buds are eaten cooked or raw as salads. The kernels of the young fruits are processed into sweets. The trunk of the buri tree contains a good quality of starch even during its growing stage. The starch is collected when the tree dies. Buri sap is one of the sources of the fermented drink locally known as "tuba". The fresh sweet sap is a good source of beverage and can be made into a good cidar when fermented. Fermentation takes place within 32 hours after the sap is obtained.

85. Sago	*Metroxylon sagu*	The trunk contains plenty of starch deposits with high food value. A healthy mature tree may have about 6-7m long trunk containing starch. During World War II, sago starch served as a good substitute for rice and corn (staple food) in places where this plant abounds. At present, the starch also serves as substitute doe flour and has high demand in the world market. Sarawak (an island in Borneo) is the chief exporter of sago starch. The pith can also be toasted and eaten although the taste is somewhat bitter. The shoot in some other palms is also edible. Sago palm can be extracted and made into wine, vinegar, or sugar.
86. Takipan	*Caryota rumphiana* Mart.	The young shoot bud (ubod) can be eaten raw or cooked.
87. Niog	*Cocos nucifera* L.	Fruits of coconut are edible and can be preserved as sweets. It yields oil for food and lard.

Appendix Table 10. Forest species used as raw materials for holiday decors, wearables, gifts, and other novelty items.

Common name/ Scientific name Scientific name	Economic importance
FOREST VINES	
Abuhab-baging (*Strophantus caudatus* (L.) Kurz)	The stems are suitable for handicraft production. The species is also employed in traditional medicine, specially as a diuretic.
Bulakan (*Merremia peltata* (L.) Merr.)	Stems are collected for basket and handicraft production. Because of relatively inferior appearance and strength, the stem is utilized as substitute materials whenever the preferred species become scare or unavailable. In traditional medicine the species is employed as a purgative and a remedy of cough, diarrhea and worms. Leaves are used when washing hair and applied as poultices to sore breasts, ulcers and wounds. The leaf extract has antibacterial properties and a positive reaction to alkaloids. A drink from the juice of leaves is reputed to treat hernia. It is considered as one of the most damaging weed species in some industrial forest plantation in Indonesia (Narif Prantini, 1991).
Hinggiw kalabaw (*Streptocaulon baumii* Decne.)	An inherent strength and durability make hinggiw-kalabaw a preferred species in the vinecraft industry. The stems are made into basket and other handicraft products.traditionally, they have been used for tying purposes. However, the supply has significantly dwindled due to over harvesting and uncontrolled exploitation. Although not observed ion a 2002 field study in Tayabas, Quezon, the species may still be available in adjacent areas such as Dolores, Pagbilao and Mauban. In 1992 an estimated 1,117 lineal meters per hectare was recorded in Quezon (Aragones et al. 1992). The latex of hinggiw-kalaban is used as a vulnerary.
Lukmoy (*Rhaphidophora monticola* Krause)	The aerial roots are ideal for weaving into baskets, handicrafts and other novelty items because of their uniform width. Leaf extracts have some traditional medicinal properties.
Malagayaman (*Pothos scandens* L.)	The aerial roots are good materials for making baskets and other handicrafts because of their uniform width. Malayaman is used in Thailand as a blood coagulant for wounds. Fruits and leaves are made into a compress. In Myanmar, the infusion of stems and leaves is drunk as "tea" (Boyce, 2000).
Silong pugo (*Pericampylus glaucus* (Lam) Merr.)	The stems are favorite raw materials for woven handicrafts such as baskets and bags because of their small diameter and uniform width. The species is also used in traditional medicine. The barks and roots are rich in the alkaloids menisidine and menisine and used as narcotic. The leaves are used to cure headache, cough and asthma. The sap is applied as an eye medicine.

