

# STATE OF FORESTS AND FOREST GENETIC RESOURCES IN MYANMAR

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## Introduction

Myanmar is situated in continental Southeast Asia, between latitudes 9° 58' to 28° 00' and longitudes 92° 10' to 101° 10' E. The country covers an area of 676,577km<sup>2</sup>, extending 2090km from north to south and 805km from east to west. Diurnal temperatures range from 25°C to 33°C during the rainy season, and from 10°C to 25°C during the cold season, but can reach 43°C in the hot season, particularly in the central dry zone. Rainfall is distributed over a five-month period and averages 800–5000mm per year. Wide variations in altitude and climate mean that Myanmar's forest flora ranges from sub-alpine to tropical formations.

Myanmar is well endowed with forests and other natural resources. Forests cover about 40% of the total land area. They are traditionally classified into two categories: reserved forests and unclassified (or public) forests. Forest exploitation is controlled by law, but the government allows rural communities to use various forest products (except protected plants and animal species).

Myanmar has a population of about 49 million people, over three-quarters of whom depend heavily on forest products, particularly fuelwood, posts and poles. Forest genetic resources play a major role in socio-economic development and forest product exports are an important source of foreign exchange. Myanmar is the world's largest supplier of natural teak (*Tectona grandis*). Myanmar's forests also support large numbers of plant and animal species.

## Status of forests and forest genetic resources

Table 1 gives figures for forest cover based on Landsat data from 1989. As the table indicates, Myanmar is still relatively well endowed with natural forests.

**Table 1.** Forest cover in Myanmar. Source: Forest Department (1998).

Land Category	Area (km <sup>2</sup> )	% Total Land Area
Closed forest	293,034	43.31
Degraded forest	50,733	7.50
Forest affected by shifting cultivation	154,389	22.82
Water bodies	13,327	1.97
Non-forest	165,094	24.40
<b>Total Land Area</b>	<b>676,577</b>	<b>100</b>

About 43% of Myanmar's total land area is under closed forests and another 30% under woodland. An assessment in 1990 revealed that forest cover had decreased at an annual rate of 220,000ha, or 0.64%, between 1975 and 1989. This decrease was attributed mainly to shifting cultivation, illegal logging and encroachment for agricultural purposes. The permanent transfer of forest land to non-forest uses, however, was only about 15,000ha per year during

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the same period. According to FAO (1999), Myanmar lost 387,000ha, or 1.4%, of its forests each year between 1990 and 1995.

Myanmar has about 7000 plant species, of which 1071 are endemic (Table 2). Eighty-five of the 2088 tree species in Myanmar produce multipurpose timber of high quality (Forest Department 2000). The properties and end uses of lesser-used timber species (LUS) are being studied and their use is widely promoted. The aim of promoting LUS is to increase commercial timber production and reduce exploitation pressures on traditional timber species.

**Table 2.** Numbers of plant species in Myanmar. Source: Forest Department (2000).

Category	Species
Big tree	1,347
Small tree	741
Bamboo	96
Shrub	1,696
Rattan	36
Orchid	841

### Forest types

The forests of Myanmar are highly diverse (Table 3). They vary from the scrubby and thorny vegetation of central Myanmar to the candlestick-like stands of evergreen dipterocarps. The coastal mangrove forests are important breeding grounds for many aquatic species. These forests support local fishing industries and provide food, shelter, small-scale timber, fuelwood and other forest products to coastal communities. Over half of the main forest types (tropical evergreen forest, mixed deciduous forest and deciduous dipterocarp forest) support valuable timber species.

