ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY II

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MYANMAR FORESTRY OUTLOOK STUDY

by

Khin Htun

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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INFORMATION NOTE ON THE ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY

The Asia-Pacific Forestry Sector Outlook Study (APFSOS) is a wide-ranging initiative to gather information on, and examine, the evolution of key forestry issues as well as to review important trends in forests and forestry. The main purpose of the study is to provide a better understanding of the changing relationships between society and forests and thus to facilitate timely policy reviews and reforms in national forest sectors. The specific objectives are to:

1. Identify emerging socio-economic changes impacting on forest and forestry
2. Analyze probable scenarios for forestry developments to 2020
3. Identify priorities and strategies to address emerging opportunities and challenges

The first APFSOS was completed in 1998, with an outlook horizon to 2010. During its twenty-first session, held in Dehradun, India, in April 2006, the Asia-Pacific Forestry Commission (APFC) resolved to update the outlook extending the horizon to 2020. The study commenced in October 2006 and is expected to be completed by September 2009.

The study has been coordinated by the Food and Agriculture Organization of the United Nations (FAO), through its regional office in Bangkok and its headquarters in Rome, and implemented in close partnership with APFC member countries with support from a number of international and regional agencies. The Asian Development Bank (ADB), the International Tropical Timber Organization (ITTO), and the United Kingdom's Department for International Development (DFID) provided substantial financial support to implement the study. Partnerships with the Asia-Pacific Association of Forest Research Institutes (APAFRI) and the Secretariat of the Pacific Community (SPC) supported the organizing and implementing of national focal points' workshops and other activities, which have been crucial to the success of this initiative. The contributions of many other individuals and institutions are gratefully acknowledged in the main APFSOS report.

Working papers have been contributed or commissioned on a wide range of topics. These fall under the following categories: country profiles, sub-regional studies and thematic studies. Working papers have been prepared by individual authors or groups of authors and represent their personal views and perspectives; therefore, opinions expressed do not necessarily reflect the views of their employers, the governments of the APFC member countries or of FAO. Material from these working papers has been extracted and combined with information from a wide range of additional sources to produce the main regional outlook report.

Working papers are moderately edited for style and clarity and are formatted to provide a measure of uniformity, but otherwise remain the work of the authors. Copies of these working papers, as well as more information on the Asia-Pacific Forestry Sector Study, can be obtained from:

Mr. Patrick Durst
Senior Forestry Officer
FAO Regional Office for Asia and the Pacific
39 Phra Atit Road
Bangkok 10200
THAILAND
Ph. (66-2) 697 4000
Fax: (66-2) 697 4445
Email: patrick.durst@fao.org

EXECUTIVE SUMMARY

This paper, drafted as part of the second Asia-Pacific Forestry Sector Outlook Study has the objective of sketching the possible state of the Myanmar forestry sector in the year 2020. The paper comprises eight sections: introduction, the role of the forestry sector, the current state of forests and forestry in Myanmar, the influences on the future state of forest and forestry, probable scenarios for forestry, the vision in 2020, proposed strategy to create a better future, and conclusions.

The section on the current status of forests and forestry uses both quantitative and qualitative approaches. The total forest area in Myanmar decreased from 56% of the total land area in 1990 to 52.1% in 2000 and 50.2% in 2005. According to the Central Statistical Organization in Myanmar, reserved forest increased from 10.033 to 16.730 million hectares between 1985/1986 and 2005/2006. The increased area was recruited from the area designated as other wood land and, in relation, the area of other wood land fell from 22.219 to 16.898 million hectares. Forest cover increased slightly from 48% to 49%.

With regard to forest ownership all types of forests are owned by the State except some community forests which are owned by local people under long-term lease agreements with the government. Looking at the composition of important growing stock in the period between 1990 and 2000, the ten species constituting the bulk of the overall composition decreased dramatically in volume from 1340.05 million m^3 (47.81 percent of total growing stock) to 559.62 million m^3 (19.51 percent of total growing stock). It is thus concluded in relation to the current status of forests and forestry that both quantity and quality are decreasing day by day.

To restore forest cover in the country, establishment of forest plantations has been seen as the main remedy. Plantations for commercial purposes, local and industrial use and watershed protection have been encouraged to fulfill domestic requirement, exports and environmental preservation. For commercial plantations, a major constraint has been the difficulty with acquiring seeds and seedlings as a result of previous overexploitation and removal of seed bearing trees.

Different ranges of forest products are used for local and export purposes. Analysis of supply and demand for wood and wood products in Myanmar shows that fuelwood is used domestically and industrial roundwood is used for both export and domestic consumption. Some wood products such as paper and paper board are produced but in insufficient quantity for domestic demand such that imports are required to make up the shortfall. Analysis of wood industry exports and imports shows that the country used to export raw materials and low value-added products while importing finished goods and high value-added products. Insufficient supply of raw logs to local wood-based industries and the shortage of high value-addition industries as well as an inappropriate tax system were major challenges in developing the national wood-based industry. The country produces small quantities of various non-wood forest products (NWFPs) but it has been estimated in the National Forest Master Plan that production exceeds sustainable yield. Another important forest product is woodfuel which comprises firewood and charcoal. With the aim of preventing deforestation, charcoal production has been restricted in some regions. At the same time, widespread utilization of substitute fuels has been encouraged.

The forests provide not only tangible outputs but also intangible ones called services. Core service functions of forests include protecting soils and hydrological functions, shielding biodiversity, ameliorating weather and climate, and providing locations for recreation. As a result of deforestation, soil degradation has been taking place in the country, particularly in the central dry zone of Myanmar. Similarly, the rapid pace of shrinkage and degradation of mangroves has put the livelihoods of coastal dwellers at risk and has threatened the integrity

of the coastal environment. Fortunately, the relative richness of forests, wetlands and grasslands in Myanmar has positive benefits in relation to biodiversity conservation and wildlife protection. Additionally, the condition and cover of forest in the country is a major contribution in moderating climate change.

Looking back at the history of forestry in Myanmar, the forestry sector has been well equipped with functional forest management systems, policy and institutions. The Myanmar Selection System (MSS), organized forest management units, and plans for forest operations and forest plantation have been key mechanisms in the forest management system. The Myanmar Forest Policy 1995 focused on six priorities including protection, sustainability, basic needs, efficiency, participation and awareness. It aimed at managing 30 percent of the total land as Permanent Forest Estate (PFE). The Forest Law 1992, Forest Rules 1995, National Forest Master Plan, Ministry of Forestry and its Departments, additionally provide backing for sound forest management in the country.

There have also been issues which have hindered progress with sustainable forest management. These include overexploitation in relation to annual allowable cut (AAC), disorganized shifting cultivation, illegal logging, conflicts of interests between economy and ecology, and inconsistency between and among sectors vying for larger shares of limited resources such as land.

In determining future trends in the Myanmar forestry sector, demographic changes, economic transition, environmental issues and future energy demand are believed to be major factors of influence. With an annual growth rate of 2.02 percent, the population of the Union of Myanmar in 2005/2006 was estimated at 55.40 million, rising from 40.78 million in 1990/1991 to 44.74 million in 1995/1996 and 50.13 million in 2000/2001. The growth rate is thus approximately one million for every single year. Along with the growing population, wood utilization, especially firewood, for daily cooking increased from 17.77 million cubic tons[1] in 1995/1996 to 20.54 million cubic tons in 2005/2006.

The effects of population increase on forests would be more likely to be negative if the economy were dominated by the primary sector. The economic structure of Myanmar has improved but reliance on the primary sector is still considerable. The contribution of the industrial sector to the economy in Myanmar increased slightly from 15 percent in 1985/1986 to 16 percent in 2005/2006 while the share of agriculture and other primary sectors declined from 61 percent to 49 percent.

The role of environmental concern has increased in Myanmar since UNCED and enunciation of Agenda 21 raised the issues of protection and conservation of forest resources; reservation of production and protected areas; forest management, participatory forestry, and extension activities; sustainable utilization of resources; harvesting and utilization; and capacity building at all level. Likewise, the Myanmar Forest Policy focused on the development of the forestry sector and sustainability of the forests. Important tools in implementing the policy included the following: Forest Law (1992), Forest Rules (1995), Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law (1994), Community Forestry Instructions (1995), National Forestry Action Plan (1995), Criteria and Indicators for Sustainable Forest Management (1999), Format and Guidelines for District Forest Management Plans (1996), National Code of Practice for Forest Harvesting, National Framework for Environmental Law, and National Forest Master Plan.

The national Energy Planning Department has forecast future domestic energy demand in relation to supply capacity. To fulfill household and industrial requirements, enormous efforts are needed. For example, Myanmar has potential to produce 38,000 megawatts from

[1] 1 cubic ton = 1 000 000 000 kg^3.

hydropower of which only 340 megawatts — equivalent to less than 1 percent — is actually generated. Surveys have also been conducted to estimate the potential for production of geothermal energy from 93 hot streams which reach a temperature of 200 degree centigrade.