Tagolaway *(Parameria laevigata* (A.L.Juss) Moldenke)	The stems are used in basket and handicraft production. The species is used in traditional medicine. It yields good quality rubber although the quantity obtained is not on a commercial scale.
Wood rose (*Merremia tuberose* (L.) Rendle)	In Europe,the woody fruits are used in flower arrangement. In the Philippines, the fruits are collected while still buds, air dried until they open and varnished or painted for flower arrangement and decoration purposes. Wood rose is employed in traditional medicine in Southeast Asia. The tuber is used as a drastic purgative. The roots contain 12-25% resin, which show allelopathic activity on the radicle of *Amaranthus sp.* wheat and oats. No antibacterial activity has been reported, however, against *Bacillus subtilis* and *Escherichia coli.* The species is also planted as an ornamental in Africa.
SEEDS	
Gugo (*Entada phaseoloides* (L.) Merr.)	The bark fibers are strong and durable and converted into rope and raw materials for baskets and handicraft. The large and hard seeds are used for novelty items, while the large pods are made into coin purses. The plant is one of the chief sources of traditional hair wash throughout Southeast Asia. However, when using as hair wash, contact with the eyes should be avoided because the juice is irritating, painful and may even cause conjunctivitis. Gugo is widely employed in traditional medicine as remedial wash for pityriasis, wounds and itch and externally applied as a remedy for filariasis or elephantiasis. It is used to treat many other illnesses and complaints throughout Southeast Asia. Its medicinal use is traced to the presence of saponins in the bark, wood and seeds.
Job`s tears (*Coix lacryma-jobi* L.)	Job`s tears is cultivated as an ornamental plant and more importantly for its beads, which are used in rosaries and jewelry. The soft shelled false fruit are easily husked, while the large kernels are eaten in the same way as rice. Job`s tears can substitute for rice in rice based recipes. Flour is produced from the kernels. The whole grains are fed to poultry. The species is also cultivated as fodder for cattle and horses. It reportedly has medicinal application.
Kansasaga (*Abrus precatorius* L.)	The peculiar beautiful and hard seeds are used for ornaments and handicrafts, particularly as beads in rosaries and necklaces and also in soldering jewelry. The species is widely used in traditional medicine to treat a variety of illnesses and diseases. It has a high reputation in the Ayurvedic, homeopathic, Unani and allopathic system of medicine. Seeds are used to treat conjunctivitis, malaria and dysentery in various parts of the world. The juice extracted from the roots and leaves are used to treat aphtha.

FIBERS	
Abang abang [*Curculigo capitulate* (Lour.) Kuntze]	It has been recently used as accents on basket and other handicraft products. False hair from the leaf fibers has been made by natives of the Camarines Province (Luzon, Philippines). It is used by children in Ifugao province (Luzon, Philippines) for warp in toy looms. The tough and thin leaves are used by natives of northern Thailand for wrapping just like banana leaves. Abang abang fibers are relatively hard in contrast to the cotton fibers and durable in humid, warm climate because they naturally resist fungi. Strong and durable garments have bee made from the fibers by natives of Borneo. The species is widely used in traditional medicine to treat several illnesses. In Peninsular Malaysia, an infusion of the leaves, stem tips and roots is used internally against fever. The flower and root decoction is taken as a cure for stomach aches and as a diuretic. The rhizome decoction is used to treat menorrhagia and applied as lotion against ophthalmia. It is widely employed as an ornamental plant in the Philippines. Indonesia, India, Africa, Europe, and the United States because of its inflorescence that resembles that of ground orchids. The fruit are known to be edible, taste like sweetened cucumber, and increase appetite. They are not extremely sweet by themselves, but leave a very sweet aftertaste. This is most noticeable when a sour substance is consumed after eating the fruits. The sweetness is provided by a protein known as curculin, which is synthesized in the fruits a week after pollination. Curculin`s sweet taste disappears rapidly after about 10 minutes.
Anubing (*Artocarpus ovatus* Blanco)	Bast fibers from the bark matted, dull, strong and durable, pinkish brown to yellowish brown with time, soft and pliable. Acquired after retting the bark for 3-4 weeks, they are beaten well to obtain uniform layered. Sheets or mats suitable for crude clothing or other novelty items. An appropriate volume of strips is twisted together to form tying materials. Latex (also known as anubing gum) from the species is a promising material for chewing gum. The species is suitable for purposes of requiring strength and durability such as house posts, telegraph poles and bridges based on its wood density. The bark decoction is applied against stomach ache.
Mais (*Zea mays* L.)	The modified leaves enclosing the ear (also known as husk) and the cob are made into ladies bags, hats, decors, novelty items and display items. Corn is widely used as a staple food. It is also used as a main raw materials and poultry feeds and in many industrial products.