**Table 3.** Forest types by area in Myanmar. Source: Tint (1995).

Forest Type	Area (ha)	% Total Forest Area
Beach and Dune Forest	1,376,900	4
Tropical Evergreen Forest	5,507,800	16
Mixed Deciduous Forest	13,425,300	39
Dry Forest	3,442,400	10
Deciduous Dipterocarp Forest	1,721,200	5
Hill and Temperate Evergreen Forest	8,950,100	26
<b>Total Forest Area</b>	<b>34,423,700</b>	<b>100</b>

Myanmar's forest area can also be divided by vegetation type and productivity (Tables 4 and 5). Table 5 shows that the forests of Myanmar contain a growing stock of about 2.2 billion m<sup>3</sup>. Assuming a growth rate of 1.5m<sup>3</sup>/ha/yr in the productive closed broadleaved forests, total annual growth is about 31 million m<sup>3</sup>.

**Table 4.** Forest area by vegetation type (in thousands of hectares). Source: Tint (1995).

Type of Vegetation	Productive Forest	Unproductive Forest	Total
Closed broadleaf	20,655	11,908	32,563
Mangrove	382	403	785
Bamboo	963	–	963
Conifer	113	–	113
<b>Total</b>	<b>22,113</b>	<b>12,311</b>	<b>34,424</b>

**Table 5.** Wood volume by vegetation type. Source: Tint (1995).

Type of Vegetation	Productive Forest		Unproductive Forest		Total ('000 m <sup>3</sup> )
	Total ('000 m <sup>3</sup> )	m <sup>3</sup> /ha	Total ('000 m <sup>3</sup> )	m <sup>3</sup> /ha	
Closed broadleaf	1,859,000	90.0	357,000	30	2,216,000
Mangrove	12,000	30.6	4,000	10	16,000
Conifer	16,000	141.6	–	–	16,000
<b>Total</b>	<b>1,887,000</b>	–	<b>361,000</b>	–	<b>2,248,000</b>

The status of Myanmar's permanent forest estate at the beginning of 2000 is given in Table 6. Reserved forests, i.e. those completely protected by law, are expected to cover 30% of the country's land area by 2001.

**Table 6.** The permanent forest estate in Myanmar. Source: Ministry of Forestry (1999).

Legal Classification	Area ('000 ha)	% Total Land Area
Reserved Forest	11,119	16.40
Protected Public Forest	1,479	2.19
Protected Area System	1,527	2.26
<b>Total</b>	<b>14,118</b>	<b>20.85</b>

### **Bamboo forests**

Bamboo forests occur throughout Myanmar in both pure and mixed stands. Pure stands of Kayin-wa (*Melocanna bambusoides*) cover about 8000km<sup>2</sup> in Rakhine State in the western part of the country (Forest Department 1999a). Considerable areas of pure bamboo stands are also found in Tanintharyi Division in the southernmost part of Myanmar. The *M. bambusoides* stands in Rakhine State have an estimated growing stock of 21.34 million tonnes and are capable of producing around 830,000 tonnes of pulp each year. The pure bamboo stands in Tanintharyi Division have a growing stock of 6.09 million tonnes, and are capable of producing an annual pulp yield of 247,904 tonnes if managed under a ten-year cutting cycle. According to forest inventory data from the States and Divisions, the stocking of mixed bamboo and tree stands is 1.66 tonnes/ha (Forest Department 2000).

### **Use of forest resources**

The majority of important trees species such as teak, pyinkado (*Xylia kerrii*), padauk (*Pterocarpus macrocarpus*) and some lesser-used species are found in association with each other in mixed deciduous forests. Many other valuable tree species such as the dipterocarps and some lesser-used species can also be found in the evergreen forests. The deciduous dipterocarp forests are commonly found at higher altitudes in the northern part of the country.

Domestic market studies indicate that 60% of furniture manufacturers use only teak, whereas the remainder use both teak and other hardwoods. Teak and pyinkado are valued for the durability of their timber. Mangrove forests dominate the delta and coastal regions, and are the main sources of fuelwood in the country.

Export earnings from the forestry sector constituted about 30% of Myanmar's total export earnings in the early 1990s. In recent years, however, forestry's share of total export earnings has decreased owing to the increased production in other sectors. Between 1998 and 2000, the earnings of the forestry sector again increased.