Taking into consideration the current status of the forestry sector and factors that are likely to influence its development in the future, possible scenarios are defined in section 5. The range of drivers of change that are expected to affect the shape of the forestry sector in the future are environmental, technological, economic, social, demographic, and policy/institutional issues.

Of these, poverty and land-use policy are expected to be the most influential whilst also being the least predictable in their future trajectories. Poverty and forest destruction can become associated in a vicious cycle, i.e. heavy dependence on forests due to poverty results in deforestation and reduced income due to severe deforestation results in greater poverty.

Formulation and implementation of a nationwide land-use policy in Myanmar is warranted to efficiently allocate the national land area. These twin drivers of change are used to define four future scenarios with the following outcomes: socioeconomic development stalls, unsustainable growth, asymmetric development, and sustainable development.

Based on the scenario analysis, the forest resources of Myanmar are considered for three different states: continuation of current circumstance, implementing the Myanmar Selection System (MSS), and adopting a programme of systematic conservation. If current practices remain unchanged, the national forest area will fall from 50 to around 40 percent of total land area by 2020. Pursuing the MSS could maintain the current 50 percent forest coverage with 35 percent closed forests and 15 percent open forests. Integrating existing guidelines such as the MSS and establishing forest plantations could improve the quality of forest coverage.

Last but not least, building a positive future for the forestry sector needs a sound policy foundation, appropriate planning and unfailing implementation taking into account stakeholders' views and feedback for further policy consideration. Smooth and continuous running of such a policy process is recommended as a foundation for sustainable forest management and a means for creating a better future.

1. INTRODUCTION

Background setting of Myanma forest, people and the country

Myanmar is rich in vast varieties of natural resources, both renewable and non-renewable. Among them, the forest resource is one of the most critical and principal suppliers for the livelihood of the people and the national economy as well. There are various types of forests such as tidal, beach and dune, and swamp forests; tropical evergreen forests; mixed deciduous forests; dry forests; deciduous dipterocarp forests; and hill and temperate evergreen forests. Indeed, Myanmar is home to the best quality teak which is one of the most valued and sought-after tropical timbers in the world. Moreover, it is asserted that extensive and beautiful natural teak stands can be seen only in Myanmar today.

There is evidence that the fundamental cause of the Anglo-Burmese War during the 19th century was based on conflicts over the extraction of Myanma timber, teak in particular. In Myanmar at present, 70 percent of the population residing in rural area has to depend heavily on forests for their basic needs. Moreover harvesting and utilization of NWFPs support the rural people for their sustenance and for generating side income. Forests have been providing Myanma ethnic groups and people living in remote areas with posts, poles, fence and household materials, fuelwood, fodder, and food as well as wildlife for hunting. As for the national economy, timber export alone recently contributed to around 10 percent of the total export earnings. Additionally, forests give benefits to other economic sectors such as agriculture, livestock, energy and tourism.

Biodiversity distribution of Myanma forest resources is influenced by a wide range of locations between latitudes 9° 58'N-28° 29'N and longitudes 92° 10'E-101° 10'E, topography traversing from North to South through three major mountain ranges and four major river systems, and climatic factors principally of the tropical monsoon type with three distinct seasons: the hot season from mid-February to mid-May; the rainy season from mid-May to mid-October; and the cool season from mid-October to mid-February.

Based on these influential factors, the forests are diverse and vary in structure and composition, constituting ecosystems that are valuable and that conserve a wide range of plant and animal species, micro-organisms and genetic materials. About 7000 species of vascular plants including 1696 species of climbers, 65 species of rattans, and 841 species of orchids have been recorded so far (MOF 2001). Out of them, 85 species of trees are identified as multiple-use timbers of premium quality. More than 25000 species of animals, about 300 species of mammals, 360 species of reptiles and more than 1000 species of birds also inhabit the country (FAO 1985). In 2005, the forest area in Myanmar was 47.6 percent of the total land area of 67.658 million hectares with 0.58 hectare per capita and 42.51 tons per hectare of stem biomass in the forest (FRA 2005). It is the third largest forest coverage in terms of proportion in the Greater Mekong Sub-region (GMS) and second largest in terms of absolute volume in ASEAN. But the Myanma forest area had decreased from 57.9 percent in 1990 to 51.1 percent of the total land area in 2000. For 2005, the area dropped again to 47.6 percent (FRA 2005). As regards worldwide tropical rain forests, one square mile of rain forest is destroyed within every six minutes and just one tree is planted for every ten cut down; UNEP anticipated that, at this rate, all remaining tropical forests will be destroyed by 2035 (Peace 1994). Thus it is time to carry out continuous assessment on the status and trend of Myanma forests and the forestry sector in order to ensure strong sustainability.

Scope and coverage

The first country report of the Union of Myanmar for the Asia-Pacific Forestry Sector Outlook Study included data and information about the country's forest and forestry sector up to 1995. This report covers the following periods of time including not only forests and

forestry but also forest-related economic, socioeconomic and environmental issues. However, only selected contributions of the forest sector are focused on although there are numerous goods and services provided by forests.

Key questions/issues

Underlying the importance of forests and forestry for the country and then for the region, the report attempts to address the following questions and issues:

- Why the forestry sector plays a critical role in the country
- The current state of forests and forestry in Myanmar
- Which factors influence the status of forests and forestry in the country
- The strengths, weaknesses, opportunities and threats in the conservation of Myanma forests
- Probable scenarios in the future
- Necessary measures to meet sustainable forestry sector development
- The 2020 vision once the measures are realized

The process (methodology)

Since the trend of forest resources and their utilization from time to time and comparison with cases from other countries are to be studied, time-series analysis and cross-sectional analysis are included in this report.

Structure of the report

Section one is the introduction which includes background setting, scope and coverage, key questions and issues addressed in the paper, methodology applied, and structure of the report.

Section two expresses the role of the forestry sector reviewing economic viability, fulfillment of social needs, and environmental safeguarding.

Section three reveals the current state of forests and forestry in Myanmar with investigations into the trends of forest resources, wood and wood products, NWFPs, wood as a source of energy, service functions, state of forest management, policy and institutional framework, and problems undermining sustainable forest management.

Section four verifies the main factors which influence the future state of forests and forestry. Demographic change, economic transition, environmental issues and policies, and future energy demand are assumed as the major drivers of change in the Myanma forestry sector.

Section five defines probable scenarios and their implication. Customary as well as alternative scenarios are explained based on poverty and land-use policy as the main drivers of change.

Section six is the vision to 2020. It forecasts forest resources in the next two decades, the possible shape of wood and wood products, and a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis.

Section seven suggests how to build a better future for forests in Myanmar. It accomplishes the context of policy, plan, implementation and people's participation.

Section eight concludes with the summing up of general points of the report and the way forward.

2. THE ROLE OF THE FORESTRY SECTOR IN MYANMAR

As Myanmar is an agrarian country, the agriculture sector comprising proper agriculture, livestock and fisheries, and forestry contributes to more than 50 percent of the country's GDP and about 30 percent of the export earnings. Although the forestry sector's contribution to the national GDP is less than 1 percent, timber export alone constitutes about 10 percent of the total export. Like other developing countries, Myanmar's external trade has also to rely on exports of primary products from natural resources, including those of forestry. Earnings from exports of forest products have increased over time but with a decreasing trend in average prices. This is due to increasing volume of low grade teak. Teak export increased by more than one and a half times from 200,500 tonnes to 333,100 tonnes within four years from 2001/2002 to 2005/2006. Hardwood export more than doubled during the same period with a stable price of around US$250 per tonne. Teak alone contributed to 60-70 percent of the total export earnings from forest products but this was due to the greater volume. Exports of Myanma forest products addressing volume, value and average price are shown in Table 1.

Table 1. Exports of Myanma forest products

Fiscal year	Teak			Hardwood			Plywood	Total (Mil $)
	Tonnes	Average Price ($)	Value (Mil $)	Tonnes	Average Price ($)	Value (Mil $)	Value (Mil $)	
2001/2002	200500	1182.5	237.1	285600	266.8	76.2	17.7	331.0
2002/2003	205600	1124.5	231.2	308000	261.4	80.5	16.2	327.9
2003/2004	281100	884.7	248.7	390800	237.5	92.8	14.1	355.6
2004/2005	319200	790.4	252.3	496800	243.2	120.8	15.4	388.5
2005/2006	333100	862.2	287.2	636700	268.9	171.2	19.0	477.4

Source: CSO, Selected Monthly Economic Indicator October 2007.

The most significant attraction of forests for the service sector is tourism development through ecotourism. Myanmar has vast potential for ecotourism promotion, encompassing dense forests, various types of flora and fauna, snow capped mountains, long sandy beaches, etc. Fifteen ecotourism sites are prescribed by the Ministry of Forestry in Myanmar.[2] Popa, Natmataung, Moeyingyi, Kandawgyi and Yangon Zoological Garden are included in the major ecotourism sites of ASEAN member countries. Although tourist arrivals are comparatively low in Myanmar, for instance tourist arrivals in 2006 reached just over 0.6 million while those in Cambodia amounted to 1.7 million, tremendous prospective changes are expected for the development of ecotourism or nature tourism.