Patola (*Luffa aegyptiaca* Mill.)	Mature and fibrous fruits are used as display items and for other handicraft products. Patola is a well known vegetable especially in the tropics. The immature fruits, young leaves and flower buds are cooked and used in soups, or sliced and dried for later use. Sweet cultivars are now available. Young fruits are eaten pickled. The plant also yields constituents for traditional medicine and cosmetic purposes especially in China and Japan. The seeds produce edible oil. The mature and ripe fruit are fibrous and very bitter due to the development of purgative substances, rendering them inedible. However, their internal fibrous network makes very good sponges. The sponges are easily extracted by removing the rind and the seeds, before and during World War II. The sponges were commercially important as filters in several kinds of engines because of good shock and sound absorbing properties. They were also used as lining in steel helmets and armored vehicles during the war. At present, they are harnessed as insulating materials (sound, shock and temperature), and as component of potholders, table mats, door and bath mats, insoles, sandals and gloves.
DYE PLANTS	
Achuete (*Bixa orellana* L.)	The red dye obtained from the seeds is widely used for coloring fabrics and for cosmetic purposes. Commonly sold in the local markets. It is often utilized as a food colorant in various parts of the country, particularly in rural areas. It is also used to tint butter and polishes for russet leather. The seeds contain a primary coloring material known as bixin, a carotenoid carboxylic acid and a harmless organic dye. The ethyl ester of bixin is used as a suspension in vegetable oil to color food a golden yellow. The dye obtained is sensitive to light and contains sulphur dioxide, limiting its use in food products and beverages. Although the color fades with light exposure, it is resistant to soap, alkaline and acids. A bark decoction is employed in febrile catarrhs and considered as an efficient remedy for some skin diseases. It has anticancer potential, according to Angeles (1986). The dye from the seeds is reported to purge gently. The leaves are said to be febrifugal. Cordage can be made from the bark fibers. The gum extracted from the bark is similar to gum Arabi. Achuete is also an ornamental tree and is often planted in home gardens and public parks.

Binunga [*Macaranga tanarius* (L.) Muell.-Arg.]	The bark yields a brown dye. The poles are frequently used for temporary construction and especially as parts of native houses not in contact with the ground. In southern Sumatra the poles serve as ladders for pepper growers. The wood is a favorite material for wooden shoes aside from being a good fuel wood. It also yields high quality pulp and may be used for particleboard, cement-bonded board, wood-wool board and plywood production. Binunga is used in traditional medicine in many ways. The powdered roots is an emetic for fevers. The root decoction is administered against haemoptysis. The leaf or root decoction is used in internal medicine. The root bark decoction is drank to treat diarrhea dysentery and fever, to clean wounds or applied after childbirth. The medicinal effects may be due to the tannins obtained from the bark and leaves.
Hagonoy [*Chromolaena odorata* (L.) R.M.King & H. Robinson]	The leaves produce a yellow dye. The species is now considered as a very noxious weed in agriculture and range management. It is used as green manure and mulch crop and has also been employed in traditional medicine. The leaves are reportedly useful in controlling the weevil *Cylus formacarius* and the butterfly *Phtorimae operculella* in sweet potato, the nematode *Heterosera marioni* in black pepper, as well as the nematodes in sugarcane and tomato.
Ipil Ipil [*Leucaena leucoephala* (Lam.) de Wit.]	A dye has been extracted from the seed, pods and bark in Central America. In the Philippines, the brown dye obtained from the bark us used to color fishing nets. The dried pods are made into accents/decoration of polymer resin laminated trays and jewelry boxes. Ipil ipil is a multipurpose tree in Southeast Asia; fuel wood, shade, fodder, green manure, mulch, post, food, and often combination of these products. It is also turned into live fences, fire breaks, shelter belts, live support for vines such as pepper, vanilla, yam and passion fruits, and shade tree for coffee and cacao. The leaves are fed to ruminant animals or mixed with other green fodders. They are milled as a supplement to poultry feeds and the pelletized form is exported. The wood is used as fuel in households and industries such as ceramics; converted into charcoal, and processed into furniture and parquet flooring, chipboard, and plywood and pulp paper. The bole serves as post and prop for other crops like banana. The young shoots including the young leaflets and green seeds are eaten raw, cooked or mixed with other ingredients; substituted for soya beans, or used as additives to coffee after roasting. The species is also tapped in traditional medicine as an anthelmintic especially against ascaris and trichina. In the Philippines, the tree has been used for reforestation, afforestation, soil improvement, shade plant and nurse crop for a wide range of tropical trees and crops.