The main threats to forest resources in Myanmar are:

- Encroachment by farmers;
- Shifting cultivation;
- Forest fires;
- Building of dams;
- Urbanization and building of roads; and
- Lack of awareness of the importance of biodiversity.

Myanmar's government has recognized the role of forests in conserving soil and water resources, and in protecting the environment. Myanmar is also committed to sustainable use of forests and other biological resources through a number of international conventions and agreements (see below).

### *Management of natural forests*

The Myanmar Selection System (MSS) is the principal silvicultural system employed in Myanmar's natural forests. This prescribes a cutting cycle of 30 years, as well as selective marking of other hardwoods, felling of less-valuable trees interfering with the growth of teak, thinning of dense teak stands, identification of future crop trees and fixing of annual allowable cuts (AACs) for teak and other hardwood species. Various coppicing systems are also used to supply small-scale timber and fuelwood.

Until early in 1996, the AAC for teak was 609,500m<sup>3</sup>. Later in the same year, the AAC was revised downwards to 409,062m<sup>3</sup>. Harvest volumes of non-teak hardwoods has been increased in line with AACs to keep the volume of exports constant. The current AACs for teak and other non-teak hardwoods are given in Table 7.

*Table 7. Annual allowable cuts. Source: Forest Department (1998).*

<b>Tree Species</b>	<b>Number of Trees</b>	<b>Volume (m<sup>3</sup>)</b>
Teak	124,213	409,062
Other Hardwoods	1,795,424	3,236,071

With respect to biodiversity and environmental conservation, Myanmar's protected area system is being expanded from 2% to 5% of the land area. To date, 23 sanctuaries and 5 national parks have been established. The diverse forest ecosystems of Myanmar are home to nearly 300 known mammal species, 360 reptiles and about 1000 bird species.

The natural forests of Myanmar provide substantial opportunities for ecotourism development. The areas identified for this purpose include the Meinmahla Kyun Wildlife Sanctuary in the

Ayeyawaddy Delta, the Hlawga Park near Yangon, the Yangon Zoological Garden, the Moyungyi Wetlands Wildlife Sanctuary near Bago and the Seinyay Forest Resort on the strategic road across the Bago Yoma teak forests. In addition, the Popa Mountain Park and Shwe-set-taw Wildlife Sanctuary in Central Myanmar, the Pyin-Oo-Lwin Botanical Garden, the Alaungdaw Kathapa National Park in Upper Myanmar and the Inle Lake Wetlands Wildlife Sanctuary on the Shan Plateau of Eastern Myanmar have outstanding ecotourism potential.

The ecotourism potential of the Inn-daw-gyi Wetlands Wildlife Sanctuary in northern Myanmar and Natma Taung National Park in the northwest Chin Hills is now under development. Development of ecotourism activities is also proceeding in the Chattin Wildlife Sanctuary in Upper Myanmar. In addition, Khakarborazi National Park in the far north of the country provides an attractive environment for outdoor recreation with snow-capped mountains and sub-alpine forests.

### *Forest plantations*

The first teak plantations in Myanmar were established in 1856 using the taungya method. By the end of 1941, the area of plantations had reached 47,167ha. Large-scale plantation forestry began in 1980 and more than 30,000ha of plantations have been established each year since 1984.

A special teak plantation programme, divided into eight consecutive phases, has been operating since 1997. Each five-year phase covers 20 plantation centres. Each centre establishes 405ha of teak plantations annually, which means that a total area of 40,500ha should be established by the end of the first phase. By the end of the 40-year period, the plantation programme is expected to have established 324,000ha of teak plantations. Tables 8 and 9 show forest plantation areas in Myanmar by species and by type.

