

THE STATE
OF THE WORLD'S

FOREST GENETIC RESOURCES

COUNTRY REPORT

MYANMAR

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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Executive Summary

The Union of Myanmar is geographically located in Southeast Asia between latitudes 9°32' and 28°31'N and longitudes 92°10'E and 101°11'E. . The total area of Myanmar is 676,577 km². The Forest Resource Assessment (FRA-2010) conducted by the Food and Agriculture Organization (FAO) in cooperation with the Forest Department indicated that Myanmar is still covered with a forest covered of about 46.96% (317,730 km²) of the country's total land area.

The country is rich in biodiversity because of diverse ecosystems of different elevations from sea level to high mountains with an elevation of almost 6,000 meter. Biodiversity is vital resources for the sustainable development of human being in every corner of the world.

To deal with population, Myanmar has reached 58.38 million in 2008-09 and its growth rate is 1.52%. . As a matter of fact, over 70% of the country's total populations are rural and dependent on forest resources for basic needs such as food, fodder, fuel, and shelter.

In 2001-08, timber was the government's fourth most important export: annual earning is around US\$ 538 million (Global Witness, 2009). It is estimated that timber generates around 10% of Myanmar's total export earnings, as well as contributing to other sectors of the economy such as agriculture, energy, livestock and tourism (Htun, 2009).

Myanmar is often cited as the last frontier of global biodiversity in Asia. Natural forests in Myanmar have been managed and conserved on a sustainable basis including biodiversity conservation. Myanmar still possesses a diverse species of flora and fauna. At present, plant biodiversity status by taxonomic groups is shown as species of vascular plants of gymnosperm and angiosperm at 11,800 plant species belonging to the genera 2,371 and families 273. Among plant species, only 85 species are being used as commercial timber species because of their prominent high quality (FD, 2000). Global threat assessments have only been conducted for a small proportion of Myanmar's plant species, principally angiosperms and certain gymnosperm families. Only 38 plant species recorded in Myanmar have been assessed as globally threatened, comprising 33 species of angiosperm and five species of gymnosperm.

Conservation of these biological resources has been incorporated in the broader scope of nature and wildlife conservation which is regarded as one of the national priorities in Myanmar. Protection of soil, water, wildlife, biodiversity and entire environment is identified as an important imperative in the 1995 Myanmar Forest Policy and the protection wildlife and wild plant and conservation of Natural Areas Law 1994.

The main forest species actively managed are *Tectona grandis* (Teak), *Pterocarpus macrocarpus* (Padauk), *Xylia xylocarpa* (Pyinkado), Some *Dipterocarpus species*, *Pinus spp.* (Htinyu) and some species of mangrove for timber production aims in Myanmar.

In Myanmar, reserved forests, protected public forests, and protected areas system constitute permanent estate (PFE) are classified. The status of Permanent Forest Estate (PFE) has 28% of total land areas in 2010.

The fifty priority species of mainly consists of valuable timber species, locally important mangrove species (for local use and stability of mangrove ecosystem), and multipurpose species for agro-forestry, watershed management and soil reclamation in the dry zone and currently

popular medicinal plants, bamboo and rattan species which contribute a substantial amount of income to the rural people.

This report contains seven main chapters. Chapter 1 deals with the overview of forest genetic resources and forest types and globally threatened plant species in Myanmar. Further, chapter 1 provides with priority species for FGR Conservation and management and major tree species in plantation programme.

Chapter 2 gives the state of *in situ* conservation programme and development of protected areas, restoration in degraded lands, seed production areas and conservation of selected plus trees. Chapter 3 summarized the *ex situ* conservation by means of provenance trials, clonal seed orchards and establishment of teak hedge gardens. In this chapter, needs and priority implementation were described for *ex situ* conservation in Myanmar. Chapter 4 depicts the main species used in tree improvement programme. Chapter 5 gives the account of the current status of national forest genetic resources strategies and action plan of Myanmar and the strengthen communication, education and public awareness.

Chapter 6 depicts the mainstreaming of forest genetic resources conservation and management into forestry, Myanmar Agenda 21, and Myanmar commitments in regional and international agreements. Chapter 7 describes the important species including non-wood forest products to contribution of forest genetic resources to poverty reduction.

Like other developing countries, Myanmar is facing with the loss of forest genetic resources primarily due to the socio-economic pressure. Major threats identified in this report are habitat destruction and degradation. Some achievements of forest genetic resources conservation and management are as follows;

- About 30% of the country area has been established as Permanent Forest Estates (PFE).
- National Workshop on Forest Genetic Resources was held in February 2008 by the guidance of APFORGEN.
- Myanmar Agenda 21 has been formulated.

To deal with the national implementation for plant genetic conservation, due to several constraints, the proper implementation is appeared to be limited. Some areas where effective management and conservation of plant genetic resources are lacking are as follows;

- Urgent need for development of strategies of plant genetic resources conservation,
- Poor application of ecosystem approach,
- Lack of mainstreaming biodiversity conservation into land-use practices,
- Poor cross-sectoral coordination among stakeholders,
- Weakness in promotion of environmental awareness among the public and local authorities concerned,
- Poor capacity building and institutional capabilities of biodiversity-related Institutions, and
- Data based biodiversity conservation, management and assessment need to be upgraded.

The government of Union of Myanmar is striving the best to conserve Myanmar's biodiversity by its own resources, but the issue is to be tackled not only by the nation alone but also with the cooperation of outside agencies and partners. In particular, the current demand on natural resources in the region is one of the major threats to the long existence of biodiversity in Myanmar. A regional network on biodiversity conservation consisting of neighboring countries is thus advisable for long term plant genetic resources conservation.

The State of the World's Forest Genetic Resources
Country Report on Forest Genetic Resources in Myanmar

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Introduction

General Description of the Country

The Union of Myanmar is geographically located in Southeast Asia between latitudes 9°32' and 28°31'N and longitudes 92°10'E and 101°11'E. Myanmar is bordered on the north and northeast by China, on the east and southeast by Laos and Thailand, on the south by the Andaman Sea and the Bay of Bengal and on the west by Bangladesh and India. The total area of Myanmar is 676,577 km². It stretches for 936 km from east to west and 2,051 km from north to south.

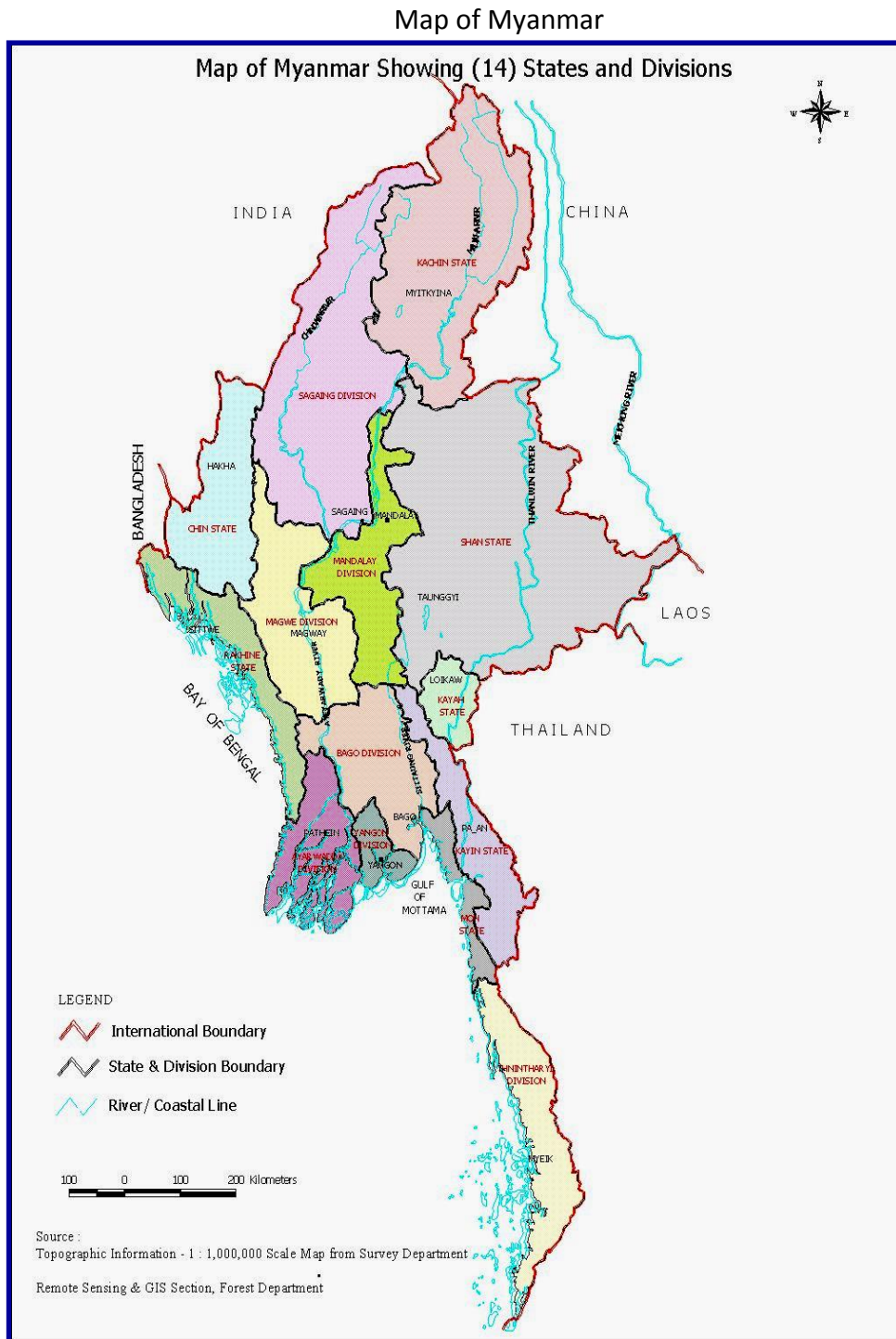
The topography of Myanmar can roughly be divided into three parts-the Western Hills Region, the Central Valley Region and the Eastern Hills Region. The Central Valley of the River Ayeyawady consists of Sittaung Valley and Chindwin Valley. The Eastern Hills Region is the Shan Plateau. River Thanlwin flows through the Shan Plateau to the northern Tanintharyi Coastal Strip.