Kakawate [*Gliricidia sepium* (Jacq.) Kunth.ex Walp.]	The leaves contain a brown dye coumarin. Kakawate is a widely known multipurpose tree. Before, it was mainly harnessed as a shade tree in crop plantations. But is has been integrated in several cropping systems as a shade tree in tea, cocoa, or coffee plantation; as live stake to support black pepper, vanilla and yam, and as soil stabilizer. The wood is used as firewood, charcoal, or sports and farm implements, and locally for furniture, construction and many other, the tree is also planted to stabilize soil prevent erosion and to reclaim denuded lands. Its leaves green stems and bark are used as forage for goats and cattle. The flowers are a source of nectar for bees. It is also employed in traditional medicine as antipuritic, antifungal and antirheumatism.
Kamote [*Ipomoea batatas* (L.) Lamk.]	The leaves and stem yield a purple to reddish dye when boiled in water; kamote is widely cultivated for its edible tuber. The young leaves are used as vegetable; the young shoots are eaten as salad and also used as poultice.
Lantana [*Lantana camara* (L.)]	The leaves yield beige dye. Lantana is also employed in traditional medicine in Southeast Asia to heal cuts, ulcers and swelling and to treat rheumatism. A leaf flower decoction is used to treat constipation, as a febrifuge, diaphoretic and stimulant, and to relieve catarrh and bronchitis. A roots decoction is used to treat toothache, headache, inflammation, gonorrhea and leucorrhoea. Lantana is widely preferred as an ornamental plant in parks and as hedges.
Lipay [*Mucuna pruriens* (L.) DC.]	The leaves are sources of brown to violet dye. The species is also widely used in traditional medicine. The root infusion and ointment are used to cure cholera and elephantiasis, respectively. The root decoction acts as a diuretic, while syrup made from the hair of the pods is an anthelmintic. The plant extract exhibits analgesic and antipyretic effects. (Lauk et al., 1993). Mature seeds contain large amount of globulins and albumins, potassium, phosphorus, and calcium (Siddhuraju et al., 1996). The stems are suitable for handicraft manufacture. Breeding of lipay has been done such that cultivars, as the annual hervaceous vine *M. pruriens cv.* Group utilis is presently utilized as a cover crop and green manure throughout the tropics, as well as subtropical areas. It is one of the most widely used crops for reclaiming weed infested lands.