**Table 8.** *Forest plantations by species. Source: Forest Department (2000).*

<b>Species</b>	<b>Area (ha)</b>	<b>% Total Area</b>
Teak	280,963	42
Pyinkado	52,177	8
Padauk	15,527	2
Pine	15,886	2
Eucalyptus	74,621	11
Other	236,023	35
<b>Total</b>	<b>675,197</b>	<b>100</b>

**Table 9.** *Forest plantations by type. Source: Forest Department (2000).*

<b>Type</b>	<b>Area (ha)</b>	<b>% Total Area</b>
Commercial	370,775	55
Village Supply	188,550	28
Industrial	50,315	7
Watershed	65,557	10
<b>Total</b>	<b>675,197</b>	<b>100</b>

Establishment methods for teak plantations include direct sowing, planting of potted seedlings and stump planting. Direct seed sowing is normally done as soon as possible after *kyunkwe* (reburning). Stump planting is usually preferred in areas with high rainfall. Planting of potted

seedlings ensures a high rate of survival despite the relatively high cost of production. Root-shoot cuttings from one-year-old seedlings are especially useful for enrichment planting.

The availability of an adequate amount of high-quality planting stock is essential for establishing large-scale plantations and maintaining genetic diversity. The East Bago Yoma plantation project began establishing seed production areas (SPAs) in the early 1980s. This practice has been extended since 1996. About 650ha of SPAs have been established in one state and four divisions in Myanmar (Table 10).

*Table 10. Forest seed production areas in Myanmar. Source: Forest Department (1999b).*

<b>State/Division</b>	<b>Area (ha)</b>	<b>Source</b>
Mandalay Division	89.03	Plantation
Magway Division	204.37	Plantation/Natural Forest
Bago Division	260.08	Plantation/Natural Forest
Kayin State	20.23	Plantation
Sagaing Division	80.94	Plantation
<b>Total</b>	<b>654.65</b>	

Teak seed orchards were established in Bago and Mandalay Divisions in 1981. A clonal seed orchard of 34ha has been established in Toungoo District of Bago Division and one of 6ha at a research station in the Yamethin District of Mandalay Division. The Forest Research Institute at Yezin is conducting germination tests on seed collected from these orchards.

### **Institutional and policy framework**

Four governmental institutions under the Ministry of Forestry participate in forestry sector activities. The Forest Department is responsible for the protection, conservation and sustainable management of forests. The Myanmar Timber Enterprise (MTE) carries out timber harvesting, milling, downstream processing and marketing of forest products. The Dry Zone Greening Department (DZGD) focuses on reforestation of degraded lands and restoration of the environment in the dry zone of central Myanmar. The Planning and Statistics Department (PSD) coordinates and facilitates the work of the Forest Department, MTE and DZGD according to directives issued by the Ministry of Forestry. It also functions as a forest policy forum.

Myanmar's forest policy has been formulated in a holistic and balanced manner within the framework of environmental protection and sustainable development. The policy takes into account the forestry principles adopted at the United Nations Conference on Environment and Development (UNCED) in 1992. The policy identifies six priority areas for government action:

- i) Protection of soil, water, wildlife, biodiversity and environment.
- ii) Sustainability of forest resources to ensure a perpetual supply of benefits from forests for present and future generations.
- iii) Basic needs of the people for fuel, shelter, food and recreation.
- iv) Efficient use, in a social and environmentally friendly manner, of the full economic potential of forest resources.
- v) Participation of people in the conservation and use of forests.
- vi) Public awareness of the vital role of forests in the well-being and socio-economic development of the nation.

The Forest Act of 1902 has been replaced by a new law enacted in November 1992. This new law emphasizes environmental protection and biodiversity conservation, and provides for the creation of a permanent forest estate and protected area system. It also provides opportunities for promoting private sector involvement in reforestation and the timber trade, and in decentralized management regimes. The law also encourages participatory approaches to forest management designed to satisfy the basic needs of rural people. In general, the law reflects a shift in government roles from restricting access and generating revenues from forests to motivating local people and sharing management responsibilities.