An important but less visible service provided by forests is watershed protection. Water quality and flow are highly influenced by the status of forests. Once, Bago Yoma served the purpose of watershed protection for lower Myanmar particularly the northern part of Yangon Division, Bago Division (East), Bago Division (West), and the southern parts of Mandalay Division and Magway Divisions. Besides natural watershed protection, multiple watershed management projects comprising watershed plantations in the watersheds of important dams, Inlay Lake and Phu-gyi Reservoir have also contributed to the enrichment of water resources.

Last but not least, there are prospects for net earnings from forests in the carbon trading initiative proposed by a coalition of developing countries at the UN climate talks in Kenya during November 2006. Under a proposed carbon finance initiative, Myanmar could earn from US$128 million to over US$$1.8 billion from industrialized countries if the country mitigated 32-93 megatonnes of carbon dioxide generated by deforestation of some 466000

[2] Hlawga Wildlife Park, Yangon Zoological Garden, Moeyingyi Wetland Wildlife Sanctuary, Mainmahla Kyun Mangrove Wildlife Sanctuary, Inlay Wetland Wildlife Sanctuary, Shwesettaw Wildlife Sanctuary, Popa Mountain Park, Alaungdaw Kathapa National Park, Chatthin Wildlife Sanctuary, Natmataung National Park, National Kandawgyi Garden, Khakaborhazi National Park, Po Kyar Elephant Camp, Indawgyi Wetland Wildlife Sanctuary, and Myaing Hay Wun Elephant Camp

hectares per year in Myanmar (Mongabay 2006). The "Avoided Deforestation" strategy in developing countries was suggested in addressing carbon trading to effectively offset emission limits under international agreements such as the Kyoto Protocol. According to such agreements, industrialized countries are responsible to contribute to forest conservation funds, and developing countries like Myanmar could draw on certain amounts by reducing deforestation rates. The estimation stated that carbon finance could boost per capita GDP in Myanmar from 5 to 20 percent.

Complement social needs

Forests offer an exceptional array of goods and services. Forests are, especially for poor people, major sources to generate basic needs and necessary income. All over the world, three billion people depend on fuelwood for almost all their household energy (Norman 1996). In Myanmar, inadequate electric power supply and limited provision of household fuel gas lead to continued use of fuelwood and charcoal. It was reported that estimated consumption of fuelwood in Myanmar for 1990, 2000 and 2005 was 35.20, 40.56 and 44.59 million m^3 respectively (Kyaw 1995). Although absolute consumption of fuelwood increased along the same period of time, per capita consumption decreased slightly from 0.86 to 0.80 m^3 per head (Table 2).

Table 2. Estimated consumption of fuelwood in Myanmar

	1990	2000	2005
Total consumptions (mil: m^3)	35.20	40.56	44.59
Total population (mil:)	40.78	50.13	55.40
Per capita consumption (m^3)	0.86	0.81	0.80

Source: Kyaw Tint and CSO (various issues).

As for income generation, charcoal production is conducted for money-making purposes in various regions of the country. Extracting NWFPs including wild fruit, latex, essential oils, wax, medicinals and many others also supports additional income for rural people. Moreover, forests provide shelters for poor people in the deep rural and remote areas almost free of charges in monetary terms.

Another important contribution by forestry sector is employment creation. Forest related work ranging from collecting fuelwoods to producing logs (either legally or illegally) reduces unemployment or underemployment of rural families. In urban areas, saw mills, wood processing and other value-added wood manufacturing such as furniture making absorb some of the labour force. There are about 100 wood-based industries in Yangon and Mandalay industrial zones producing export quality garden furniture and indoor furniture. They create job opportunities for both skilled and unskilled labourers.

Environmental harmony

Renewable natural resources produce a flow of services while nonrenewable natural resources generally yield no services until they are extracted (Jonathan 2001). Forests as renewable resources care are conducive for good climate for the region. Myanmar is relatively free from natural disasters compared to neighbouring countries due to its favourable location as well as its rich forest resources. Forests stabilize landscapes, protect soils by helping them to retain their moisture and to restore and cycle nutrients, and serve as buffers against the spread of pests and diseases. They also preserve watershed functions, helping to regulate the quality and quantity of water flow.

Forests are diverse in Myanmar, varying from sub-alpine on the snow-capped mountains in the north, through dry and moist deciduous to tropical monsoon forests in the south with mangroves along the coastal areas and coral reefs offshore. There are several thousands of

recorded plant species, thousands of bird species, hundreds of mammal species and hundreds of reptile species. Myanmar is often mentioned as the last front line of large-scale biodiversity.

An important task of forests in Myanmar is safeguarding the ecology. For example, Myanma mangroves play both economically and ecologically vital roles. The economic importance of Myanma mangroves includes fisheries, fuelwood provision, charcoal production, construction materials and medicine, while ecological importance includes shoreline stabilization, protection from wind and storms, coastal ecosystem stability, habitats for creatures and biodiversity protection (Nay 2004).

3. CURRENT STATE OF FORESTS AND FORESTRY IN MYANMAR

The trend of forest resources

According to the national classification for forests, the total area of the country is divided into five classes: closed forest, open forest, other wooded land, inland water bodies and other land. Land classification and estimated area changes from 1990 to 2000, and then to 2005 are shown in Table 3. The total forest area decreased from 56 percent of total land in 1990 to 52.1 percent in 2000, and yet again to 50.2 percent in 2005. The percentage change of the total forest area between 1990 and 2000 was -6.9 percent and that between 2000 and 2005 was -3.7 percent. From 1990 to 2005, the total forest area changed at the rate of -10.3 percent. The quality of Myanmar's natural forests has dropped day by day because selected good quality trees are harvested with little or no attention given to the rest of the forests through improvement felling, thinning, etc. (Table 6).

Table 3. Changes of land classes in Myanmar (hectares, percentage)

Classes	1990		2000		% Change (1990-2000)	2005		% change (2000-2005)	% change (1990-2005)
	Extent	Share	Extent	Share		Extent	Share		
Closed forests	28114.7	41.6	25841	38.2	-8.1	24704.2	36.5	-4.4	-12.1
Open forests	9755.8	14.4	9426.9	13.9	-3.4	9262.4	13.7	-1.7	-5.1
Total forests	37870.5	56.0	35267.9	52.1	-6.9	33966.6	50.2	-3.7	-10.3
Other wooded land	10405.8	15.4	11435.3	16.9	9.9	11950	17.7	4.5	14.8
Other land (including water bodies)	19381.6	28.6	20954.7	31.0	8.1	21741.3	32.1	3.7	12.2
Total land area	**67657.9**	**100**	**67657.9**	**100**	**0**	**67657.9**	**100**	**0**	**0**

Source: FAO (2006).

The total land area in Myanmar is also classified by the Settlement and Land Records Department into five types: reserved forest, other forest area, fallow land, net sown area, cultivable waste land, and others. From 1985/1986 to 2005/2006, the types of land in terms of acreage are shown in Table 4 and in terms of percentage share in Figure 1.

Table 4. Land area classified by type of land in Myanmar (hectares)

Year	Reserved forest	Other wood land*	Current fallows	Net area sown	Cultivable wasteland other than fallows	Others	Total land area
1985/1986	10033.5	22219.5	1858.5	8221.5	8526.5	16850.8	67710.3
1990/1991	10150.1	22262.9	1913.2	8151.4	8353.1	16879.6	67710.3
1995/1996	10328.7	22095.6	1232.0	8916.9	7977.3	17159.9	67710.3
2000/2001	12923.6	19801.3	686.5	9916.8	7210.6	17171.6	67710.3
2001/2002	13985.9	19342.0	622.1	9997.4	6668.7	17094.2	67710.3

2002/2003	14184.3	19252.9	584.0	10093.0	6526.2	17069.9	67710.3
2003/2004	15145.8	18326.3	517.6	10261.9	6579.2	16879.6	67710.3
2004/2005	15393.6	18147.2	439.8	10523.9	6421.3	16784.4	67710.3
2005/2006	15719.2	17842.2	368.5	10930.5	6283.9	16565.7	67710.3

Source: Statistical Yearbook (2003), (2004), (2005) and (2006).
Note: Acres are converted into hectares.
* Forests outside protected areas are under the disposal of the Government.