Myanmar has a tropical monsoon climate and has three seasons-summer, rainy and cold seasons. The Central Myanmar has an annual rainfall of less than 1,000 mm while the Rakhine coast receives more than 5,000 mm. Besides, the average highest temperature in the Central Myanmar during the summer months of March and April is above 43.3° C while in Northern Myanmar, it is about 36.1° C and on the Shan Plateau, between 29.4° C and 35° C. Myanmar is endowed with a rich diversity of habitat types arising largely from its unusual ecological diversity. The Forest Resource Assessment (FRA-2010) conducted by the Food and Agriculture Organization (FAO) in cooperation with the Forest Department indicated that Myanmar is still covered with a forest covered of about 46.96% (317,730 km²) of the country's total land area of 676,577 km². The country has been protecting and conserving its diverse biological resources on a sustainable basis.

To deal with population, Myanmar has reached 58.38 million in 2008-09 and its growth rate is 1.52%. Myanmar's forests are socially and economically significant to the country. As a matter of fact, over 70% of the country's total populations are rural and dependent on forest resources for basic needs such as food, fodder, fuel, and shelter. Relative abundance of natural forests in the country is a reflection of the consistent exercise of sound forest management practices for years.

Myanmar, with about half of its total land area under forest cover, still is the world's prime supplier of premier natural teak wood which contributes significantly to the national economy through export earnings. Forestry has been a major source of income for Myanmar for many decades and has played an integral part in the development of the country. In 2001-08, timber was the government's fourth most important export: annual earning is around US\$ 538 million (Global Witness, 2009). It is estimated that timber generates around 10% of Myanmar's

total export earnings, as well as contributing to other sectors of the economy such as agriculture, energy, livestock and tourism (Htun, 2009).



Forest Resource Base

The forest types are classified as mangroves and estuarine forests in the delta region; deciduous and dipterocarpus forests in the regions with pronounced dry season; evergreen

forest in areas of high moisture regime and rainfall; hill evergreen and sub-alpine forest at high altitudes and subtropical regions; and dry thorn forests in places with scanty rainfall. The following table 1 shows the forest cover areas of Myanmar which includes the primary forests, naturally regenerated forests and planted forests, and tables 2 shows the forest ownership in Myanmar in 2010 respectively.

Table 1. Forest characteristics and area (FRA)

No.	Main forest characteristics	Total Area (1000ha)	Remarks
1.	Primary forests	3192	
2.	Naturally regenerated forests	27593	
3.	Planted forests Commercial Village supply Watershed Industrial	988	
	Total	31,773	

Source: FRA 2010

With the decreasing availability of logs from natural forests, plantations are the important source of timber to meet future timber demand. This suggests a need for more private investment in plantations apart from state-owned with the aim to provide development of private sector and national economy, and also to ensure existence of sustainable forest. In Myanmar, The majority of plantation has been established under government; however government is now actively encouraging private sector investment for plantation establishment since 2005. Particularly, the private sector has increasingly shown interest for the establishment of teak plantation and is likely to be significant for foreign earnings. Up till 2010 March, private teak and non-teak plantations have been established 13,127 ha and 16,220 ha respectively.

Table 2. Forest ownership and area in 2010

Forest Ownership	Plantation type	Area (ha)
Public	Community forests	41,967
	Village supply plantation	180,009
Private	Teak plantation	13,127
	Non-teak plantation	16,220
Others	-	-

Source: Forestry in Myanmar 2010 (unpublished)

In adherence to the Myanmar Forest Policy, the natural forests will continue to be managed to provide timber, especially premium teak wood and other forest products sustainably while rendering protective functions to ensure ecological and biodiversity stability with supportive services for agriculture, recreation and ecotourism. The increase of the Permanent Forest Estate is also being afforded to facilitate management.

To meet the increasing demand for timber, plantation forestry, with the involvement of the private sector, is on the rise to assume an increasing share of the economic responsibility and complement the primary effort in natural forest management. Community forestry also

plays a crucial role to fulfill the basic needs of the local communities and relieve pressure on the natural forests.

Forest Conservation and Management

Myanmar possesses flora and fauna of rich diversity. Various forest types of Myanmar are inhabited by a vast array of plants and wildlife species. Conservation of these biological resources has been incorporated in the broader scope of nature and wildlife conservation which is regarded as one of the national priorities in Myanmar. Protection of soil, water, wildlife, biodiversity and entire environment is identified as an important imperative in the 1995 Myanmar Forest Policy and the protection wildlife and wild plant and conservation of Natural Areas Law 1994.

Plant resources can be conserved through a variety of approaches at different scales, from genes and population of individual species, through sites to habitats and entire landscape. There is a need to improve the long term conservation of plant diversity *in situ* (plant communities, associated habitats and ecosystem), through appropriate management to safeguard and restore populations at sustainable levels, complemented where necessary with *ex situ* measures. The conservation of plant diversity is fundamental to maintaining fully functioning ecosystem and the quality of ecosystem services such as clean water, climate regulation, natural flood defenses, erosion control, animal habitats and tourism.

The Forest Department (FD) of the Ministry of Forestry (MOF) is mainly responsible for the protection and conservation of biodiversity and sustainable management of the forest resources of the country. Conservation of forest genetic resources (FGR), including teak was started in 1984. Since then, the major conservation of teak plantations and full-stocked teak natural forests into seed production areas (SPA), and the establishment of teak hedge gardens (THGs), teak seed orchards and the protected area system(PAS).

Myanmar Selection System (MSS) has been the principle forest management system applied in managing to the sustainable harvest and use of plant resources of the natural forests in Myanmar since 1856. It involves formation of felling series, each of which is divided into 30 annual coupes based on equal productivity and more or less the same size and worked over a period of 30- year felling cycle.

In Myanmar, conservation and management of forest resources primarily wildlife, wild plants and pristine forests has traditionally been prioritized at the national level. Wildlife conservation in Myanmar dates back to 1995 Myanmar Forest Policy stipulates to form a network of naturally protected areas up to 5% of the country's landmass.

With regard to biodiversity conservation, Myanmar has made commitments to some international agreements and organizations (e.g. CBD, ACB, CITES, etc.)

The combination of *ex situ* and *in situ* conservation methods are considerably conducted for most effective in the conservation of FGRs. Recently conservation efforts in Myanmar, were *in situ* based and were concerned mainly with the protection of forests. It means that the habitat

of FGRs is maintained for their naturally growing and illegally harvestings of plant resources are protected by the Forest Protection Laws and legislations.

Many other protected areas were established in the different geographical regions of the country as national park, wildlife reserve and sanctuary. The Policy seeks to extend the Protected Area System (PAS) by gazetting 5% of the total land of the country from 4.7% at present to 10% in the long run. It also includes a system of environmental pricing based on the polluter pays principle to compensate for environmental and ecological degradation.

Reserved Tree Species in Myanmar

In Myanmar, following tree species are declared as reserved tree to prevent over utilization of their products in different regions.

No	Scientific Name	Common Name	Whole Country	Upper Myanmar	Lower Myanmar
1	<i>Tectona grandis</i>	Teak	****		
2	<i>Pentace burmanica</i>	Thitka	****		
3	<i>Xantolis burmanica</i>	Thitcho	****		
4	<i>Hopea odorata</i>	Thingan	****		
5	<i>Xylia xylocarpa</i>	Pyinkado	****		
6	<i>Acacia catechu</i>	Sha	****		
7	<i>Pterocarpus macrocarpus</i>	Padauk	****		
8	<i>Excoecaria agallocha</i>	Thayaw	****		
9	<i>Shorea obtuse</i>	Thit-ya	****		
10	<i>Shorea siamensis</i>	Ingyin	****		
11	<i>Pinus khasya</i>	Tinshu	****		
12	<i>Dipterocarpus alatus</i>	Kanyin			****
13	<i>Lindera assamica</i>	Karaway			****
14	<i>Cinnamomum pachyphyllum</i>	Hmanthin			****
15	<i>Lagerstroemia floribunda</i>	Kamaung			****
16	<i>Prunus cerasoides</i>	Cherry		****	
17	Some medicinal plant	-	****		
18	Some orchid species	-	****		

**** : In this region declared as reserved tree

Source: Forest Department Fact and Figure, 2006.

Chapter 1

The Current State of Forest Genetic Resources

Forest genetic resources play a very important role in the country's economy and the most valuable renewable natural resources. Myanmar possesses flora and fauna of rich diversity. Various forest types of Myanmar are inhabited by a vast array of plants and wildlife species. These resources are vulnerable to climate change, forest fire, soil erosion, landslides and rapid loss of habitat and genetic diversity. The main forest species actively managed are *Tectona grandis* (Teak), *Pterocarpus macrocarpus* (Padauk), *Xylia xylocarpa* (Pyinkado), Some *Dipterocarpus species*, *Pinus spp.* (Htinyu) and some species of mangrove for timber production aims in Myanmar.

The sustained ability of forest trees species to provide goods and environmental services thus depends on the maintenance and management of FGR. There have been limited efforts to assess the conservation concerns of forest genetic resources.

To reach the improving understanding of the state of forest genetic diversity, the following needs and priority areas for conducting have been pointed out:

- Assessment on reforestation of degraded lands
- Assessment of the biodiversity in the hotspot areas, e.g. national parks, degraded areas, etc.
- Increasing the forest genetic resources of existing forests by the establishment of entirely protected areas system (PAS).
- Improvement of species and varieties using the advance technology (e.g. biotechnology, modified the traditional breeding methods).
- Effective utilization of FGR.
- Enhancement of conservation, protection and sustainable development of existing forests to conserve the biodiversity by reviewing the current implementations.
- Conducting the systematic survey or inventory the population of species using the GIS approach, and
- Conducting the estimation of the present status of tree species for conservation and utilization programme.

1.1. Forest Types and Forest Genetic Resources in Myanmar

The forest flora of Myanmar is diverse, varying from sub-alpine, dry forest and moist deciduous forests, tropical rain forests to mangrove forests. The forest types vary depending on topographic, edaphic and climatic conditions. They are classified as mangroves and estuarine

forests in the delta region; deciduous and dipterocarps forests in the regions with pronounced dry season; evergreen forest in areas of high moisture regime and rainfall; hill evergreen and sub-alpine forest at high altitudes and subtropical regions; and dry thorn forests in places with scanty rainfall. About (317,730 Km²) 46.96% of the country's total land area is still covered with natural forests (FRA 2010).

Myanmar is often cited as the last frontier of global biodiversity in Asia. Out of about 11,800 plant species recorded to date, 1,071 are endemic. It also has a rich wildlife resource which includes over 1,000 species of birds, more than 300 species of mammals and 400 species of reptiles and amphibians.

The present forest cover of Myanmar and the current and sustained yields of teak and other valuable hardwoods indicate that the Myanmar Selection System, together with its least destructive logging method, work well and that also sustain biodiversity to a remarkable extent even in the production forests. The following tables 3 and 4 shows that the status of forest cover and major forest types of Myanmar in 2010 respectively.