Luyang dilaw (*Curcuma longa* L.)	The bright yellow inner part of the rhizomes is a source of yellow dye for coloring and flavoring rice. The dye is also used to tint abaca fibers woven into the "tinalak" cloth of the Tibolis, but not as commonly used as the dyes from *Morinda bracteata* and *Piper nigrum.* To collect the rhizomes, the plant is uprooted and the rhizomes cut oof the stems, cleaned, pounded with mortar and boiled water. Abaca fibers are boild in the rhizome solution for several hours until the desired hue is obtained. The Ubo tribe of South Cotabato in Mindanao, Philippines cultivates luyang dilaw in their surroundings. Luyang dilaw is a widely known medicinal plant. The main rhizomes are used as a stomachic, carminative, haematic or styptic, hemorrhage jaundice and other liver troubles. It is also applied to relieve itch, small wounds, insects' bites and many others. It has some insecticidal fungicidal and nematicidal properties making it a potential biocide.
Makahiya (*Mimosa pudica* L.)	The leaves are a source of a light green dye. The entire plant is extensively used as anti asthmatic, while the roots decoction is given as diuretic and also to treat dysmenorrhoea. The plant contains tannins that can be used in leather production. The young stems and leaves can cause poisoning. Makahiya can be used as a green manure, although it is regarded as a noxious weed especially in grazing lands.
Prickly chaff flower (*Achyranthes aspera* L.)	The leaves are source of light green dye suitable for coloring fabrics and other porous materials. The roots, seeds, and whole plant are widely used for medicinal purposes. The leaves are applied to wounds and to mature abscesses and boils. The root decoction is drank for rheumatism, stomach ache, menstruation pains, absence of menstruation or as an abortifacient. The plant sap is taken for dysentery and rheumatism. In Papua New Guinea, the leaves or roots are applied on boils and swollen legs. In Thailand, the roots serve as anti inflammatory and diuretic.
Tayung tayungan (*Indigofera tinctoria* L.)	It is a source of the indigo blue dye through touts in the tropics. It contains glucoside indicant, which is transformed by enzymatic hydrolosis into indoxyl (indigo white) and glucoside after soaking the plant in water. Indoxyl can then be oxidized to indigo blue. Tayung tayungan is also used as cover crop and as green manure, especially in tea, coffee and rubber plantation, the leaves are used in traditional medicine for epilepsy and nervous disorders and to heal sores and ulcers.
Ulasiman (*Portulaca oleracea* L.)	A beige dye is extracted from the leaves. Ulasiman is employed in various ways in traditional medicine. It is also a host to root knot nematodes *Meloidogyne arenaria M.* incognita and *M.incognita var.* acrita, damping off fungus *Rhizoctonia solani,* curly top virus, and white fungus *Albugo portulaceae*. The plant is believed to be among the earliest vegetable. The leaves and tips are cooked as vegetable, and sometimes eaten as green salad.

BAMBOOS	
Buddha`s belly bamboo (*Bambusa vulgaris* Schrad. Ex Wendl. Cv wamin McClure)	The culms are made for handicrafts such as candle holders and pencil holders and also furniture. It is preferred as an ornamental plant and much used for landscaping or cultivated in pots.
Puser [*Cyrtochloa fenixii* (Gamble) S. Dransf.]	It is presently utilized as raw materials (although unknowing by the furniture and handicraft industries) in a variety of products such as decorative hats, mats, fans, baskets and "kaings and bilaos". It also serves as fences and crop trellises.