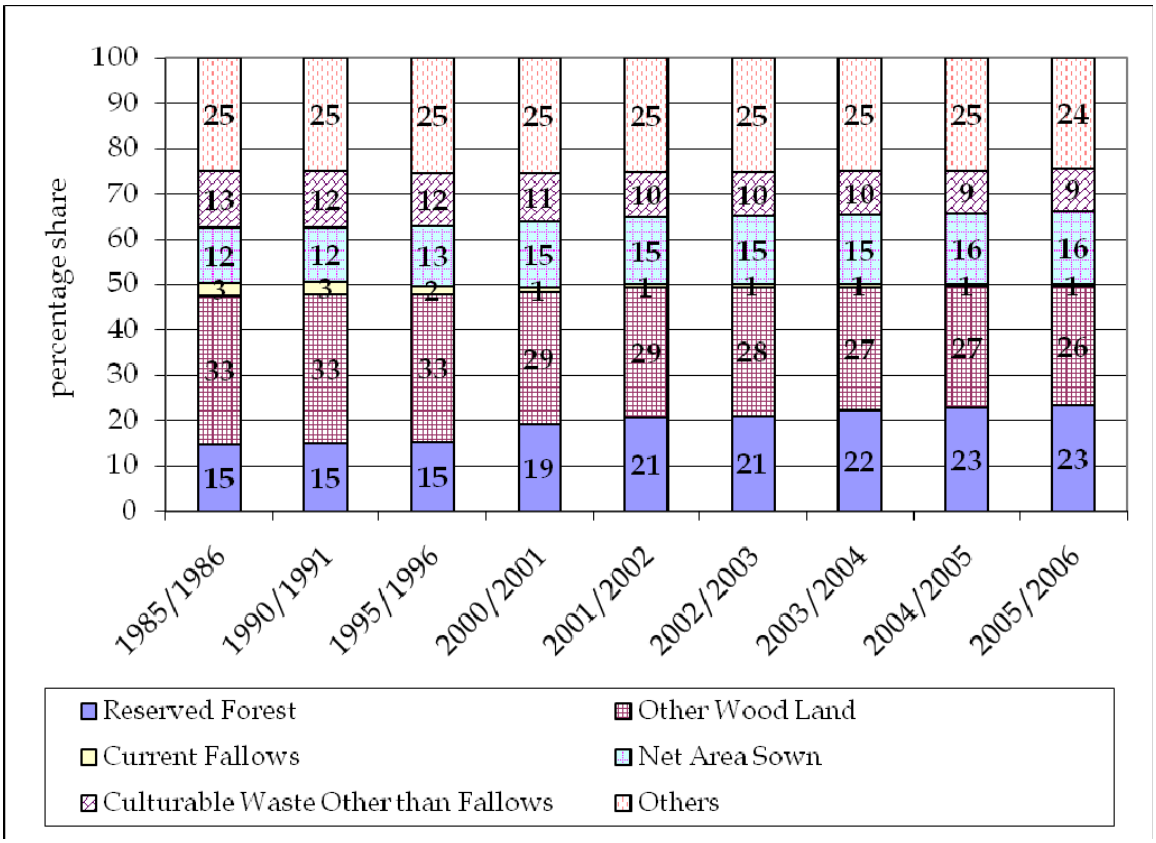

Figure 1. Percentage share of type of land
Source: Statistical Yearbook (2003), (2004), (2005) and (2006).

From 1985/1986 to 2005/2006, reserved forest increased from 10.03 million hectares to 15.72 million hectares; It was recruited from other woodland areas. Other woodland declined from 22.22 million hectares to 17.84 million hectares. The percentage share of forest coverage area involving reserved forest and other woodland slightly increased from 48 percent to 49 percent of the total land area.

The contradiction is obvious between changes of land class and land area classification whereas areas for reserved forest (probably plus other woodland) were progressively assigned while total forest areas declined to a certain extent. Other than wood production, forest insects, forest disease and forest fire are important detriments to forest health and viability. In Myanmar, there is no official document related to forested areas affected by insects and diseases. It would be minimal. Moreover no seriously devastating forest fire has been recorded in the country, but the forested area affected by forest fire was estimated at 6.5 million hectares annually (Goldammer, 1986). More important, it is usually said that forest fires in Myanmar are simply surface fires which may affect wide areas but not severely. Moreover, such forest fires are believed to be beneficial for teak growth.

Out of fourteen administrative areas, seven States and seven Divisions, severe negative changes in forest area were found in Ayeyarwady Division (5.6 percent), Mandalay Division (5 percent), Yangon Division (5 percent), and Magway Division (4.2 percent) between 1989 and 1998 (NCEA, 2005). From 2000/2001 to 2004/2005, Ayeyarwady Division, Mandalay Division, Yangon Division, Rakhine State, and Bago Division were the most serious deforestation areas with annual rates of 14.3, 9.8, 5.7, 5.3 and 3.9 percent respectively (data based on CSO, 2005).

The common ownership pattern for forests and other wooded land is categorized into private ownership, public ownership and other ownership. On the other hand, there are three types of forests within legal classification in Myanmar: reserved forest, protected public forest and unclassed forest. Whatever the legal classification may be, they are all owned by the State except for some community forests which are owned by local people with long-term lease permission from the government (FAO 2006). Table 5 reveals the status of ownership patterns on classes of forests in Myanmar.

Table 5. Ownership of forests (hectares, percent)

	Forests			Other wooded lands		
	1990	**2000**	**% Change**	**1990**	**2000**	**% Change**
Private Ownership	-	-		-	-	
Public Ownership	39219	34554	-11.89	10219	10629	4.01
Other Ownership	-	-		-	-	

Source: FAO (2006).

All forests and other wooded lands are owned by the state. From 1990 to 2000, forests decreased by 4.665 million hectares or about 12 percent while other wooded land increased by 0.410 million hectares or 4 percent.

Regarding the composition of important growing stock during 1990 and 2000, Kyun (internationally known as teak) and Pyinkado dropped off in terms of both absolute volume and relative share. Kyun, for example, changed its composition position from second in 1990 to first in 2000, but its volume and share decreased from 241.91 million m^3 and 8.63 percent to 149.40 million m^3 and 5.21 percent respectively. Moreover, the top ten species with the highest share of composition also dramatically decreased from 1340.05 million m^3 (47.81 percent of total growing stock) to 559.62 million m^3 (19.51 percent of total growing stock). This was revealed in the FRA 2005 (Table 6).

Table 6. Growing stock composition in Myanmar forests

Myanmar name	**Scientific name**	**Volume (million m^3)**	**% share**	**Myanmar name**	**Scientific name**	**Volume (million m^3)**	**% share**
1990				**2000**			
Pyinkado	*Xylia xylocarpa*	285.44	10.18	Kyun	*Tectona grandis*	149.40	5.21
Kyun	*Tectona grandis*	241.91	8.63	Thabye	*Eugenia* spp.	96.95	3.38
In	*Dipterocarpus*	221.40	7.90	In	*Dipterocarpus*	75.98	2.65
Kanyin	*Dipterocarpus* spp.	196.05	6.99	Taukkyan	*Terminalia tomentosa*	58.09	2.02
Taukkyan	*Terminalia tomentosa*	111.61	3.98	Pyinkado	*Xylia xylocarpa*	46.65	1.63
Ingyin	*Pentacme*	103.51	3.69	Thadi	*Protium*	44.48	1.55

	siamensis				*serrata*		
Thitya	*Shorea oblongifolia*	65.42	2.33	Ingyin	*Pentacme siamensis*	41.46	1.45
Thabye	*Eugenia* spp.	59.41	2.12	Thitya	*Shorea oblongifolia*	19.92	0.69
Thinwin	*Millettia pendula*	37.00	1.32	Sagat	*Quercus spicata*	17.54	0.61
Thadi	*Protium serrata*	18.30	0.65	Thitsi	*Melanorrhoea usitata*	9.15	0.32
Top 10 Total		**1340.05**	**47.81**	**Top 10 Total**		**559.62**	**19.51**
Rest		1462.67	52.19	Rest		2309.42	80.49
Total		**2802.72**	**100.00**	**Total**		**2869.04**	**100.00**

Source: FAO (2006).

A conservation option is forest plantations. Compensatory plantation to enrich existing natural forests was initiated in Myanmar as early as in the late 1850s. In the early 1970s, mass planting schemes were chosen due to the rapid rate of natural forest degradation and deforestation. The Myanmar Forest Policy 1995 also encourages forest plantation in order to supply local use and industrial use as well as to improve the natural environment.

Four types of plantation such as commercial plantation, local supply plantation, industrial plantation, and watershed plantation are classified in forest planting. Forest plantations already established and plantations categorized by species are shown in Table 7 and Table 8 respectively.

Table 7. Establishment of forest plantations

Classification	**2000**		**2005**	
	Area (hectare)	**Percentage share**	**Area (hectare)**	**Percentage share**
Commercial	371,355	55	396,263	51
Local supply	188,845	28	207,127	27
Industrial use	50,394	7	64,581	8
Watershed	65,659	10	104,884	14
Total	**676,254**	**100**	**772,854**	**100**

Source: Forest Department & CSO.

Table 8. Forest plantations by species

Type of wood	**2000**		**2005**	
	Area (hectare)	**Percentage share**	**Area (hectare)**	**Percentage share**
Teak	281,403	42	355,512	46
Pyinkado	52,259	8	61,828	8
Padauk	15,551	2	15,457	2
Pine	15,911	2	23,185	3
Others	311,130	46	316,872	41
Total	**676,254**	**100**	**772,854**	**100**

Source: Forest Department & CSO.