Table 3. Major forest types categories and main tree species

No.	Types of forests	Area		Main species for each forest type	
		(,000ha)	%	Trees	Other species
1	Tidal forest Beach and dune forest Swamp forest	1,375	4	<i>Rhizophora apiculata</i> , <i>Rhizophora mucronata</i> , <i>Bruguiera gymnorhiza</i> , <i>Heritiera fomes</i> , <i>Sonneratia apetala</i> , <i>Aegiceras corniculatum</i> , <i>Ceriops decandra</i> and <i>Exocoecaria agallocha</i>	<i>Acanthus</i> spp.
2	Tropical evergreen forest	5,500	16	<i>Michelia champaca</i> , <i>Tetrameles nudiflora</i> , <i>Dipterocarpus</i> spp., <i>Eugenia</i> spp., <i>Cedrela</i> spp.,	<i>Dendrocalamus hamiltonii</i> <i>Cephalostachyum pergracile</i>
3	Mixed deciduous forest	13,407	37	<i>Tectona grandis</i> , <i>Xylia xylocarpa</i> <i>Terminalia crenulata</i> , <i>Terminalia chebula</i> , <i>Terminalia pyrifolia</i> , <i>Pterocarpus macrocarpus</i> , <i>Adina cordifolia</i> , <i>Shorea siamensis</i> , <i>Shorea obtusa</i> and occasionally <i>Dipterocarpus tuberculatus</i> (In).	<i>Dendrocalamus strictus</i> <i>Bambusa polymorpha</i> and <i>Cephalostachyum pergracile</i>
4	Dry forest	3,438	10	<i>Terminalia oliveri</i> (Than) <i>Tectona hamiltoniana</i> (Dahat) <i>Acacia catechu</i> (Sha), <i>Acacia leucophloea</i> (Tanaung) <i>Zizyphus jujuba</i> (Zi) <i>Diospyros ehretiodes</i> (Aukchinsa), <i>Millettia pendula</i> (Thinwin)	<i>Dendrocalamus strictus</i> (Hmyinwa).
5	Dipterocarp forest	1,719	5	<i>Dipterocarpus tuberculatus</i> (In) <i>Pantacme siamensis</i> (Ingyin), <i>Shorea obtusa</i> (Thitya)	
6	Hill and temperate evergreen forest	8,938	25	<i>Quercus</i> and <i>Castanopsis</i> , <i>Schima wallichii</i> (Laukya), <i>Alnus nepalensis</i> (Maibau)	
7	Fallow land	998	3		
Total		35,375	100		

Source: FRA, 2010.

Table 4. Forest covers status in 2010

Category	Area (,000 ha)	Percent (%) of total land area
Closed Forests	13,445	19.87

Open Forests(Degraded forests)	18,328	27.09
Total Natural Forests	31,773	46.96
Other Wooded Lands	20,113	29.73
Other Land Use	13,869	20.50
Inland Water Bodies	1,903	17.62
Total Land Area	67,658	100.00

Source: FRA, 2010

In Myanmar, reserved forests, protected public forests, and protected areas system constitute permanent estate (PFE) are classified. The status of Permanent Forest Estate (PFE) has 28% of total land areas in 2010 is shown in Table 5. Both RF and PPF enjoy almost equal status under the 1992 Forest Law.

Table 5. Status of Permanent Forest Estates (PFE) in Myanmar in 2010

Legal classification	Area (sq. km)	Percent of land area
Reserved Forest	123,373.23	18.23
Protected Public Forest	39,880.48	5.89
Protected Area System	26,613.47	3.93
Total area of PFE	189,867.18	28.05

Source: Forestry in Myanmar 2010 (unpublished)

Natural forests in Myanmar have been managed and conserved on a sustainable basis including biodiversity conservation. Myanmar still possesses a diverse species of flora and fauna. At present, according to the checklists of the trees, shrubs, herbs, and climber of Myanmar (2003), 11,800 plant species (only angiosperm and gymnosperm) have already been listed and belonging to the genera 2,371 and families 273. Among plant species, only 85 species are being used as commercial timber species because of their prominent high quality (FD, 2000). Table 6 shows the status of plant genetic resources in Myanmar.

Table 6. The status of plant genetic resources in Myanmar

No.	Categories	Number of species
1.	Plants	11,800
2.	Bamboo	102
3.	Rattan	37
4.	Shrubs	1696
5.	Orchids	841

Source: Forest Department 2003.

1.2. Globally threatened plant species in Myanmar

Global threat assessments have only been conducted for a small proportion of Myanmar's plant species, principally angiosperms and certain gymnosperm families. Only 38 plant species recorded in Myanmar have been assessed as globally threatened, comprising 33 species of angiosperm and five species of gymnosperm (Attachment 1).

All the globally threatened angiosperms are trees, and over two thirds are members of the Dipterocarpaceae. The globally threatened gymnosperms comprise the cycad *Cycas siamensis*, and the conifers *Calocedrus macrolepis*, *Cephalotaxus mannii*, *Picea farreri* and

Taiwania cryptomerioides. The major threats to globally threatened plant species in Myanmar are degradation and loss of forest. Species with a high economic value are also threatened by over exploitation, for example *Aqualaria malaccensis*, a source of an aromatic resin non-timber forest products (NTFP) called agarwood.

1.3. Priority Species for Conservation and Management

In Myanmar, detailed information on tree species is still lacking. However, identification of the priority plant species has been carried out based on the following criteria (IPGRI 1998), which are suitable for the current conditions of the country (Thaung Naing Oo, 2004).

- Ecological value
- Financial value (Nguyen Xuan Lieu, 2000)
 - Fit into the objectives of the planting programme
 - Bring high benefits
 - Have large and stable market
 - Availability of seed sources and propagation methods
 - Availability of planting and tending techniques
- (Potential) socio economic value
- Distribution pattern of the species and its population
- Distribution pattern of its genetic variation
- Threats imposed on the species
- Conservation status
- Reproductive biology
- Associated species

The following forest genetic resources have been identified as priority species for conservation in national and regional level as well (Table 7). The priority species mainly consists of valuable timber species, locally important mangrove species (for local use and stability of mangrove ecosystem), and multipurpose species for agro-forestry, watershed management and soil reclamation in the dry zone and currently popular medicinal plants, bamboo and rattan species which contribute a substantial amount of income to the rural people.

Table 7. Proposed National Priority Species for conservation in Myanmar

No.	Scientific Name	Myanmar Name	Tree (T) Or other (O)	Native (N) Or Exotic (E)	Reasons for priority
1.	<i>Tectona grandis</i>	Kyun (Teak)	T	N	Economic
2.	<i>Xylia xylocarpa</i>	Pyinkado	T	N	Economic
3.	<i>Pterocarpus macrocarpus</i>	Padauk	T	N	Economic
4.	<i>Hopea odorata</i>	Thingan	T	N	Economic
5.	<i>Dalbergia oliveri</i>	Tamalan	T	N	Economic
6.	<i>Milletia pendula</i>	Thin-win	T	N	Economic
7.	<i>Pinus khasya</i>	Tinyu	T	N	Threatened
8.	<i>Pinus merkusii</i>	Tinyu	T	N	Threatened
9.	<i>Shorea obtuse</i>	Thitya	T	N	Economic
10.	<i>Shorea siamensis</i>	Ingyin	T	N	Economic
11.	<i>Dipterocarpus tuberculatus</i>	In	T	N	Economic

12.	<i>Terminalia crenulata</i>	Taukkyan	T	N	Economic
13.	<i>Gmelina arborea</i>	Yemane	T	N	Economic, Threatened
14.	<i>Avicennia officinalis</i>	Tha-me	T	N	Ecology
15.	<i>Sonnertia caseolaris</i>	Lamu	T	N	Ecology
16.	<i>Sonneratia alba</i>	La-me	T	N	Ecology
17.	<i>Rhizophora candelaria</i>	Byu-chidauk	T	N	Ecology
18.	<i>Grewia acuminata</i>	Thayaw	T	N	Ecology
19.	<i>Heritiera fomes</i>	Kanasoe	T	N	Ecology
20.	<i>Sonneratia apetala</i>	Kanbala	T	N	Ecology
21.	<i>Azadirachta indica</i>	Tama	T	N	Ecology, Social
22.	<i>Leucaena leucocephala</i>	Bawsagaing	T	E	Social, Invasive
23.	<i>Allibizzia lebbek</i>	Ahnya-Kokka	T	N	Social
24.	<i>Cassia mimosoides</i>	Mezali	T	N	Social
25.	<i>Tamarindus indica</i>	Magyi	T	N	Economic, Social
26.	<i>Sesbania grandisflora</i>	Paukpan-byu	T	N	Ecology, Social
27.	<i>Prosopis juliflora</i>	Gandasein	O	E	Ecology, invasive
28.	<i>Acacia catechu</i>	Sha	T	N	Ecology
29.	<i>Acacia Arabica</i>	Subyu	T	N	Ecology
30.	<i>Acacia leucophoea</i>	Tanaung	T	N	Ecology
31.	<i>Acacia microcephala</i>	Sha-tanaung	T	N	Ecology
32.	<i>Aqualaria agallocha</i>	Thithmwe	T	N	Economic, Social
33.	<i>Michelia champaca</i>	Sagawa	T	N	Ecology, Social
34.	<i>Xylocarpus molluccensis</i>	Kyana	T	N	Ecology
35.	Medicinal plants				
36.	<i>Bambusa polymorpha</i>	Kyathaung-wa	O	N	Social
37.	<i>Bambusa tulda</i>	Thaik-wa	O	N	Social
38.	<i>Bambusa longispiculata</i>	Tabindaing-wa	O	N	Social
39.	<i>Bambusa arundinaceae</i>	Kyaket-wa	O	N	Social
40.	<i>Cephalostachyum pergracile</i>	Tin-wa	O	N	Social
41.	<i>Dendrocalamus giganteus</i>	Wabo-gyi	O	N	Social
42.	<i>Dendrocalamus strictus</i>	Hmyin-wa	O	N	Social
43.	<i>Dendrocalamus vulgaris</i>	Wa-net	O	N	Social
44.	<i>Thyrsostachys siamensis</i>	Htiyo-wa	O	N	Social
45.	<i>Calamus longisetus</i>	Kabaung-kyein	O	N	Economic
46.	<i>Calamus floribundus</i>	Ye-kyein	O	N	Economic
47.	<i>Calamus erectus</i>	Thaing-kyein	O	N	Economic
48.	<i>Calamus latifolius</i>	Yamahta-kyein	O	N	Economic
49.	<i>Calamus platyspathus</i>	Kyet-U-Kyein	O	N	Economic

1.4. Major tree species in plantation programme

Some Tree species are preferred by the local rural people and also planted in community forestry and annual tree planting programme across the country. Table 8 shows the species commonly used in plantation programmes (re-forestation) in Myanmar.