COMMON NAME/ SCIENTIFIC NAME	ECONOMIC USES
FERNS	
Kabkab [*Drynaria quercifolia* (L.) J.Smith]	Foliage leaves are used in floral arrangement. Species are widely grown as an ornamental plant even as hanging plant. Rhizome decoction used as an astringent and said to be anthelminthic in concentrated form. Pounded leaves are applied to swellings as poultice; diluted juice sprinkled over a patient head to treat fever, also remedy for stomach aches and cough. Alkaloids are found in leaves and rhizomes; saponins and oxalic and formic acids are also found in leaves.
Lagolo *(Acrostichum speciosum* Wild.)	Split or whole stems are used in making Venetian blinds, partition walling and similar items and handicrafts. Rhizome with medicinal properties as vulnerary especially in healing ulcers and as emollient. Powdered rhizomes topically applied to wounds and boils in Malaya and Borneo. Fertile fronds mixed with rhizomes are used against syphilitic ulcers.
Tilob (*Dicranopteris linearis* (Burm.) Underw.)	A favorite weaving material are handicrafts owing to its durability and strength. Fronds sometimes used as accents in floral arrangement. Splints from rachises laces into excellent necklaces, bags, bracelets, placemats, and belts. Stems are also woven into partition walls for houses, fish traps, chair or stool seats, caps, and pouches. Oldest stems make the best pens for domestic animals. Young leaves are applied as poultice. Leaf infusion and decoction have antifungal activities; sometime drank to cure fever; laxative; antiasthmatic; also a cure for thrush.
H E R B S	
Bamban [*Donax canniformis* (G.Forster) K. Schumann]	Stems are made into hats, laundry and waste baskets, bags, mats, trays, flower pots, holders, tables, magazine racks, bookshelves, musical instruments and fish traps. Also used in stitching thatch and for tying purpose. Stems formed into blowpipe darts in Malaysia. Pith of the stem suitable for papermaking, and leaves for cigarette paper in New Guinea. All plant parts with medicinal properties and used especially by inhabitants of areas where the plant is available. Rhizomes are said to be edible. Flesh portion of the fruit is eaten raw.
Guinea grass (*Panicum maximum* Jacq.)	Inflorescence is used in floral décor. Leaf stalks are used purely or in combination with other materials to make mats, Venetian blinds, partition and handicrafts items. A preferred forage species owing to its good quality and palatability to ruminants in grazed pastures or in cut and carry systems.
Gumi gumi (*Xyris complanata* R. Br)	Flowers are dried and used as floral décor. The naturally twisted scapes (Floral stem/stalks) are woven with other materials into mats, blinds and partition inflorescence with medicinal values. Cultivated as an ornamental species.

Lubigan (*Lepironia articulate* (Retz.) Domin)	Whole or split stems are made into mats, bags, basket, window blind, and other similar items. Stems pounded with hard and heavy objects until flat and ready for weaving. In Borneo and South Sumatra, the mats are used in packing tobacco, rubber, kapok, cotton, cane sugar and other products and for transporting food items such as rice, salts, and dried fish. Rhizome is reported to be edible.
Ragiw [*Rhynchospra corymbosa* (L.) Britton]	Inflorescence are used in floral décor. Whole or split fibers from the stems are fashioned into mats, sandals, baskets, screens, novelties, and similar items. It is also plowed in the fields as green manure for rice.
Vetiver [*Vetiveria zizanioides* (L.) Nash]	Leaves are woven into bags, mats, mail holders, and other handicraft items. Leafstalks also made into hats. Leaves sometimes used as thatching; young leaves good forage material. Rhizomes and roots the sources of the well known "vertiver oil" obtained by steam distillation and used in perfumes, deodorants, soaps, and toiletries. Vetiver oil with medicinal value as a carminative, diaphoretic, diuretic, emmenagogue, refrigerant, stomach, tonic, antispasmodic and sudorific. Also has an insecticidal and insect repellant property. Roots woven into prized fans for their agreeable odor. Rhizomes and roots moistened to five pleasant smells to a room moistened to give a pleasant smell to a room and cooling screen. Dry powdered roots and rhizomes inserted in between clothes as deodorize and insect repellant. Species used in erosion control owing to its dense downward root system up to 4 m deep that effectively anchors strips of plant behind it.
Pandan	
Pandan dagat (*Pandanus odoratissimus* L.f.)	Leaves converted into strips that are woven into small handbags and containers to large floor mats or light interior wall panels. Also made into strong and durable "sabotan" hats and sometimes used for thatching. Leaf fibers suitable for hand made papermaking. Fragrant oil from the male florescence known as "kewda oil". Characteristic aroma of kewda oil due to 2 phenylethyl methyl ether (about 66-85% and terpinen-4-ol (9-21). Oil a stimulants and antispasmodic. Also used to flavor tobacco and betel and to scent clothes, bouquets, lotion, cosmetics, soaps, hair oil and incense sticks. Roots with diuretic effects. Species planted as live fence, coastal windbreaks and soil stabilizer.
Vayasubas (*Freycinetia formosan* Hemsl.)	Aerial or prop roots made into high quality handicrafts such as baskets, fans, hats, coin purses and similar items. Sustainable as strong ropes. Inflorescence sometimes used as emergency food.