Commercial plantations include exportable woods such as teak, pyinkado, padauk and pine. The major constraint for commercial plantations is ensured seed supply due to poor access to quality seed sources as a result of legal/illegal overexploitation that removes seed-bearers.

Wood and wood products

Myanmar produces a wide range of wood and wood products from firewood to more or less high class furniture. Although Myanmar has been increasingly providing electricity and gas to substitute for firewood and charcoal, woodfuel is still the most important source for daily cooking. Exports of forest products, especially teak and hardwood, are increasing, but that of value-added products such as plywood is stagnant or, in certain cases, diminishing (see Table 1). Some wood and wood products such as fuelwood are used for self-consumption and some, such as industrial roundwood, are used for both export and domestic consumption. Some wood products such as paper and paper board are produced but underprovided and have to be imported for local use. Both exports and imports include some products such as wood-based panels. Table 9 reveals supply and demand conditions for wood and wood products in Myanmar.

Table 9. Supply and demand conditions of wood and wood products in Myanmar (2004)

	Woodfuel ('000m^3)	Industrial roundwood ('000m^3)	Sawnwood ('000m^3)	Pulp for paper ('000 tonnes	Paper and paperboard ('000 tonnes)	Wood-based panels('000 m^3)
Production	37560	4196	1056	15	43	118
Consumption	37560	2720	781	16	82	68
Export (import)	0 (0)	1476 (0)	275 (0)	0 (1)	0 (39)	54 (4)

Source: FAO, State of the World Forests 2007.

With regard to forest industry, the national forest policy, which was instituted in 1995, specifies six key guidelines for completion of the national strategic goals.

1. Efficient utilization of wood and wood products in accordance with sustainable production within allowable cuts
2. Establishment of wood-based industries that generate minimum waste and maximum productivity
3. Encouragement for the use of less-used species of wood and promotion for exports of value-added products to external markets
4. Adequate local production and supply to fulfill domestic needs
5. Promotion of wood-based finished goods export to external markets
6. Producing NWFPs and fulfillment of local needs; establishing small industries for employment creation

The country initiated a market-oriented economic system after 1988 and private wood-based industries consequently started to grow after 1990. Due to certain circumstances, however, log harvesting and exporting by the private sector were banned in 1993, but allowed to work in contract under the Myanmar Timber Enterprise (MTE) for exporting value-added wood products only. With the aim of developing wood-based industries, the Myanmar Forest Products and Timber Merchants' Association (MFPTMA) was established on 11 May 1993. The association encourages production of value-added wood products by providing technical know-how and market information. Under the motivation of the MFPTMA, 1209 entrepreneurs from production, manufacturing and marketing enterprises were registered as members by 2007. There are about 100 wood-based industries in Myanmar. Among them, 25

factories produce export-oriented furniture and the remaining factories produce decking, S4S, flooring, furniture components, finger joints, veneer and plywood (MFPTMA).

Wood-based industries produce and export mostly furniture and parts, parquet, doors and door frames, and smooth surfaced on all four sides (S4S) products. As ordered by foreign customers, curving chairs, garden furniture and indoor furniture are also made. Among the value-added wood-based products, the finger joint panel is a product which saves waste. Although Myanmar entrepreneurs' efforts are to be highly regarded, improvement seems unsatisfactory. According to the MFPTMA, Myanmar produces 1.4 million tonnes of teak and hardwood annually, exports about 0.8 million tonnes and earns US$400 million while Malaysia produces 0.3 million tonnes of timber and earns US$6 billion for wood-product exports. This means that Myanmar enjoys only US$500 per tonne while Malaysia benefits by US$20,000 for every tonne on average. This is not surprising because most of Myanmar's wood-based businesses are operating as low-tech industries like saw mills. Table 10 breaks down the types of industry in Myanmar and compares them with Malaysia.

Table 10. Types of wood-based industries in Myanmar and Malaysia (2006)

Type of factory	Myanmar			Malaysia
	Private	MTE	Total	
Plywood/veneer	14	5	19	176
Finger joint	1*	-	1	11
Particle board/chip board	1	1	2	7
Molding	40	3	33	174
Furniture	25	5	30	1771**
Pencil	1	-	1	2
Match	1***	-	1	4
Saw mill	228	91	319	1056
Grand total			**406**	**3201**

Source: MFPTMA and MTC.

Note: *There are about 15 finger joint plants associated with the main saw mills.
**Export oriented
***Under the Ministry of Industry (1).
– not available.

Underdevelopment in Myanmar wood-based industries is due to lack of adequate investment in capital and technology. And again, low investment is due to uncertainty in acquiring an adequate and steady flow of raw materials. Entrepreneurs are reluctant to inject huge investment in high-tech capital-intensive industries, but keen to establish low-tech labour-intensive industries such as saw mills, and to produce and export S4S. As an example, the average acquisitions of raw materials per month for one private wood-based industry were 260 tonnes, 60 tonnes and 36 tonnes in 2003/2004, 2004/2005 and 2005/2006 respectively (U Chit 2006). As a solution to generate skilled labour, the MFPTMA established a training centre for wood products in March 2005. The centre gives various training courses for workers from the private and public wood-based industries in the production of value-added goods. It is the first and only one of its kind in Myanmar.

Up to the present day, round logs, especially teak logs, are the main export item among wood and wood products although the Myanma Industrial Development Plan has targeted regular reduction of round log exports and increasing supply to domestic wood-based industries. The tax system in the country also discourages export of finished products because there is a 10 percent lump sum tax on all items of export by the private sector. Myanmar is a relatively important source in providing timber for such Asian countries as India, Thailand, China, Singapore and Malaysia. As these countries have remarkable booms or newly emerging economies, their economic development demands more Myanma timber all the time as shown in Table 11.

Table 11. Direction of timber export trade (thousand cubic tons)

Destination	1998/99	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05
India	238	367	384	266	267	390	486
Thailand	83	78	52	63	67	87	109
China (including Hong Kong)	25	47	26	28	27	38	42
Singapore	16	18	17	24	22	27	31
Malaysia	10	2	4	11	11	13	20
Subtotal	**372**	**512**	**483**	**392**	**394**	**555**	**688**
Rest of Asia	33	49	58	79	102	103	106
Asia total	**405**	**561**	**541**	**471**	**496**	**658**	**794**
Middle East	2	1	1	3	5	2	3
America	*	*	1	1	1	*	*
Europe	8	7	4	11	12	12	19
Africa	*	-	-	-	-	-	-
Country unclassified	*	-	1	*	*	*	*
Total	**415**	**569**	**548**	**486**	**514**	**672**	**816**

Source: CSO, Statistical Yearbook (2005).
Note: * Quantity less than 1 thousand cubic ton.

More than 95 percent of Myanma timber export, including around 80 percent to five major trading partners — India, Thailand, China, Singapore and Malaysia — flows into the Asia region. Except Singapore which mostly re-exports Myanma timber, the remainder is used domestically by these individual countries. Exports to Europe are very small, and to the USA negligible. Thus, economic sanctions by the USA and EU are less effective directly on the export trade of Myanma wood and wood products.

Non-wood forest products

Besides wood and timber, Myanmar is well endowed with other forest resources including NWFPs. About 70 percent of the total population in Myanmar resides in rural areas, and their demand for NWFPs heavily depends on the natural forests surrounding them. These NWFPs are very important for the rural community for their subsistence and trade for income. Thus, the National Forest Policy 1995 acknowledged their socio-economic role in its priority lists for forest development.

Six major groups are distinguished among the NWFPs in Myanmar according to their nature and uses. They include (1) fibre materials, (2) edible products, (3) herbal and cosmetic materials, (4) extractive resin and oleoresin, (5) non-food animal products, and (6) other miscellaneous products. Legally produced NWFPs assigned by the Forest Department are bamboo, cane, cutch, Indwe-Pwenyet, Kanyin resin, turpentine, Dani-Thetkye (thatch), honey, bee-wax, bat guano, orchids, edible birds' nests and lac. Production of NWFPs during 1995/1996 and 2004/2005 is shown in Table 12.

Table 12. NWFP production from 1995/1996 to 2004/2005

Product	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05
Bamboo (000) no	947,880	989,163	102,224	101,739	1,017,786	1,022,243	1,062,641	1,099,243	1,128,829	1,321,211
Cane (000 no.)	103,983	58,262	4,642	4,091	54,693	46,041	38,970	48,268	48,381	72,473
Cutch (000 viss)	135	133	200	340	255	259	388	298	150	250
Indwe-Pwenyet (000 viss)	415	200	220	162	228	261	223	247	298	323
Kanyin Resin (000 viss)	0.5	-	-	-	80	530	560	567	660	-
Turpentine (000) viss	1		20	2	0.5		0.5	0.5	0.5	7
Dani-Thetkye (000 byit)	776,739	773,531	8,266	796,134	840,287	863,549	891,741	909,673	938,102	1,083,619
Honey (000 viss)	11	11	10	10	15	17	21	23	30	40
Beeswax (viss)	250	310	430	94	571	872	756	783	1193	1235
Bat guano (000 viss)	175	265	238	244	276	353	347	416	427	466
Orchids (000 no.)	10	1	9	15	15	15	14	14	11	13
Edible birds' nest (viss)	1,091	2,399	1,723	0	1,385	1,504	1,088	846	570	452
Lac (000 viss)	15	8	0.5	6	22	22	21	59	51	82

Source: Forest Department.
Note: 622.22 viss is equal to 1 tonne.