Table 8. Tree species currently used in plantation programmes.

No.	Scientific name	Native (N) or Exotic (E)	Current Uses* (code)	Type of management system (e.g. Natural Forest, plantation, agroforestry)	Remarks
1	<i>Tectona grandis</i>	N	1	Natural forest, Plantation	
2	<i>Xylia xylocarpa</i>	N	1	Natural forest, Plantation	
3	<i>Pterocarpus macorcarpus</i>	N	1	Natural forest, Plantation	
4	<i>Pinus spp.</i>	N, E	1,2	Natural forest, Plantation	
5	<i>Gmelina arborea</i>	N	1,2	Natural forest, Plantation	
6	<i>Terminalia bellerica</i>	N	4	Natural forest, Plantation	
7	<i>Eucalyptus spp.</i>	E	1,5,6	Plantation	
8	<i>Azadirachta indica</i>	N	4,5,6	Natural forest, Plantation	
9	<i>Leucaena leucocephala</i>	E	3,5	Plantation	
10	<i>Allibizzia lebbek</i>	N	3,6	Natural forest, Plantation	
11	<i>Cassia mimosoides</i>	N	3,5,6	Plantation	
12	<i>Ziziphus jujuba</i>	N	4,5,6	Plantation	
13	<i>Tamarindus indica</i>	N	4,5,6	Plantation	
14	<i>Sesbania grandiflora</i>	N	3,5,6	Plantation	
15	<i>Acacia catechu</i>	N	3,6	Natural Forest, Plantation	
16	<i>Acacia arabica</i>	E	4,6	Plantation	
17	<i>Acacia leucophoea</i>	N	3,5,6	Natural Forest, Plantation	
18	<i>Acacia microcephala</i>	N	6	Natural Forest, Plantation	
19	<i>Acacia auriculiformis</i>	E	3,5,6	Plantation	
20	<i>Acacia senegal</i>	E	4,6	Plantation	
21	<i>Rhizophora apiculata</i>	N	1,6	Natural Forest, Plantation	
22	<i>Rhizophora mucronata</i>	N	1,6	Natural Forest, Plantation	
23	<i>Bruguiera gymnorhiza</i>	N	1,6	Natural Forest, Plantation	
24	<i>Heritiera fomes</i>	N	1,6	Natural Forest, Plantation	
25	<i>Sonneratia apetala</i>	N	1,6	Natural Forest, Plantation	
26	<i>Aegiceras corniculatum</i>	N	1,6	Natural Forest, Plantation	
27	<i>Ceriops decandra</i>	N	1,6	Natural Forest, Plantation	
28	<i>Cynometra ramiflora</i>	N	1,6	Natural Forest, Plantation	
29	<i>Avicennia officinalis</i>	N	1,6	Natural Forest, Plantation	
30	<i>Excoecaria agallocha</i>	N	1,6	Natural Forest, Plantation	
31	Bamboo species	N	2,5,4	Natural Forest, Plantation	

* Current use

- | | |
|-----------------------|--|
| 1 Solid wood products | 4 Non wood forest products (food, fodder, medicinal, etc.) |
| 2 Pulp and paper | 5 Used in agro-forestry system |
| 3 Energy | 6 Other (Dry zone greening, environmental conservation) |

Chapter 2

The State of *in situ* Genetic Conservation

2.1. *In situ* Conservation

Both *in situ* conservation and *ex situ* conservation strategies are important because *in situ* conservation is more effective ideal method of conserving wild plant genetic resources to grow and regenerate in native environment, and *ex situ* conservation is a valuable complementary method for many species in order to secure genetic resources threatened with inevitable loss in their natural habitats (FAO, 1985). Therefore, they need to be considered it is important to formulate appropriate strategies to conserve threatened genetic resources before they are lost forever. The strategies must be simple, flexible, and cost-effective as much as possible.

In situ conservation is carried out in the following areas: nature reserve, national parks, wildlife sanctuaries and degraded forests.

They need to be considered complementary and be carried out in parallel as an integral part of the programmes. In order to fit in the actual situations of the country, and to be implemented as realistically as possible, the following *in situ* forest genetic resources conservation programmes and practices are as follows:

- strengthening protected areas system for FGRC
- Enrichment planting, Restoration and reforestation of degraded ecosystem
- Enhancement of seed production areas (teak and other timber species) in different eco-region to collect the quality seeds and support the plantation.
- Selection and conservation of genetically good superior teak trees in the natural teak bearing forest.

Strengthening Protected Areas System (PAS)

Protected Areas System (PAS) is the most suitable strategy for FGRC because PAS are the areas especially dedicated to the protection and maintenance of biological diversity and associated cultural resources, and managed through legal or other effective means (IUCN, 1994). They cover various situations ranging from managed resources areas, protected watersheds, national parks and strictly protected reserves, to sacred forest groves.

Up till March 2010, 32 Wildlife Sanctuaries, 2 National Park and 6 parks had been notified as protected areas which covered 3.93% of the total land area and another 9 (3.37%) are being proposed. Both of them constituting about 7.3% of the total land area (49456.46sq.km) have been managed by the Forest Department. Nature and Wildlife Division of Forest Department is the primary agency managing these conservation areas.

However, the management regimes of existing PAS are typically designed for conservation of forest ecosystems, which is often compatible with conservation of genetic resources in situ but not always so. The current PAS are not likely to provide conservation of important plant species. Therefore, PAS need to be designed for conservation of many species (especially priority species) and effectively conserved forest ecosystems can maintain a reservoir of continually evolving tree species and population. Thus, special measures need to be planned and undertaken in order to conserve, if possible, each species or habitat or biological diversity. FGR in PAS also need to be assigned consumptive and non-consumptive values so that the conservation of FGR can be linked to the sustainable socio-economic development of the local people.

Enrichment Planting, Restoration and Reforestations in Degraded Ecosystem

Myanmar initiated the formation of teak plantation as early as 1856 on a small scale using *taungya* method. Large-scale plantation forestry began in 1980 and about 30,000 ha of forest plantations have annually been formed since 1984. Plantation forestry has always been the supplement to the natural forest management. It is asserted in the 1995 Myanmar Forest Policy that existing natural forests will not be substituted with forest plantations.

Plantation forestry has a complementary role to the natural forest management. The objectives of plantation establishment in Myanmar have been to rehabilitate degraded forest lands, restore deforested areas and supplement various timber yields from the natural forests. Forest Department (FD) establishes four types of plantations, of which local supply plantations and watershed plantations especially aim at satisfying wood fuel demand of local communities and rehabilitation of degraded watershed areas. Total planted areas and percentage by types of forest plantations and also by species are given in Table 8.

Table 8. Areas of Forest Plantations by Type (1981-2009)

No.	Plantation type	Area (ha)	% of total area
1	Commercial	450,655	53.74
2	Village Supply	180,009	21.46
3	Watershed	135,459	16.15
4	Industrial	4 72,519	8.65
	Total	838,642	100.00

Source: Forestry in Myanmar, 2011

In addition to the normal teak plantation scheme, a Special Teak Plantation Programme has been launched since 1998. The rotation is fixed at 40 years at the end of which the plantations will be clear-felled. It is designed to annually establish about 8,100 hectares (20,000 acres) of teak plantations with increased inputs in almost every aspects, including provision of budget, quality planting materials, selection of planting sites and measures minimizing monoculture impacts and site productivity maintenance. The establishment of teak plantation over an area of 324,000 ha will have been completed at the end of the 40-year rotation. The primary objectives of the programme are to maintain and increase teak production, to reduce pressure of demand for teak from natural forests, to rehabilitate degraded forest lands and to stabilize international trade in teak timber. Apart from intermediate thinning yields, a sustainable production of 1.8 mil.m³ of teak is estimated to be annually available as final yield from 8,100 ha of these plantations starting from the year 2003 (Forestry in Myanmar 2010).

Although re-afforestation got momentum in early 1960s, large-scale plantation forestry had not begun until 1980. More than 30,000 ha of forest plantations had annually been formed in the 1980s. Since then the annual plantation program has been intensified gradually till it has reached the present target of over 40,000 ha. This annual planting target includes over 30,000 ha planted by the Forest Department and about 10,000 ha planted by Dry Zone Greening Department (DZGD) for greening the Central Dry Zone of Myanmar. A total of 838,642 ha of various forest plantations have been established between 1981 and 2010 by Forest Department throughout the country.

The Forest Department, Bago Yoma Greening Project (2004-2009) has been carried out as one of the special programmes. Although Bago Yoma has been well known as the home of natural teak, it has been facing the degradation of natural forests at an alarming rate. So as to alleviate the suffering of these pressures, Forest Department has taken the responsibility of the restoration and re-greening of Bago Yoma. During the project, the major activities are being implemented as conservation and protection of natural forests, enrichment planting, natural regeneration and establishment of plantations (Table 9).

Table 9. Up till 2010, the major activities of Bago Yoma Greening Project

No.	Major activity	Area (ha)
1.	Conservation and protection of Natural forests	368207
2.	Enrichment planting	36685
3.	Natural Regeneration	46459
4.	Plantation establishment	61264

Source: Forest Department 2010.

Dry Zone Greening Department (DZGD) is responsible for reforestation of degraded forest lands, protection and conservation of remaining natural forests, and restoration of the environment in the dry zone of the Central Myanmar.

Every year in the Dry Zone about 8,000 ha of forest plantations are established on deforested and degraded areas to restore the forest cover and rehabilitate the environment. The total area already planted up to 2009-2010 is about 127,421 ha. The Following types of plantations are mainly included in the plantation establishment;

- (a) Village supply plantation;
- (b) Watershed plantation;
- (c) Plantation for greening of hill; and
- (d) Other greening plantation.

To rehabilitate the existing 0.73million hectares (1.8 million acres) of natural degraded forests in the Dry Zone, every year the Dry Zone Greening Department effectively protects about 80,000 ha out of the existing remaining natural forests in the Dry Zone of Central Myanmar. Within the natural forest selected for protection, about 10% of the area is selected again for the special natural regeneration operation. About 677,835 ha of remaining natural forests have been effectively protected during the period from 1997-98 to 2009-10.