The Burma Wildlife Protection Act of 1936 was replaced in 1994 by the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law. This new law highlights habitat maintenance and restoration, protection of endangered and rare species of both fauna and flora, establishment of new parks and naturally protected areas, and buffer zone management.

Myanmar has made commitments to the following international agreements on forestry and other environmental issues:

- UN Convention to Combat Desertification in those countries experiencing serious drought and/or desertification in January 1994.
- UN Framework Convention on Climate Change in November 1994.
- UN Convention on Biological Diversity 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.

In addition, Myanmar has been a member of the International Centre for Integrated Mountain Development (ICIMOD) since 1992. The main areas of cooperation between the Forest Department and ICIMOD are information exchange and dissemination, demonstration of conservation technologies and training on other technologies such as remote sensing, geographic information systems and global positioning systems.

### ***Forestry training in Myanmar***

The Institute of Forestry (IOF) is a university-level institute under the Ministry of Forestry and the only institute in Myanmar that offers an undergraduate degree (B.Sc.) in forestry. The Institute's annual output of about 50 forestry graduates, however, is less than the graduate officer requirements of the Forest Department, the Dry Zone Greening Department and the Myanmar Timber Enterprise. Post-graduate teaching at the Institute consists of course work for a diploma and original research work for a master's degree. In addition to forestry and wood processing, modules in community forestry, national parks and wildlife management, watershed management and environmental forestry are offered.

The history of the Myanmar Forest School can be traced to the 19th century. The school was started in 1898 in Tharawaddy, a town in Bago Division. In the years between the two world wars, the school moved to Pyinmana and took in an additional 21 students from Thailand. The school moved a further three times before the Japanese occupation of 1942–45, but after the war it was reopened in Pyinmana. After a further move in 1950, the school moved to its current location in Pyin-Oo-Lwin (Maymyo) in 1953. The school provides training in logging operations.

The Myanmar Timber Enterprise (MTE) has a staff complement of over 45,000. Human resource development is of particular importance to this large and economically important enterprise. Employees of MTE are trained periodically in its three vocational training centres for timber extraction, wood processing, machinery operations and clerical works. They are also sent to relevant training courses organized by different government ministries and the central institute of civil service. Officials and technicians are occasionally sent abroad for training, to attend conferences, seminars and workshops, and to study various production facilities and markets.

The Central Forestry Development Training Centre (CFDTC) supports forestry education. The increasing demand for forest products and new efforts towards sustainable forest management necessitate more trained staff. CFDTC is designed to fill this training need. The Centre has a joint training programme with the Japan International Cooperation Agency (JICA).

### ***Forest Research Institute***

Myanmar has a long history of scientific forest management. Efforts to improve forest research capabilities, however, are of recent origin. A research division was established under the Forest Department in 1922 but it took over 50 years for this to develop into a research institute. The Forest Research Institute (FRI) of Myanmar was established and strengthened in two phases from 1978 to 1987, with funding from FAO and UNDP. The Myanmar government contributed US\$9.75 million to establishing FRI.

The main objective of FRI is to provide technical information on all aspects of forestry and forest-based activities to increase the contribution of the forest sector to the well-being of the nation. The Institute consists of three sectors divided into eight divisions. Nine field research stations in different eco-climatic zones conduct field research throughout the country. At present, FRI has 50 researchers and 187 supporting staff.

Under the technical guidance of the Research Supervising Committee, FRI has prioritized the following research programmes on the basis of anticipated developments in the forestry sector:

- Sustainable management of natural teak forests.
- Development of economic plantations.
- Reforestation in the central dry zone.
- Development of non-wood forest products.
- Fuel wood resources and wood energy.

Six sub-divisions under FRI's Forestry Development and Forest Utilization Divisions (Forest Management and Silviculture, Tree Improvement and Forest Botany, Natural Resources, Forest Protection, Wood Properties, and Utilization and Forest Industrial Processes) carry out research and development activities. The following research activities have been initiated:

- Establishment of teak provenance trials under the Special Teak Plantation Project in Bago Yoma.
- Fertilizer application in teak plantations.
- Establishment of teak seed orchards.
- Growth comparison between stored stumps and teak seedlings.
- Development of new techniques for successful rooting of teak cuttings.