The production of all NWFPs excluding turpentine and Kanyin resin was stable during the years studied. Among NWFPs, cane was the most important for export. Average annual earnings from exports of NWFPs from 1996/1997 to 2005/2006 were about US$6 million. Since the average export earnings from the forestry sector for the same period was more than US$250 million, that of NWFPs was about 2.4 percent of the total forestry exports.

Although relative production of NWFPs is still small compared to wood and wood products, the MOF estimated in its "National Forest Master Plan" that the amount of NWFPs produced was more than the maximum sustainable yield (MSY). Thus it proposed short-term and long-term action plans for systematic management of NWFP resources.

Wood as a source of energy

Woodfuel is the most common biofuel in Myanmar. Not only firewood but also stems of cotton, sesame, pulse and beans, and other agricultural residuals are utilized for daily cooking in the villages. As urban households have more opportunity to substitute fuelwood with electricity and Liquefied Petroleum Gas (LPG), their use of firewood and charcoal is relatively smaller than that of rural households. The amount of fuelwood consumption depends on the scale of agriculture, size of household, availability of substitutable fuels, living standard and weather conditions. People in the northern and eastern parts of the country burn firewood for heating purposes throughout the cold season. Average fuelwood consumption per household per annum for the last decade was estimated at about 1.4 cubic ton for urban households and 2.5 cubic tons for rural households.

Charcoal is the second most important fuel after firewood. Mangroves in delta areas especially the Ayeyarwady Division have been major sources of charcoal production for many years. Other areas which are engaged in charcoal production for commercial purposes are Bago Division, Mandalay Division, Magway Division and lower Sagaing Division. As there has been overlogging for charcoal production, many mangroves are extinct or threatened in the Ayeyarwady Division.

Nowadays, charcoal production is restricted in some regions and at the same time, widespread utilization of wood-substituting fuels is encouraged to avoid deforestation. Moreover, fuelwood plantation projects at village and village tract levels have been implemented with a quota of 4,500 hectares per year on average. Plantation for local supply aims to provide fuelwood as well as posts and poles within a short-term period such as 5 years. Thus rapid growing species like Mezali (*Cassia siamea*) from domestic sources and Eucalyptus from abroad are selected for planting. In the coastal and delta areas, such species as Kanaso *(kanbalar)*, Lamu *(thame`)*, etc are prioritized. Such plantation needs no thinning but weeding and cleaning only. The NFMP has targeted various types of plantations to be established during three 10-year phases. One of them is local supply plantation in which it is planned to set up 60,750 hectares, 48,600 hectares and 40,500 hectares during the periods 2001/2002 to 2010/2011, 20011/2012 to 2020/2021 and 2021/2022 to 2030/2031 respectively. Another afforestation scheme including agro-forests and community forests also helps in providing necessary fuelwood. However, insufficient financial provisions and institutional capacity hinder efforts to meet planned targets. The Energy Planning Department, Ministry of Energy, has estimated past consumption and projected future consumption in terms of type of energy (Table 13).

Table 13. Fuel consumption by type of energy (percentage)

Type of energy	1990	1995	2000	2010	2020
Crude oil	6.69	7.05	8.00	8.00	9.00
Natural gas	3.94	4.32	4.50	6.00	10.00
Coal	0.25	0.37	0.41	0.80	1.00
Hydropower	1.70	3.91	6.00	9.00	13.00
Agricultural residuals	3.31	4.00	4.48	6.80	9.00
Firewood and charcoal	84.11	80.35	76.61	69.40	58.00
	100.00	100.00	100.00	100.00	100.00

Source: Energy Planning Department.

Although the percentage share of firewood and charcoal consumption is significantly decreasing, it cannot be anticipated to decrease in terms of amount because of the growing population. The MOF estimated in its master plan that firewood consumers would decrease from 76.61 percent in 2001/2002 to 63 percent in 2019/2020, but fuelwood demand would increase from 17.52 million cubic tons to 19.90 million cubic tons due to the increase of the fuelwood consuming population from 39.18 million to 44.49 million.

A plan to initiate biodiesel as an alternative fuel by planting *Jatropha curcus* also known as physic nut on a large scale was introduced in 2005. The five-year plan was to plant the crop across 202,000 hectares of each State and Division resulting in a total of 3,237,000 hectares or nearly 5 percent of the total land area. The plants are grown everywhere including along roadsides, in housing, school and hospital compounds, and on lands formerly producing rice and other crops. Jatropha oil blended with diesel is encouraged to be used in low quality engines in rural areas. Diesel will be substituted by diesel blended with 5 to 20 percent jatropha oil. The most important challenges for the plan seem to be in the collection of required amounts of seeds from the scattered places where *Jatropha cursus* is planted and access to technical know-how and investment from abroad in plantation and extraction of jatropha oil.

The service functions of forest

As renewable resources, forests perform various services even without any extraction. Protecting soils and water, shielding biodiversity, maintaining climate, and providing recreational values are the obvious services. However, the functionality of forest services in many countries including Myanmar is being impacted by aggressive economic goals, growing population, expansion of agricultural land, and urbanization.

Due to deforestation, soil degradation is now taking place particularly in the central dry zone of the country (NCEA 1997). As a result of soil degradation, land productivity in the agricultural sector begins to decline. For example, Figure 2 shows decreasing trends for yield per harvested acre of each variety of cotton — Wagyi, Mahlaing 5/6 (a local variety of short staple cotton) and long staple cotton — which is the typical crop grown in the dry zone where water for agricultural purposes is provided by irrigation.

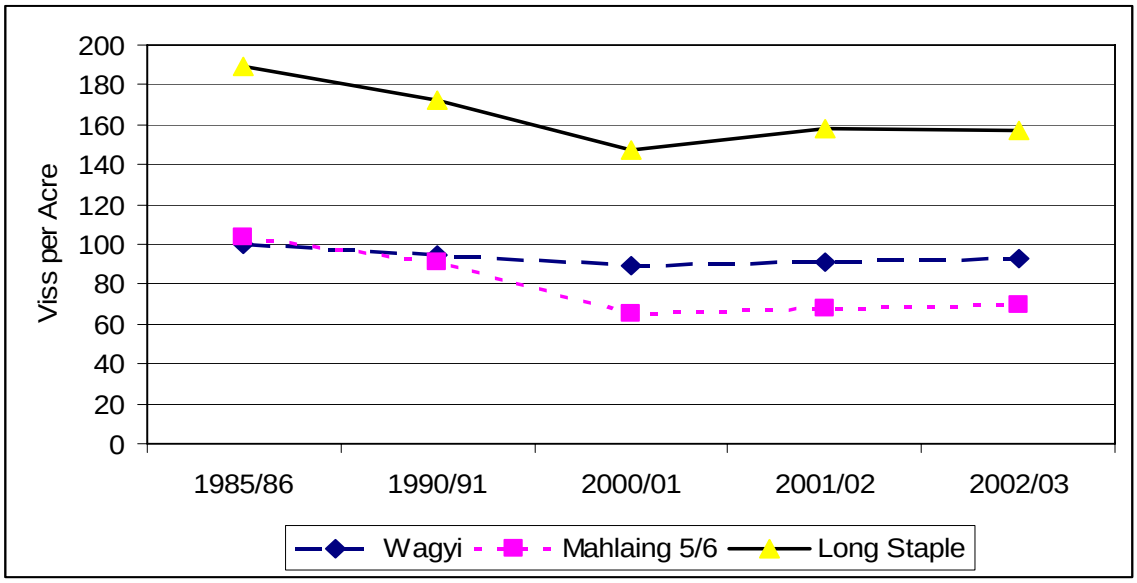

Figure 2. Decreasing cotton yield due to soil degradation
Source: Statistical Yearbook (2003).

Similarly, the rapid pace of shrinking in degrading mangrove areas is putting at risk the livelihoods of the people and the integrity of the coastal environment.

The World Conservation Union (IUCN) observed in 2004 that Myanmar is a tentative sanctuary to approximately 2.4% of the globally threatened species. This standing includes roughly 3.6% of globally threatened mammals, 4% of globally threatened birds, 8.5% of globally threatened reptiles, and 1.3% of globally threatened fish (NCEA, 2005). Including 34 sanctuaries, so far 42 locations comprising 7.3 percent of the total area of the country, are proposed and included in the Protected Area System (Annex 1). Out of them, 20 are well managed by the Nature and Wildlife Conservation Division under the Forest Department. Moeyingyi Wetland Bird Sanctuary, a wetland reservoir, with 104 square kilometres has been included in the list of wetlands of international importance in ASEAN countries (ASEAN 2005).