Enhancement of Seed Production Areas (SPAs)

Establishment of Seed Production Areas of some commercially important timber species is the program for *in situ* conservation of forest genetic resources in different eco-region of Myanmar, to ensure and support the quality seeds. Seed production areas have increasingly been established since 1996 as seed sources for teak and other commercial plantations. Up till 2009, some 235 SPAs, having a total area of about 4,254 ha have been setup and details are shown in Table 10.

Table 10. Seed Production Area (2009)

No.	Species	Eco-region	No. of SPAs	Area (ha)
1.	Teak (<i>Tectona grandis</i>)	Various regions	191	3,256
2.	Pyinkado (<i>Xylia xylocarpa</i>)	Various regions	27	768
3.	Padauk (<i>Pterocarpus mcrocarpus</i>)	Various regions	1	10
4.	Pinus spp;	Chin Hills and ShanState	9	111
5.	Yename (<i>Gmelina arborea</i>)	Lower Myanmar	2	20
6.	6 Mangrove spp;	Mangrove Delta	5	89
	Total		235	4,254

Source: Plantation and Natural Forest Division, FD 2009.

Myanmar teak has been able to hold its reputation internationally for over a century and it is still considered to be the best. Myanmar forests are the legendary home of some of the best and the last remaining natural teak stands in the world. Teak is the most sought after timber because it is durable, stable, has anti-termites chemical, and with beautiful grain and color. Some go for black stripe teak which is darker in color while some who prefer lighter color go for golden teak. The variety of stripes and color indicates that there is variation in teak. Myanmar, in a sense is lucky, because it produces all these varieties. Moreover, its natural forests produce seasoned and large size teak that adds to the good reputation of the teak from this country. Teak from Myanmar has held this good reputation for over 100 years and can therefore be considered to be well proven in quality. In order to be able to maintain the reputation of Myanmar teak, it is vital that the seed used for these plantations should come from good mother trees that are of good genetic quality.

The present SPAs cannot fulfill the large amount of seeds required for the current reforestation programme. Thus, establishment of SPAs for teak and other priority species must be encouraged and urgently implemented throughout the country (in each relevant seed zone).

Selection and conservation of genetically good superior teak trees

Genetically superior teak trees are selected in their natural forests and strictly protected without permitting any kinds of disturbance including harvesting. From which selected superior trees, superior gerplasms (seed, vegetative parts, etc.) are collected for *ex situ* conservation programme.

Assessment and Monitoring of Forest Resources

Over the last 20 years, new technology has increasingly been used in assessing forest resources, including microcomputers, long-distance surveying via low- or high-resolution satellite, and GIS and global positioning systems (GPS). Considering the essential role of forest assessment and surveillance in good forest management, forest authorities should allocate resources to assessment and surveillance. Like other developing countries, Myanmar is in lack of

adequate forest inventory resources. In addition, the accurate and updated information is very critical for resource planner and decision markers. Thus, it is vital to build the necessary capacity.

Main constraints to improving *in situ* genetic conservation

Main constraints to improving *in situ* genetic conservation in Myanmar are limitation of assessment on plant species, lack of information, encroachment to natural forests, lack of interest in other woody species (lesser known species), lack of government resources and public awareness in conservation.

Chapter 3

The State of *ex situ* Conservation

2.2. *Ex situ* Conservation

Ex situ conservation can be implemented to the maintenance of species at outside their original habitats in botanical garden, arboreta, bambuseta, seed gene bank, seed orchards, multiplication garden, or in vitro gene bank. It is an important technique for long-term storage of genetic materials for future genetic improvement programmes and sustainable development of species. Most of the rural community who depended on natural forest for their daily needs, they are more interested in utilization of forest resources than in conservation of FGR, it is the major motivation for conservation. For that reason, some level of *ex situ* conservation becomes important. Although, *ex situ* Conservation of FGRs is practiced on a very limited in species, and just emphasis on the some timber species likes, teak in Myanmar.

Concerning with the *ex situ* conservation, the following activities are being conducted by the Forest Department:

- Establishment of teak provenance trials to assess their variations by the locality.
- Establishment of Teak Hedge Garden (Gene Bank) to collect superior planting materials.
- Vegetative propagation especially shoot cutting of valuable timber species for genetic improvement
- Planting of medicinal plants in Herbal Parks and Medicinal Plant Gardens.
- Tissue culture

Botanical Garden

National Kandawgyi Botanical Garden is situated in Pyin Oo Lwin, 3605 feet above sea level and 44 miles by road from Mandalay. National Kandawgyi Botanical Gardens is a national pride of the people of Myanmar as it attracts tens of thousands of local visitors as well as those from abroad. Because of its fascinating sceneries of forests, flowers, grassland and lakes, National Kandawgyi Botanical Garden is very popular for recreation and relaxation, particularly in summer. Having 36 C of maximum and 1.6 C of minimum temperature and an annual rainfall of 1600 mm the prevailing weather is mild creating blossoms of flowering plants in all seasons and therefore is known as the flower city of Myanmar.

The National Kandawgyi Botanical Garden has grown and developed with varieties of collections of plants from all over Myanmar. Its area has increased to 437 acres. Trees of 514 local and 75 exotic species are conserved of interest to the visitors who love flora. In addition, 50 orchard species, 270 native orchids and 75 crotons are important supplementary to the existing taxonomic collections in the garden. Besides, the bamboo garden comprising 75 Myanmar

species signifies the floristic richness of our forests. An herbal garden with the collection of 410 local medicinal plants is also conserved.

Establishment of Teak Provenance Trials

Following table shows the provenance trials which were established for teak resource conservation. Although phenotypically superior trees were selected, genetically information is unknown.

Table 11. Teak Provenance Trial in Myanmar (2010)

Established year	No. of provenance	Location
1982	18	Pyinmana, East Bago Yomas
1983	16	Oktwin, East Bago Yomas
1986	12	Pyinmana, East Bago Yomas
1998	10	Oktwin & Paukkaung, East & West Bago Yomas
2007	8	Nay Pyi Taw, Pyinmana Township, Mandalay Division
2007	9	Kyaukdaga Township, East Bago Division

Source: Forest Research Institute, 2010.

Establishment of Teak Clonal Seed Orchards and Seedling Seed Orchard

In Myanmar, teak seed orchards were established in Bago and Mandalay Divisions in 1981. A clonal seed orchard (CSO) of 34 ha was established in Toungoo District of Bago Division and one of 6 ha at a research station in the Yemathin District of Mandalay Division. The Forest Research Institute (FRI) of the FD has been conducting germination tests on seeds collected from these orchards. Average germination percent is about 25%.

Recently, under the project of “*Ex-situ* and *in-situ* conservation of teak to support sustainable forest management”, two CSOs were established in Nay Pyi Taw, Pyinmana Township, Mandalay Division (2.5 ha) and Pyi Township, West Bag Division (1.5 ha).

These orchards are still lacking the progeny test and genetic information of clones. Suitable layout design will be needed for establishment of new clonal seed orchard.

Establishment of Teak Hedge Garden

Conventional vegetative propagation methods, such as grafting, budding, layering and cutting could easily be applied for clonal propagation and establishment of Teak Hedge Gardens. Research on shoot cutting was successfully experienced by FRI in 1995-96. Short term training courses on THGs and planting stock production by shoot-cutting were regularly conducted at the Central Forestry Development Training Center (CFDTC). Both clonal and seedlings THGs have been introduced so as to ensure the sustained production of planting stock for plantations. On site field planting of rooted cuttings from THGs have been introduced to some forest districts during the rainy season of 2002.

The teak hedge gardens will be used for production of vegetative planting stock by shoot-cutting and for conservation purpose. Seven teak hedge gardens were established in the following townships.

- Bago Township, East Bago Division
- Oktwin Township, East Bago Division
- Taikgyi Township, Yangon Division
- Kyangin Township, Ayeyarwady Division
- Lewe Township, Mandalay Division
- Nattalin Township, West Bago Division
- Forest Research Institute, Yezin, Nay Pyi Taw (ITTO project)

They are mainly located in Bago Yomas region which is situated in the heart of the country which is said to be the best teak bearing area of Myanmar.

***Ex situ* conservation of other forest genetic resources including medicinal plant in Myanmar**

Some groups of forest plant species under *ex situ* conservation are medicinal orchids (15 species), medicinal plants (about 345 species) which are cultivated and conserved at Medicinal Plant Garden of Forest Research Institute, Yezin. For bamboo species conservation, 26 bamboo species and 10 bamboo species were conserved the genetic resource, about 10.5 ha in the Yangon Division and about 20 ha in Mandalay Division respectively.

Over 70% of the population lives in rural areas in Myanmar, and they rely on traditional medicines of which many are developed from herbs. One of the National Health Policies is to reinforce the services and research activities of indigenous medicine to international level and to involve in community health care activities. As an *in situ* conservation of plant genetic resources including herbs relevant laws, regulations are in place and permanent forest estates to ensure their conservation are legally formed. In addition, mainstreaming of *ex situ* conservation of useful plants to the relevant sectors has also been taking place in the agriculture and health. The National Herbal Park, 81 ha in area, was established in Nay Pyi Taw in 2008. Over 2,000 herbal and medicinal plants are being conserved in the park, which species are treated to six major diseases in Myanmar (diabetes, dysenteric, diarrhoea, malaria, hypertension, tuberculosis).

Tissue Culture

Tissue culture has become one of the key elements in the successful promotion of plantation forestry. Planting materials need not only be of adequate supply but also high quality. In this context, tissue culture is an important solution. In July 2002, the first batch of teak plants have been field planted and these plants are being observed to be growing with good health and performance. However, this achievement is still at the experimental stage and it is an indication of high potential for further progress.

2.3. Capacity building needs and priority for further *ex situ* conservation

- Development of institutional framework should be promoted to enhance research and training capabilities for human development, including to strengthen FGR Conservation in Myanmar.
- Dissemination of conservation strategies to each Township Forest Officer to undertake and develop conservation strategies for FGR.
- Extension on Awareness of FGR their important to environment and conservation
- Strong coordination is needed to strengthen the international organization, like the FAO, CBD, ACB and the APFORGEN.
- National strategies for *ex situ* conservation of FGR

- Assessment of the conservation status of plant species of the nation should be implemented, which is necessary step towards identifying threatened and endangered species for which protection is required. Population of plant species that are classified as threatened, need to be effectively managed and maintained through a variety of approaches involving *in situ* and *ex situ* conservation measures. List of threatened and endangered species can be drawn up for national priority species for *ex situ* conservation.