SEED FRUIT LEAVES	
Araucaria (*Araucaria* spp.)	Leaves as components in floral décor. Timber used in all kinds of construction and interior works like mouldings, linings, paneling, domestic flooring, furniture and cabinet work and other special application such as matches, match boxes, broom handle, chopstick, agricultural implement and aircraft frames. Several species used as ornamental and Christmas trees. Seed of several species edible.
Auri (*Acacia auriculiformis* A. Cunn. Ex Benth.)	Dried fruits(pods) used in floral decors. Timber suitable for furniture and cabinet making, construction, floor and window frames, moulding, boat building, carts, wheels, joinery, turnery, oil crusher, tool handle and agricultural implements. Auri a reforestation and an afforestaion species. Planted as an ornamental tree along roads for its beautiful, bright yellow inflorescence. Used for erosion control and as a shade tree in western Malesia including the Philippines.
Balitbitan (*Cynometra ramiflora*)	Dried fruits used in floral décor. Wood heavy, hard, only moderately durable but still suitable for interior construction, tool handles and woodcraft. Species an ornamental wayside tree owing to the beautiful juvenile leaves.
Banaba [*Lagerstroemia speciosa* (L.) Pers.]	Dried fruit used for novelty items, interior décor, hanging décor, and similar items. Wood used for medium heavy construction under cover (post, beams, scantlings, door and window frames), bridge and wharf building, boat building, and others. Also suitable for sliced veneer and plywood production. Species cultivation for ornamental purposes and as a nature park tree. Bark with medicinal properties.
Bitaog (*Calophyllum inophyllum* L.)	Dried fruits used in floral decors. Oil from the seed used for lighting purposes, soap making, and skin care product such as creams, lotions ad cosmetic. Timber obtained in fairly quantities and suitable for construction, furniture and cabinets' works, cartwheel hubs, vessels, musical instruments, canoes and boats. Fruit edible.
Dungon late (*Heritiera littoralis* Aiton)	Dried fruits used together with other materials for floral décor and similar items. Wood heavy and suitable for uses requiring strength and durability; has high energy value and ideal for firewood and charcoal. Tannins from the bark used in toughening fishing nets. Seeds edible; seed extract used to treat diarrhea and dysentery. Root used as fish poison.

Fringon (*Bauhinia* spp.)	Seeds used in floral décor. Species planted as an ornamental or road side tree for its beautiful flowers. Leave and barks with medicinal properties, and well known for their astringent, anthelmintic, carminative and diuretic effects. Also use against diarrhea and cough. Flowers said to be a laxative and used in curries and pickles. Bark a source of bast fiber. Species a source of a lectin with an affinity to galactose and lactose, which are widely applied in biochemical, histochemical and immunochemical studies in medicine. Also reported to have stimulatory effects on thyroid function without hepatotoxic effects.
Kalumpang (*Sterculia foetida* L.)	Fruits crafted into novelty items and seeds into necklaces and beads for handicrafts. Wood used for temporary construction and also for sidings, ceilings, and partitions. Seeds may be slightly poisonous when fresh but edible and may also be a source of oil for illuminants and paints. Leaves and flowers with some medicinal properties. Trees planted for shade. Natural dye extracted from the fruit rind. Beautiful, ribbon-like bast fibers, suitable for handicrafts.
Lipay (*Macuna* spp.)	Seeds hard and made into bead chain (charms key chains) and other novelty items. Seeds with traditional medicinal properties. *M. pruniens* widely grown as a cover crop and green manure. Its stem likewise used in handicraft production such as basket, bags and similar items.
Narra (*Pterocarpus indicus* Willd.)	Fruits as components in floral décor. Wood used as structural timber for light to heavy construction, joist, rafters, beams and interior finish. Ranks among the finest for furniture, paneling, musical instruments, high grade cabinets work, high class interior joinery, billiard tables, decorative flooring for both light and heavy traffic and many other purposes. A resinous substance called "kino" or "sangre de drago" exuded by the bark and considered as a powerful stringent. Boiled, shredded bark used against diarrhea and dysentery, sometimes as diuretic. Also has tanning properties and yields a reddish or yellowish dye. Tree extensively used for ornamental purposes or for shade especially in Peninsular Malaysia, Singapore, Indonesia, and the Philippines. Also reforestation species to stabilize denuded and marginal soils since the roots can fix atmospheric nitrogen. Flowers and young leaves reported edible.
Palosanto (*Triplaris cumingiana* Fisch. & Mey)	Dried flower used in floral décors. Species planted for ornamental purposes.