Climate change is an important outcome of forest degradation and deforestation, but it is a global issue rather than a national concern only. Although climate change is a borderless crisis, a variety of parameters such as frequency of depressions and cyclones, average temperatures and others are features of climate change. Myanmar's forest cover and the conditions of forest are major contributors in moderating climate change. For example, the Asia Least Cost Greenhouse Gas Abatement Strategy (ALGAS) project, already conducted in Myanmar, proved that the country was a net sequester in terms of pure CO_2 emissions.

State of forest management

In order to assure the sustainability of natural forests in perpetuity, Scientific Forest Management was initiated in Myanmar around 1856 when the Exploitation-Cum-Cultural System was established by Dr. Dietrich Brandis (subsequently called the Brandis Selection System). Preparation of policy and guidelines for forest sector development and forest resource management were based on India's policy and legislation but Brandis considered the customs and culture of Myanma nationals and the administrative ideas of Myanmar kings (MOF 2001). The Brandis System was later modified into the Burma Selection System (BSS) and then the Myanmar Selection System (MSS). The main objectives of the MSS are to harvest annual yield on a sustainable basis and to work out estimated future yield. The system is still steadfastly adhered to and is based on an identified Annual Allowable Cut (AAC), girth

limit and a 30-year felling cycle. Other treatments such as improvement felling, regeneration work and encouragement of the creation of one acre (0.405 hectare) of plantation per 40 tonnes of round logs extracted are included.

The Brandis System which was derived from a Linear Valuation Survey has been applied to work out an AAC. Based on the Linear Valuation Survey and the AAC, the MSS was well established by 1920 as an exclusive system in the Myanma forest management regime. The MSS works out the AAC by adaptation of the 30 year felling cycle, fixing the annual yield (number of trees) and prescribed exploitable girth. The process for working out the AAC through the MSS is shown in Figure 3.

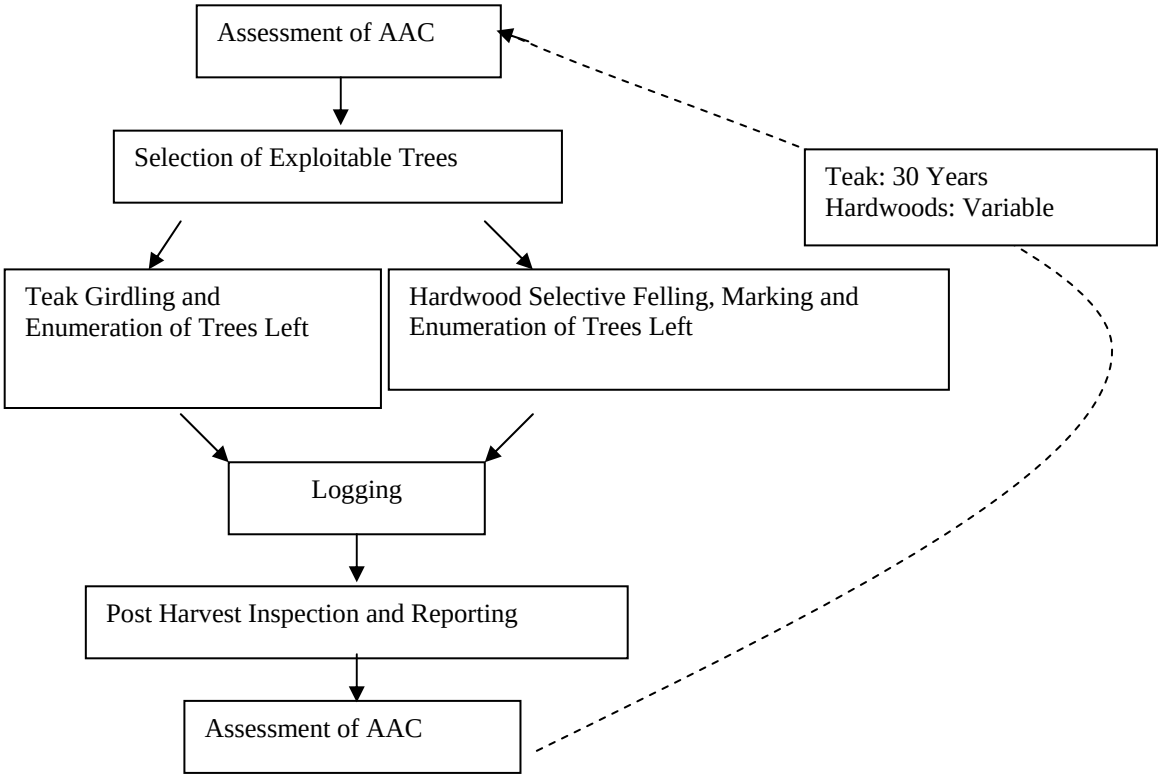

Figure 3. The Myanmar Selection System (MSS) process
Source: Forest Department. .

The system is based on selective logging of mature trees. The same basic approach is used for other hardwoods, although it is naturally modified to meet the specific requirements of various species.

The fundamental components of the MSS are:

- Fixing Annual Allowable Cut (AAC)
- Forecasting future AAC and obtaining figures about density and composition in the forest
- Improving forests by means of climber cutting, Nyaung Bat felling, improvement felling, thinning and broadcasting of teak seeds in the bamboo flowering area
- Repairing reserve boundaries
- Getting better natural regeneration through the selection of sound trees as seed bearers
- Improving natural regeneration of the forest through coppicing of desirable species and cutting undesirable species of the regional supply working unit level, also known as the Felling-Cum-Regeneration Programme

The MSS favours selection and extraction of wood, collection and computation of future plantlets, nurturing the forests and preserving them simultaneously. Teak girdling and other hardwood marking of exploitable trees are done within the prescribed AAC. The previous AACs for both teak and hardwood were revised again in 1992/1993. They are given in Table 14.

Table 14. Annual Allowable Cut (AAC) in Myanmar

	Before 1992/1993		After 1992/1993		% change	
	No. of trees	Cubic tons	No. of trees	Cubic tons	No. of trees	Cubic tons
Teak	178,750	339,625	124,213	210,000	-30.5	-38.2
Other hardwood	1,366,300	1,300,000	1,795,424	1,800,000	31.4	38.5
Total	**1,545,050**	**1,639,625**	**1,919,637**	**2,010,000**	**24.0**	**23.0**

Source: MOF (2001).

In 1992/1993, the AAC for teak production was adjusted with a reduction by over 30 percent in number of trees and 38 percent in cubic tons, but that for hardwood was raised by more than 31 percent in number of trees and 38 percent in cubic tons. Thus, the overall AAC increased by 24 percent in number of trees and 23 percent in cubic tons. The readjustment was due to fulfilling targeted income on the one hand and reducing exploitation of scarce wood. Because of the dwindling stock of teak, its AAC was lowered while that for other hardwoods was increased to offset the decrease.

Regarding detailed forest management plans, the first working plan was formulated in 1856 for the teak forests in Bago Region. It was drawn up to count teak resources by means of a "linear valuation survey" based on data specified. New "Administrative District Forest Management Plans" were prepared in 1996, and completed for 61 administrative districts. Forest Management Units (District Forest Areas) were organized along and in line with civil administrative districts. Each unit comprises various working areas depending on its objectives. These working areas include those for production, plantation, watersheds, community forest, NWFPs and natural land (MOF 2001).

Besides, there are thirteen annual forest operations undertaken by the Forest Department for the purpose of forest management. These operations are teak girdling and green teak marking, selection felling marking, artificial regeneration, natural regeneration, improvement felling, weeding, thinning, Nyaung-bat felling, repair of forest roads, repair of reserve boundaries, repair of compartment boundaries, fire protection and new reservations. The performance trend of forest operations is shown in Table 15.

Table 15. Performance trend of forest operations for 1991, 2000 and 2005

Categories	Unit	1990	2000	2005 Provisional
Teak girdling & green teak marking	tree	135,085	116,721	110,000
Selection felling marking	tree	783,866	761,219	660,000
Artificial regeneration	hectare	30,721	30,718	30,375
Natural regeneration	hectare	3,908	11,369	13,537
Improvement felling	hectare	6,000	9,666	9,918
Weeding	hectare	139,369	162,755	165,645
Thinning	hectare	12,035	16,422	127,632
Nyaung-bat felling	hectare	109,466	128,973	88,448
Repair of forest road	kilometre	2,631	2,626	2,261
Repair of reserve boundaries	kilometre	2,047	2,678	1,995
Repair of compartment boundaries	kilometre	2,234	2,687	1,835
Fire protection	hectare	155,893	149,588	141,021
Reservations	sq-km	0	3,555	9,876

Source: FAO (2006).