Chapter 4

The State of Use and Sustainable Management of Forest Genetic Resources

Forest resources have played an important role not only in socio-economic development but also in ecosystem management and biodiversity conservation in Myanmar. Therefore, Ministry of Forestry has formulated a National Forest Master Plan covering a time span of 30m years from 2001-2001 to 2030-2031. The Forest Department was implemented the National Forest Management plan (30 year National Forest master Plan) to support the sustainable management of FGRs.

The NFMP was worked out comprehensively into two volumes and the strategies areas are (a) management of natural forests, (b) establishment of forest plantations, (c) establishment of community forests, (d) growing trees in homestead and non-forested areas, and (e) promotion of wood-based industry value-added forest products. At the end of the planned period (2030-31), the permanent forest estate (PFE) will remain 40% of the country area.

The natural forests of Myanmar possess a wide range of non-wood forest products (NWFPs) besides timber. The trade of NWFPs is mainly undertaken by the private sector under the control of FD. Most NWFPs are essential commodities for domestic consumption as well as a source of income for local people.

4.1. The annual quantity of seed transferred internationally

As for Myanmar, there are no activities on seed and vegetative propogules transferred internationally.

4.2. List of the species to tree improvement programme

In Myanmar, *Tectona grandis* (Teak), *Pterocarpus macrocarpus* (Padauk), and some commercially species is presently conducted to tree improvement programmes by means of selection of plus tree, collect the breeding materials from plus tree and vegetative propagation.

Table 13. List of the species for tree improvement programme

Species		Improvement programme objective					
Scientific name	Native (N) or exotic (E)	Timber	Pulp wood	Energy	MP*	NWFP**	Other
<i>Tectona grandis</i>	N	*					
<i>Pterocarpus macrocarpus</i>	N	*					
<i>Pongamia pinata</i>	N			*	*		
<i>Gmelina arborea</i>	N	*	*				
<i>Eucalyptus camaldulensis</i>	E	*	*				
<i>Aqualaria agallocha</i>	N					*	

Chapter 5

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

5.1. Programme of FGR C & M

The National Forest Programme of Myanmar includes a teak tree improvement programme for the conservation and management of Forest Genetic Resources. As many other tree improvement programmes, the main elements in the teak improvement programme are: strategies, tree populations, operation and management, research and development.

Strategies

Tree improvement strategies involve planning and execution for achieving general objectives, especially of long term breeding, propagation and conservation in the improvement programme. The formulation and development of an improvement strategy requires biological and technological knowledge including: genetic variation and gain, flowering biology, mating system, seed production, clonal propagation, planting technique etc.

Population

Tree species population in an improvement programme consists of genetic resources, breeding, propagation and wood production. The genetic structures of these four populations are the core elements in the breeding programme. Due to the differences in their objectives, genetic structures, variability and long-term utilization, these four populations are usually established and maintained separately.

Operation/Management

Operations and management in an improvement programme are mostly concerned with the availability of human resources, financial resources, infrastructure and organization, knowledge of the genetic parameters and reproductive biology of the species, information, technologies, etc.

Institutions involved in Forest Genetic Resources Conservation and Management

The Ministry of Forestry (MoF) has five institutions:

- The Forest Department (FD) is the main government body for forestry sector policy and implementation and is responsible for the protection, conservation and sustainable management of the nation's forests;
- The Myanmar Timber Enterprise (MTE) carries out timber harvesting, milling, processing and marketing of forest products;

- Dry Zone Greening Department (DZGD) carries out reforestation of degraded lands and environmental restoration in the central Myanmar dry zone;
- The Planning and Statistics Department (PSD) coordinates the work of other organizations according to directives issued by the Minister's Office; and
- The National Commission for Environmental Affairs (NCEA) is the focal point for environmental policy planning at national level and is concerned with forest depletion and degradation.

Key NGOs include the Forest Resource Environment Development and Conservation Association (FREDA), the Biodiversity and Nature conservation Association (BANCA), Friends of the Rainforest Myanmar (FORM), the Renewable Energy Association (REAM), the Ecosystem Conservation and Community Development Initiative (ECCDI), and Myanmar Academy of Agriculture, Forestry, Livestock and Fishery (Htun, 2009).

Research and Development

Research and development in an improvement programme is essential to solve certain key problems. Moreover, the development of appropriate technologies will assist and facilitate the breeding activities (e.g. pollen extraction and storage, flowering induction, etc.) and propagation operations (e.g. seed production, cuttings, tissue culture, etc.).

The Objectives of Tree Improvement Programme

The objectives in teak improvement programmes are divided into short-term and long-term objectives as follows:

Short-term objectives include increased volume production per unit area of the plantation through the improvement of growth rate (e.g. diameter and height growth). Improved stem quality of tree in terms of stem straightness, clear bole, or pruning capability; persistence of stem axis other desirable characters. Improved wood qualities e.g. wood color and density. Production of genetically improved seed (e.g. through the establishment of seed production area and seed orchards) and vegetative propagates (e.g. through the establishment of clone banks) sufficient for planting programmes.

Long-term objectives include establishment of long-term breeding population for greater variability of the breeding populations through as many generations as possible. Securing the supply of improved seed and/or planting materials of greater cumulative gain for planting programmes.

5.2. Research on FGR C & M

The Myanmar Forest Research Institute (MFRI) is one of the divisions under the Forest Department which has established in 1978 and it is situated in Yezin, Nay Pyi Taw. The main research activities concerned with biodiversity conservation and tree improvement are:

- Development of natural forests
- Development of plantations
- Establishment of provenance trials of some valuable tree species
- Establishment of Clonal Seed orchards (CSOs) and Seed Production Areas *SPAs)

- Vegetative propagation on teak, padauk, thitsein, eucalyptus and other tree species
- Utilization of lesser-used species
- Introducing some tropical exotic tree species as trial basis
- Seed Improvement Activities
 - Comparison of the general characteristics of teak fruit and seed from different provenances
 - Study on the relation seediness and emptiness of teak, and its [potential germination capacity by cutting test
 - Phenology and controlled hand-pollination of teak in CSO
- Plus Tree Selection as a tool in Tree Improvement and *In situ* and *Ex situ* Conservation of Genetic Resources
 - Plus tree selection in any tree species population is simply “The Selection of Phenotypically Superior Trees” that would give better quality of regeneration and materials for breeding.
- Selection
 - in natural stands
 - in even-aged stands

As many desirable traits as possible such as good stem form, good height and dbh, crown position and form, good bole height and quality, resistance to pest and diseases.
- Independent Culling Levels Approach
 - Candidate tree will be compared to a number of neighboring trees for various characters.
- An Index Approach
 - Genotype and Phenotype
- Base Line Selection Approach
 - Candidate tree will be selected and compared to a regional average (or base line) calculated from a composite of measurements taken on a number of trees within a region.

5.3. Education and Training

Nature and Wildlife Conservation Division (NWCD), Forest Department establishes education centers in each protected area. Communication, Education and People Awareness programmes (CEPA) were conducted for the public visiting the parks and wildlife Sanctuaries. Park staffs and wanders carry out education on biodiversity conservation at village schools. The local Non Government Organizations (NGOs) also collaborate with NWCD in this activity.

University of Forestry, Forest Research Institute, Department of Agriculture Research (DAR), University of Agriculture, Central Forestry Development Training Center (CFDTC), Myanmar Forest School, etc. are giving the training programmes to the Government Staffs and people working in plant conservation.

5.4. National Legislation

Myanmar has adopted policy and legislative measures: Forest Law (1992), Forest Rule (1995), Protection of Wildlife and Wild Plant and Conservation of Natural Areas Law (1994), Protection of Wildlife and Wild Plant and Conservation of Natural Areas Rule (2002), Myanmar

Forest Policy (1995) and The Mines Law (1994), which are concerned with conservation, protection and proper utilization of its natural resources.

Myanmar Forest Policy was formulated in 1995 keeping in line with the forestry principles adopted at the United Nations Conference on Environment and Development (UNCED). Six imperatives identified in the policy are:

- **Protection** of soil, water, wildlife, biodiversity and the entire environment
- **Sustainability** of forest resources to ensure perpetual supply of both tangible and intangible benefits accrued from the forests for the present and future generations.
- **Basic needs** of the people for fuel, shelter, food and recreation;
- **Efficiency** to harness, in the socio-environmentally friendly manner, the full economic potential of the forest resources;
- **Participation** of the people in the conservation and utilization of forests; and
- **Public awareness** about the vital role of forests in the well-being and socio-economic development of the nation.

Under the guidance of the Government, laws and legislations related to biodiversity conservation are promulgated by all biodiversity related sectors. For example, the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law is in place to protect the wild fauna and flora. The law stipulates to establish scientific reserves, national parks, marine parks, nature reserves, wildlife sanctuaries, national heritage sites, etc. as deemed necessary, in order to conserve, in perpetuity, wildlife, wild plants, scenic beauties, natural areas of geo-physical or cultural significance for prosperity.

Table 14. Laws and Legislations Relating to FGR C & M and Protected Areas in Myanmar

Law/Act	Year	Major Aims/ Notes
Wild Elephant Protection Act	1879	To safeguard the population of wild elephant vital in timber operations
Forest Act	1902	Responsibility for wildlife management empowered to Forest Department
Wildlife protection Act	1936	Provides for designation of protected areas and protected species
Forest Law	1992	Can designate Reserves Forests for environmental and biodiversity conservation.
Protection of Wildlife and Wild Plant and Conservation of Natural Areas Law	1994	To implement the policies on protecting wild flora and fauna and natural areas, to fulfill international convention obligation; to enable to conduct research.
Forest Rules	1995	Provide article to protect biodiversity
Forest Policy	1995	Provide basic fundamentals to preserve biodiversity
Protection of Wildlife and Wild Plant and Conservation of Natural Areas Rules	2002	To conserve natural ecosystems and protect wildlife species.

Source: Forest Department

Chapter 6

The State of Regional and International Agreement and Collaboration

With regard to biodiversity conservation, Myanmar has made commitments to the following international agreements and organizations.

- UN Convention to Combat Desertification (UNCCD) in those counties experiencing serious drought and/or desertification in January 1994,
- UN Framework Convention on Climate Change (UNFCCC) in November 1994,
- UN Convention on Biological Diversity (CBD) in November 1994,
- International Tropical Timber Organization (ITTO) in November 1993 and ratification of the International Tropical Timber Agreement in January 1996
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in June 1997.
- Botanical Gardens Conservation International in November 1998.
- The Cartagena Biosafety Protocol, a subsidiary agreement to the UN Convention on Biological Diversity in March 2001.