- Teak defoliator outbreaks in some plantations, particularly in Pyinmana Township.
- Wood properties and utilization potential of plantation teak.
- Growth of *Gmelina arborea* in an international provenance trial.
- Establishment of *Acacia mangium* seedling seed orchard in collaboration with CSIRO.
- Fertilizer application trials in *G. arborea*.
- Provenance trials in *P. macrocarpus*.
- Establishment of seed production areas for *Acacia crassicarpa* and *Acacia aulacocarpa* in collaboration with CSIRO.
- Forest nursery diseases and management of nurseries.
- Survey of the flora of Mount Popa.
- Tree species composition in Ngalaik Reserved Forest.
- Natural regeneration and growth of *Cephalostachyum pergracile* (Tinwa) after gregarious flowering.
- Feasibility study of producing bamboo boards from selected species.
- Lesser-known medicinal and industrial plants of East Yoma.
- Collection and identification of rattan and bamboo species.
- Indigenous and exotic species selection for the central dry zone of Myanmar.
- Soil improvement study of *Eucalyptus camaldulensis* in the central dry zone of Myanmar.
- Provenance trials of *E. camaldulensis*.
- Study on fertilizer application for *E. camaldulensis* on degraded soils.
- Study on production and utilization of wood for fuel substitution.

FRI's research findings are made available to the Forest Department and others by means of leaflets, pamphlets, technical documents and other publications. By 1999, the Institute had published 147 papers for the research meetings held annually in Yangon.

### Conclusions and recommendations

Myanmar has one of the highest proportions of forest cover in Asia and the Pacific. The country's forests harbour abundant fauna and flora, and must be safeguarded for present and future generations. Like many other countries, Myanmar's forests face threats from unsustainable land use, a lack of clear land-use policies, forest encroachment, deforestation, wildlife poaching, a lack of trained staff and inadequate material resources.

Developing countries such as Myanmar must use forest genetic resources to advance economic and social development. The Forest Department balances the demands of development and conservation within an overall framework of sustainable forest management. The government recognizes the importance of systematically conserving and using forest genetic resources for their long-term benefits and for the economic development of the country.

At present, well-integrated arrangements for managing Myanmar's natural resources are lacking. These will be promoted in future by establishing an appropriate policy, planning and regulatory framework. Environmental awareness, active participation of local communities and better coordination between local authorities and the various agencies active in agriculture, forestry, fishery and rural development will be essential to this integrated approach.

In conclusion, therefore, the following recommendations can be made to enhance the management, conservation and sustainable use of Myanmar's natural resources:

- Policies and laws should be further developed to ensure that natural resources are used sustainably by both the public and the private sectors.
- Local people should be integrated into planning processes from the outset.
- Public awareness of the importance of sustainably managing natural resources should be promoted through mass media.
- Environmental education should be promoted through influential groups (religious groups, community leaders and non-governmental organizations), training and formal education channels.
- Incentives should be given to local communities to ensure their active participation in natural resources management.

### References

FAO (1999) *State of the World's Forests 1999*. Food and Agriculture Organization of the United Nations, Rome.

Forest Department (1998) *Forestry Facts and Figures of Myanmar*. Planning and Statistics Division, Forest Department, Yangon.

Forest Department (1999a) *Forestry in Myanmar*. Forest Department, Yangon.

Forest Department (1999b) *Teak Plantation in Myanmar*. Forest Department, Yangon.

Forest Department (2000) *Forestry in Myanmar*. Forest Department, Yangon.

Ministry of Forestry (1999) *Facts about Ministry of Forestry*. Ministry of Forestry, Yangon.

Tint, K. (1995) *Status Report on the Forestry Sector of Myanmar*. Forest Department, Yangon.