Pili (*Canarium ovatum* Engl.)	Fruit nut shield crafted into novelty items and decors and make for excellent cooking fuel. Wood used for temporary construction and as firewood. Kernels or nuts used for various confectionary and bakery product. Boiled pulp edible and yield oil for cooking and illumination. Resin suitable for similar purposes as Manila elemi. Young shoot and leaves edible. Trees planted as wind breaks, as ornamental and for shade along roads and highways. Bark a source of tannin. Roasted kernels serve as laxative. Oleoresin applied to relieve pain from arthritis and rheumatism and also n boils, abscesses and furuncles.
Talisai *(Terminalia catappa* L.)	Dried fruits used with other materials in floral décor. Wood, suitable for house and boat construction furniture and cabinet making. Bark and leaves used for tanning leather, dyeing cloth and making ink. Seeds edible. Trees commonly planted for shade and as ornamental along roads and in gardens. Oil from seed used medicinally as a substitute for true almond oil. Leaves sudorific and aookued ti rheumatic joints. Tannins from the leaves and bark used as astringent in dysentery gastric fever, bilious diarrhea and thrush; also as diuretic and cardiotonic and applied externally on eruptions. A decoction of old leaves (red leaves) used as vermifuge. Fruits purgative. Crushed flowers mixed with water and drank to incude sterility. Sap of young leaves mixed and cooked with the seed oil said to be specific against leprosy.

Voyavoy (*Phoenix loureiroi* Kunth var. *loureiroi*)	The hard, durable and rain resistant leaves used as fence. Leaflets with a variety of domestic application such as the production of mats, hats, baskets, brooms, and the famous raincapes "vakol" and "suot" , the latter being the hooded capes worn by women. Apical bud eaten as vegetable. Fruits sweet and commonly eaten by children, the floury pith cooked in many ways.
Wades pitogo (*Cycas wadei* Merr.)	Seeds used as hanging décor. Species as an ornamental tree gardens and parks.
TREES	
Kaitana (*Zanthoxylum limonella* (Dennst.) Alston)	Wood is a favorite material for carvings and small decorative novelty items. Also for house, building (planking, rafters, scantings),furniture, small articles such as jewelry box, kris handle and sheaths, axe handle, walking sticks, inlay works and gun stock. Fruits used as spice and yields an essential oil with medicinal properties. Pounded bark mixed with oil externally used for stomach ache; a bark decoction used fro chest pains. Chewed bark applied to snake bite. Fibrous materials from the roots used to caulk canoes.
Raintree (Acacia) [*Samanea saman* (Jacq.) Merr.]	Wood is good for wood carving, wall paneling, furniture, cabinet, kitchen utensils and boat building. Also planted as an ornamental tree for shade and forage. Leaf and bark decoction used as medicine. Alkaloids found in barks, stems, leaves, and seeds.

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