Chapter 7

Access to Forest Genetic Resources and Sharing of Benefits arising from their Use

Chapter 8

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

Poverty is a cause of environmental degradation. In situation of poverty human encroachment onto the environment is exacerbated by the need to survive. Natural resources are depleted at a rapid rate as the poverty-stricken strive to meet their basic needs of food, warmth and shelter. Seventy five per cent of Myanmar's populations live in rural and often remote areas.

A national programme to eradicate poverty and achieve greater equity in income distribution and human resource development is needed. In formulating policies and strategies for sustainable development, the focus should be on human development and conservation and protection of resources must be taken of those who depend on the resources for their livelihoods.

Harvesting/utilization of non-wood forest products are for sustenance as well as income. It is also an important source for supplementing non-farm income. Forest dwellers for practicing

Shifting Cultivation in reserved forest have rights for collection and utilization of forest produce as provided in the reservation process. These rights include fuelwood collection, grazing and collection of non-wood forest products.

Forest Department established the village supply plantations and community forests throughout the country yearly. Fuelwood, pole and post have been contributed to the rural community for their needs from village supply plantations and community forests.

Community Forestry in Myanmar is an age old tradition. The forest enactment allows for community forest establishment and the instructions made under the act provide for a land and tree tenure of 30 years with royalty and tax exemptions for domestic use. According to the Community Forestry Instruction, rural peoples can established the community forest in the degraded forest areas by the permission of FD. They can get their needs of livelihoods form community forests without payment of revenue.

Conclusion

Myanmar still retains most of its biodiversity values, including population of endemic and globally threatened plant species. The recent implementations of a numerous species new to science suggest that much remains to be learnt about this biologically rich country. However, Myanmar is not a country caught in time, and the forces driving biodiversity loss in other parts of the Asia Region, including population growth, economic development, increasing consumption and integration into the global economy, are at play in the country. Over-exploitation of wildlife, large-scale timber extraction, conversion of natural habitats to other land-uses and infrastructure development are all major threats to biodiversity. Fortunately, there are still opportunities to plan and introduce conservation measures to mitigate these threats.

Myanmar with vast natural resources and plant diversity, the extent of efforts are required for FGR C & M. For effective conservation and management of National FGR conservation, the followings activities should be prioritized:

- Coordination and collaboration in the regional programme for sustainable management, research and conservation of FGR,
- Review and support the expansion of the national protected area system to address gaps in coverage of globally threatened species.
- Strengthen protected area management at Priority Sites,
- Support strengthening of the legislative framework for protected area management and species conservation,
- Forge partnerships between biodiversity conservation and rural development initiatives, maximize synergies, poverty reduction and mitigate risks,
- Conduct status surveys of priority species, where there is a need for greatly improved information on their status, distribution and ecology, and link results to conservation and management,
- Develop mechanisms for coordination and information sharing among NGOs and relevant organization, government departments, academic institutions active in Myanmar,
- Development of tree improvement through out the advance biotechnology,
- Establishment of CSOs, SPAs in the different areas for contribution the quality seeds,

Given the situation in Myanmar, it is obvious that more efforts and endeavors are needed as far as FGR conservation and management is concerned. In order to strengthen and

promote FGR conservation and management in Myanmar, capacity building is inevitably required because FD staff and relevant partners with adequate skills to implement FGR C&M programmes effectively and efficiently are rather limited. In addition, budget, physical infrastructure and laboratory facilities, etc. also need to be upgraded.

Today, the issue of FGR C&M has become a global concern. The concept of FGR C&M has changed in that the forests existing in a country is not just its own resources but the heritage of the rest of the world. As such, a country should implement FGR C&M activities in collaboration and cooperation with other countries, particularly neighboring countries. A country must fully realize its commitments in accordance with the signed international and regional treaties, conventions and agreements. Views and experiences in relation to planning and implementation of the FGR C&M programmes should be exchanged through networking, workshops and seminars for present and future benefits of mankind.

Reference

1. Asia-Pacific Forests and Forestry to 2020, Report of the Second Asia-Pacific forestry Sector outlook Study, Food and Agriculture Organization of the United Nations, Bangkok, 2010.
2. Food and Agricultural Organization, *Forest Genetic Resources*, 2002.
3. Food and Agricultural Organization, *Forest Resource Appraisal*, 2005.
4. Forestry in Myanmar 2010 (unpublished).
5. Fourth National Report to the United Nations Convention on Biological Diversity, Government of the Union of Myanmar, Ministry of Forestry, National Commission for Environmental Affairs, March, 2009.
6. Forestry Administration, Cambodia, *Conservation of Valuable and Endangered Tree Species in Cambodia 2001-2006 – a case study*, 2006
7. Forestry in Myanmar, 2010 (unpublished)
8. Global Forest Resources Assessment 2010, Main Report, FAO Forestry Paper 163. Food and Agriculture Organization of the United Nations, Rome, 2010.
9. Government of Burma, The Forest Act (Burma Act IV 1902)
10. International Tropical Timber Organization, *Criteria and Indicators for Sustainable Management of natural Tropical Forests*, 1998
11. International Tropical Timber Organization, *Operational Plans for the Conservation of Tropical Timber Species in Southeast Asian Countries*, 2000
12. International Tropical Timber Organization, *State of the art Review on Conservation of Forest Tree Species in Tropical Asia and the Pacific*, 2000
13. Ministry of Forestry, Forest Department, *Forestry in Myanmar*, 2003
14. Ministry of Forestry, *Myanmar Forest Policy*, 1995
15. Ministry of Forestry, *National Master Plan for Forestry Sector 2001-2002 to 2030-203*, 2001
16. Myanmar Investment Opportunities in Biodiversity Conservation, Yangon, November 2005.
17. National Commission for Environment Affairs, Myanmar Agenda 21, 1997
18. Proceeding of the Seminar on Teak Seed Production Area Management and Tree Improvement, Ministry of Forestry, Forest Department, *Ex situ and In situ Conservation of Teak to Support Sustainable Forest Management* (ITTO Project PD 270/04 Rev. 2 (F), Forest Research Institute, Yezin, 20 February 2008.
19. The Convention on Biological Diversity, *Global Strategy for Plant Conservation*
20. The Convention on Biological Diversity, *Handbook of the Convention on Biological Diversity*, 2001

21. The Union of Myanmar, *Forest Law*, 1992
22. The Union of Myanmar, *The Protection of Wildlife and Protection Law*, 1994
23. The World Conservation Union, *Management Guidelines for IUCN Category V Protected Areas Protected Landscapes/Seascapes*, 2002
24. Kermodé, C.W.D. 1964. Some Aspects of silviculture in Burma. Central Press Rangoon.
25. Lwin Ko Oo, Forest Genetic Resources Conservation and Management in Myanmar, National Coordinator's meeting, Dehradun, India, 15-16 April 2006.
26. Nyi Nyi Kyaw, Present Management of the Existing Teak Resources in Myanmar presented in the National Consultative Workshop on Forest Genetic Resources, FRI, Yezin, Myanmar, 26 February 2008.
27. T. Luoma-aho, L.T. Hong, V. Ramatha Rao and H.C. Sim et. al., 2003. Proceedings of the Asia Pacific forest genetic resources programme (APFORGEN) inception workshop. Kuala Lumpur, Malaysia.

ATTACHMENT

Preliminary List of Globally Threatened Plant Species in Myanmar

No.	Scientific Name	Common Name	Global Threat Status			Selection Criteria for priority Species		
			Critically endangered	Endangered	Vulnerable	Myanmar supports Significant population	Species-focused Action Required	Need for Additional Investment
1	<i>Azelia xylocarpa</i>			EN		N/A	N/A	N/A
2	<i>Anisoptera costata</i>			EN		N/A	N/A	N/A
3	<i>Anisoptera scaphula</i>		CR	EN		N/A	N/A	N/A
4	<i>Aqualaria malaccensis</i>				VU	N/A	N/A	N/A
5	<i>Burretiodendron esquirolii</i>				VU	N/A	N/A	N/A
6	<i>Calocedrus macrolepis</i>				VU	N/A	N/A	N/A
7	<i>Cephalotaxus manii</i>				VU	N/A	N/A	N/A
8	<i>Cleidiocarpon cavaleriei</i>				VU	N/A	N/A	N/A
9	<i>Cleidiocarpon laurinum</i>			EN		N/A	N/A	N/A
10	<i>Cycas siamensis</i>				VU	N/A	N/A	N/A
11	<i>Dalbergia oliveri</i>			EN		N/A	N/A	N/A
12	<i>Dipterocarpus alatus</i>			EN		N/A	N/A	N/A
13	<i>Dipterocarpus baudii</i>		CR			N/A	N/A	N/A
14	<i>Dipterocarpus costatus</i>			EN		N/A	N/A	N/A
15	<i>Dipterocarpus dyeri</i>		CR			N/A	N/A	N/A
16	<i>Dipterocarpus gracilis</i>		CR			N/A	N/A	N/A
17	<i>Dipterocarpus grandiflorus</i>		CR			N/A	N/A	N/A
18	<i>Dipterocarpus kerrii</i>		CR			N/A	N/A	N/A
19	<i>Dipterocarpus retusus</i>				VU	N/A	N/A	N/A
20	<i>Dipterocarpus turbinatus</i>		CR			N/A	N/A	N/A
21	<i>Hopea apiculata</i>		CR			N/A	N/A	N/A
22	<i>Hopea ferrea</i>			EN		N/A	N/A	N/A
23	<i>Hopea griffithii</i>				VU	N/A	N/A	N/A
24	<i>Hopea helferi</i>		CR			N/A	N/A	N/A
25	<i>Hopea odorata</i>				VU	N/A	N/A	N/A
26	<i>Hopea sangal</i>		CR			N/A	N/A	N/A
27	<i>Intsia bijuga</i>				VU	N/A	N/A	N/A

28	<i>Magnolia rostrata</i>				VU	N/A	N/A	N/A
29	<i>Parashorea stellata</i>		CR			N/A	N/A	N/A
30	<i>Picea farreri</i>			EN		N/A	N/A	N/A
31	<i>Pterocarpus indicus</i>				VU	N/A	N/A	N/A
32	<i>Shorea farinosa</i>		CR			N/A	N/A	N/A
33	<i>Shorea gratissima</i>			EN		N/A	N/A	N/A
34	<i>Shorea henryana</i>			EN		N/A	N/A	N/A
35	<i>Shorea roxburghii</i>			EN		N/A	N/A	N/A
36	<i>Taiwania cryptomerioides</i>				VU	N/A	N/A	N/A
37	<i>Vatica cinerea</i>			EN		N/A	N/A	N/A
38	<i>Vatica lanceaefolia</i>		CR			N/A	N/A	N/A
	Total		13	12	13			

Appendix

Progress towards Target of the Global Strategy for Plant Conservation and the Programme of Work on Protected Areas

A. Progress towards Targets of the Global Strategy for Plant Conservation

Targets	Progress
Target 1: A widely accessible working list of known plant species as a step towards a complete flora	A checklist of the Tree, Shrubs, Herbs, and Climbers recorded in Myanmar had been revised from the original works by J.H. Lace, R. Rodger, H.G. Hundley, and U Chit Ko Ko in 2003 with the cooperation of Forest Department of Myanmar and Smithsonian Institution, USA. A project of Inventory on the Useful Plants in Myanmar is being conducted jointly by Forest Department and Makino Botanical Garden, Japan. Review and updated information for plant species are needed to achieve the target.
Target 2: Development of models with protocols for plant conservation and sustainable use, based on research and practical experience	A Protection of Wildlife and Wild Plant and Conservation of Natural Areas Law was promulgated in 1994 in order to protect endangered species of wild flora and fauna and their habitats. Guidelines and regulations for orchid farms had been formulated to ensure conservation and sustainable use of orchids. Recently, a total of 6 private farms have been registered for commercial purpose. Regular inspections are being conducted at each farm.
Target 3: Effective conservation of ecological region	Ten bio-units have been recognized. Reserves forests covering some over 23% of the country's corporate areas are being in specific management regimes which ensure to meet the goals of sustainable forest management and ecosystem services. Since these reserved forests are located throughout the country and are legally protected and scientifically managed effective conservation of ecological regions can be realized. Besides, network of protected area systems established pertaining to snow-capped mountains and high altitude wetlands in the far north to evergreen forest and deciduous complexes, dry and sub-humid land in the central part, diversity of river and fresh water bodies to deltaic and costal complexes are permanently conserved to demonstrate Myanmar is committed to this target.
Target 4: Protection of the most important areas for plant	Northern Forest Complex made up of four wildlife sanctuaries covering some 30,205 km ² are considered as the most important

diversity	areas for plant diversity. Since its north part connects eastern Himalayan with its west scientists believe that species found in east and west Himalayan can exist here. Presently, this region is very rich biodiversity. For example, pristine forests ranging from tropical evergreen to alpine are found intact in large areas.
Target 5: Management of production lands consistent with the conservation of plant diversity.	In order to achieve reservation of 30% of total country area targeted in 30 year forestry master plan, 22.37% has been reserved as production lands consistent with the conservation of plant diversity.
Target 6: <i>In situ</i> conservation of threatened species	38 plant species was recorded and have been assessed as globally threatened, comprising 33 species of angiosperm and five species of gymnosperm. 43 Protected Areas of notified and proposed are established for the protection and conservation of threatened species as <i>in situ</i> conservation.
Target 7: <i>Ex situ</i> conservation of threatened plant species	589 tree species, 75 bamboos, 75 crotons, 270 orchids and 410 medicinal plants including the 38 globally threatened plant species are planted in the National Kandawgyi Botanical Garden as <i>ex situ</i> conservation. In addition, a National Herbal Park and local herbal nurseries are also established.
Target 8: Conservation of genetic diversity of crops and other major socio-economically valuable plant species	Systematic plant genetic resources management is being implemented at Central Agricultural Research Institute and crop varieties were collected and maintained at seed bank. A project of inventory on the useful plants in Myanmar is being conducted jointly organized by Forest department and Makino Botanical Garden, Japan. Currently Forest Department has been reviewing to amend the existing Protection of Wildlife and Natural Areas Law in order to meet the present requirement and that of CITES.
Target 9: Management plan for alien species	A focal point to Alien Species Network was nominated. A total of 60 alien species are recorded in Myanmar and management plan to control the invasion of these species is under process.
Target 10: No species of Wild flora endangered by international trade	Myanmar acceded to CITES in 1997 and exercising the regulations of the convention to control international trade of endangered plant species. At regional level, Myanmar joined the implementation of ASEAN wildlife Enforcement Network established in 2005 and consequently organized the National wildlife Enforcement Taskforce including relevant agencies such as Forest Department, Customs Department, Police Force, Department of Fisheries, etc.
Target 11: Plant-based products derived from sources that are sustainably managed	Most of all plant-based forest products are controlled by Myanmar Forest Law (1992), Community Forestry Instructions (1995) and Timber Certification with relevant criteria and indicators of International tropical timber Organization (ITTO) in order to ensure sustainable
Target 12: Communication, education and public awareness programmes for the importance of plant diversity	Nature and Wildlife and Conservation Division (NWCD), Forest Department establishes education centers in each protected area. Communication, education and public awareness programmes were conducted for the public visiting the parks and wildlife sanctuaries Park staffs carry out education on biodiversity conservation at village schools. The local NGOs also collaborate with NWCD in this activity.
Target 13: Capacity building programmes	University of Forestry, forest Research Institute, Department of Agricultural Research, University Agriculture, central Forestry Development Training Center, Myanmar Forest School, etc. are giving

	the training programmes to the Government staffs and people working in plant conservation.
Target 14: Network of plant conservation activities	Ministry of Forestry, Ministry of Agriculture and Irrigation, local communities, stakeholders, NGOs such as Forest Resources Environment and Development Association (FREDA), Myanmar Floristic Association, INGOs such Botanic Gardens Conservation International (BGCI), Makino Botanical Garden (MBK), Japan International Cooperation Agency (JICA), Asia-Pacific Forest Genetic Resources programme (APFORGEN) as a network of plant conservation activities.

B. Progress toward Target of the Programme of Work on Protected Areas

Targets	Progress
Target 1: To establish a network of protected areas covering 55 of total area of the country by the year 2010	At the moment, about 3.93% of the total area of the country had been notified as Protected Areas and about 3.73% had been proposed to establish as Protected Areas.
Target 2: to establish and strengthen trans-boundary protected areas.	To enhance the conservation and sustainable use of biological diversity and improving international cooperation, Myanmar is trying to extend the area of some important conservation areas. Myanmar Forest Department started the Northern Forest Complex project in 2003. It comprises totally four protected areas together constitute the largest contiguous block of protected areas in mainland of Indochina covering an area of 30.205 km ² . Being a member of ICIMOD, Myanmar has been implementing high altitude wetland conservation activities with the collaboration of China intend to protect the head waters of the Ayeyarwady, the major river of the country.
Target 3: To improve site-based protected area planning and management	In order to achieve one of the imperatives of Myanmar Forest Policy to enhance people participation, Forest Department is formulating effective protected area management plans by consultation with the local people and stakeholders. At present, management plans for Hkakaborazi National Park and Hukaung Valley Wildlife Sanctuary had been formulated and programmes to be implemented are in process. In addition, Community Based Natural Resources Management programmes are being introduced into protected areas management to achieve sustainable use of natural resources.
Target 4: To prevent and mitigate the negative impacts of key threats to protected areas.	To mitigate the encroachment into protected areas, buffer zone management systems are being implementing in most of the protected areas. Also, law enforcement activities such as establishing a national wildlife enforcement taskforce, setting up of Elephant Protection Unit and tiger protection Unit, effective patrolling activities, education and awareness programmes etc. are being conducted. Moreover, modern agricultural techniques for sustainable land-use systems have been introduced to minimize shifting cultivation in protected areas.
Target 5: to promote equity and benefit sharing	Community Based Resources Management Programmes are being introduced into protected area management systems for the equitable sharing of both cost and benefits.
Target 6: to enhance and secure	Myanmar Forest Law (1992) allows property rights and privileges for

involvement of indigenous and local communities and relevant stakeholders.	people living in and around the protected areas. Village-use zones are also designated based on the village consultation processes conducted in protected areas. Participation of local people is being encouraged by conducting public awareness and education programmes and recruiting local people as field staff in conservation activities and protected area management. Multi-stakeholders meetings are also held to enhance and secure involvement of their participation in protected area management.
Target 7: To provide an enabling policy, institutional and socio-economic environment for protected areas.	Myanmar Forest Policy (1995) was formulated mainly for safeguarding soil, water catchments, ecosystems, biodiversity and plant and animal genetic resources, scenic reserves and national heritage sites. Relevant institutions such as forestry, fisheries, irrigation, mining, local authorities etc. are cooperating for effective protected area management. Also, socio-economic surveys are conducted to be considered in the preparation of management plan.
Target 8: To build capacity for the planning, establishment and management of protected areas.	Training programmes for planning, establishment, and management of protected areas are being given at various institutions such as University of Forestry, Central Forest Development Training Center and Myanmar Forest School. In addition, field staffs are provided to participate in national, regional and international workshops, meetings, seminars and trainings for strengthening their knowledge and skills.
Target 9: To ensure financial sustainability of protected areas.	The Government of the Union of Myanmar is cooperation with NGOs and INGOs such as Wildlife Conservation Society (WCS), California Academy of Science, Conservation International, JICA, MBK, FAO etc. to ensure financial assistance for establishment and maintenance of protected areas.
Target 10: To strengthen communication, education and public awareness.	Education and public awareness programmes, training, seminars, workshops for decision and policy markers, students down to high school level, governmental staff. Local communities, all stakeholders are being conducted throughout the country by GOs, NGOs, private organizations for understanding and appreciation of the importance and benefits of protected areas.
Target 11: to evaluate and improve the effectiveness of protected areas management.	Based on the adopted management plan, monitoring, evaluating of protected areas management are carried out regularly in each protected areas. Three monthly reports for progress have been submitted to higher authorities and analyzed to improve and amend the existing management plan. At the moment completion report of elephant survey jointly implemented with Forest Department and WCS in Hukaung Valley Wildlife Sanctuary, and medicinal plants survey conducted by the Forest Department and Makino Botanical Garden, Japan in Natmataung National Park had been submitted. Furthermore, other scientific research activities such as occupancy of tiger and prey species, herpetological survey, home-range analysis of wild elephants etc. are still conducted and submitted as interim reports.
Target 12: To assess and monitor protected area status and trends.	At national level, 34 protected areas had been notified covering about 3.93% of the area of the country and 9 are still being proposed with the coverage of 3.73%. Regionally, the ASEAN Heritage Parks Programme is designed to complement the protection of several Natural World Heritage Sites within ASEAN's efforts to meet the UN

	<p>Millennium goals on the environment with respect to reducing biodiversity loss. A total of 27 national protected areas in the region are designated as ASEAN Heritage in 2003. Among these parks, Myanmar contributes six protected areas which occupied 22% of the total sites.</p>
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