To maintain sustainable yield of timber and forest products, natural forest regeneration and artificial forest plantation have been carried out. The area under natural regeneration for valuable tree species climbed from 3,980 hectares in 1990 to 11,369 hectares in 2000 and 13,537 hectares in 2005. Out of a total area of artificial forest plantation of 30,375 hectares during 2005, teak trees were planted on 12,150 hectares and hardwood on 18,225 hectares. The hardwood plantation area of 18,225 hectares comprises 2,511 hectares of commercial plantation such as pyinkado, padauk and pine trees, 3,119 hectares of industrial raw material plantation, 3,037 hectares of village woodlot plantation to provide fuelwood and charcoal, 8,140 hectares of watershed plantation to ensure long-term utilization and perfect irrigation flow, and 608 hectares of mangrove plantations in the delta areas. The remaining 810 hectares are plantation areas of tang oil trees.

For long-term forest management, the sustainability status of forest resources, health and vitality of forest ecosystems, flow of forest product production, biodiversity conservation, soil and water resource preservation, and economic, social and cultural maintenance are standardized to achieve sustainable development in the management of Myanma natural forests. Standardization of economic, social, environmental and cultural maintenance refers to the appraisal of the forestry sector's contribution to national income, job creation in the forestry sector, forest supplies for local community, customs and traditions of forest dwellers, environmental protection, and preservation of cultural heritage in order to assist long-term development of the country.

In order to reinforce forest sector management, forest plantation plays a major role to replace trees in deforested areas. The National Forest Policy 1995 stipulated that regeneration, either natural or artificial, must be carried out to produce forest products from natural forest, and to plant in degraded areas to repair the environment and ecology and to fulfill local and industrial uses.

In the early 1970s, the Forest Department initiated a policy related to forest plantation. With the aim of recovering past overexploitation and establishing timber resources for the future, the policy was suggested in support of the creation of one acre of plantation for every 40 cubic tons of round logs extracted from the forest. The extent was based on the fixed line

which expressed that 40 cubic tons of marketable round logs would be produced from one acre of teak plantation of average quality. It was adopted as the forest plantation policy during the 1970s and 1980s (Ohn 1996).

Initially, forest plantations were thought to be the solution to counter deforestation and large-scale plantations begun in 1980. But later, it was realized that such plantations impacted adversely on soil and water resources, the environment and biodiversity conservation. Thus, the idea for large-scale plantations was abandoned and, instead, small-scale plantations were established as a compensatory measure. Plantations are thinned heavily till they reach the age of about 25 years, leaving only around 40 trees per acre. Silviculture operations are carried out till the plantations reach the age of 40 years, after which they are regarded as natural forests and allowed to merge with their natural surroundings. Rotations are fixed at 40 years for special teak plantation, 60 years for commercial plantation including normal teak plantation, 10 years for industrial plantation, and 5 years for village supply plantation.

Policy and institutional framework

Sustainable forest sector development requires policy and institutional attention across the widest possible range of activities. The success of forest management also depends on the efficiency and effectiveness of related institutions. These policy and institutional frameworks are not meant to be static but to be dynamic along with changes in political, social, environmental and economic situations.

Myanma national forest policy is actually the fundamental guideline for systematic development of the forest sector. Moreover, the policy is a basis for laws and rules of forest exploitation and preservation, and for development and capacity building of supporting institutions. Myanma forest laws and rules are set as the tools to implement the national forest policy. The World Earth Summit 1992 also advocated for countries all over the world that forest management should not focus only on economic viability but also on environmental feasibility and social acceptability.

Up to 1994, Myanmar had not yet had a national forest policy. Forest sector development was addressed according to the India Forest Policy 1894, and sometimes by ad hoc measures until the Burma Forest Act was enacted in 1902. Because of the realization of the MSS rather than strictly adhering to the AAC, environmental degradation in Myanmar was much lower than in other countries. Thanks to Dr. Dietrich Brandis a scientific forest management system was initiated in the country. Brandis' treatment to safeguard the forestry sector advocated public participation rather than regulation and control. This worked as the basic principle in forest management even though there was no particular national forest policy at that time.

Although the previous functions for forest management were workable, a national forest policy needed promulgation. Thus, with the assistance of FAO, an expert team including international experts, government personnel from the Ministry of Forest and Myanma professionals developed a plan and finally the Myanmar Forest Policy emerged in 1995. The Myanma national forest policy identified six priority areas:

1. Protection of soil, water, wildlife, biodiversity and environment
2. Sustainability of forest resources to ensure a perpetual supply of benefits from forests for present and future generations
3. Basic needs of the people for fuel, shelter, food and recreation
4. Efficient use, in a socially and environmentally friendly manner, of the full economic potential of forest resources
5. Participation of people in the conservation and use of forests
6. Public awareness of the vital role of forests in the well-being and socio-economic development of the nation

The goals and action plans of the forest policy clearly addressed land use, preservation and administration, forest regeneration and plantation, wood-based industry, marketing and trading, research, planning, coordination, budget and finance, people's cooperation and awareness, etc. The forest policy targeted to secure and manage 30 percent of the total land area under Permanent Forest Estate (PFE) comprising reserved forest and protected public forests.

Forest law was sketched out prior to the emergence of the forest policy, and the old 1902 Forest Act was laid down as the basis for the new 1992 law. There were eight principles in preparing the new law:

- To implement the forest policy nationally
- To implement national policy regarding national environmental preservation
- To promote the role of public participation in the implementation of the above policies
- To support the national economy and basic needs of the people as well as to ensure continuous fulfillment of benefits from the forests including recreation
- To carry out international contracts related to the environment and forest preservation
- To prevent depletion of ecosystems and biodiversity, forest fire, pest and disease
- To safeguard against degradation and depletion of natural forests and to conduct afforestation in areas where natural forests were depleted
- To fulfill domestic fuel needs

Although the forest law has been enacted since 1992, forest rules were released only in 1995. Nevertheless, both forest law and rules were prepared to harmonize with the forest policy and the practical situation on the ground. Besides the forest law and rules, the law for protection of wildlife and natural plants and preservation of natural land was ratified in 1994. Moreover, Community Forestry Instructions were also issued by the Forest Department in 1995.

Regarding long-term adaptation of sustainable forestry development, the NFMP was developed in 2001. It foresees the forestry situation in the next 30 years from 2001/2002 to 2030/2031 and outlines a wide range of forest activities including wildlife and nature conservation in order to achieve the objectives of sustainable harvesting of valuable teak, protection of forests against degradation, environmental conservation and earning more foreign exchange by exporting more value-added products. The NFMP covers extensive forest activities which intend to protect reserved forests and protected public forests and to extend them for sustenance; pursue sound programmes of forest development through regeneration and rehabilitation; effectively manage watersheds for the longevity of dams and water reservoirs; optimize extraction of teak and hardwood within the available means; extend forestry research; enforce effective law against illegal extraction of forest products; encourage increasing use of fuel-wood substitutes; export timber and value-added forest products and seek ways and means to export other NWFPs; and promote ecotourism to earn more foreign exchange.

Regarding the institutional framework, the Ministry of Forestry became a separate entity in 1992 when the Ministry of Agriculture and Forest was restructured into two separate ministries. Nowadays, the Ministry of Forestry (MOF) is structured by five institutions including the Forest Department (FD), the Myanmar Timber Enterprise (MTE), the Dry Zone Greening Department (DZGD), the Planning and Statistics Department (PSD) and the National Commission for Environmental Affairs (NCEA). The FD is responsible for the protection, conservation and sustainable management of forest while the MTE carries out timber harvesting, milling, downstream processing and marketing of forest products. The DZGD performs reforestation of degraded lands and environmental restoration in the central

Myanmar dry zone. The PSD coordinates and facilitates the work of the remaining organizations according to directives issued by the Minister's Office. The NCEA is the national focal point and coordinating agency for environmental matters dealing with the environmental policy planning at the national level. Environmental deterioration such as forest degradation and depletion is an important concern of the commission.

In the private sector, the Myanmar Forest Products and Timber Merchants' Association was the sole commercial organization for wood production and marketing. To encourage timber trading, the Myanmar Forest Products Joint Venture Corporation Limited was formed as a joint venture between the Ministry of Forestry and the public. Other local NGOs include the Forest Resource Environment Development and Conservation Association (FREDA), the Biodiversity And Nature Conservation Association (BANCA), Friends of the Rain Forest Myanmar (FORM), the Renewable Energy Association Myanmar (REAM), the Ecosystem Conservation and Community Development Initiative (ECCDI), and the Myanmar Academy of Agriculture, Forestry, Livestock and Fishery, which play a particular role in forest management and building public awareness. Remaining NGOs and INGOs such as farmers' and women's income generation groups are being formed. They aim to enhance social well-being by raising off-farm incomes and helping to advance forest management.

Problems undermining sustainable forest management

As mentioned above, systematic and scientific management for the purpose of forest sector sustainability has been an endeavour in Myanmar since 1856. In line with changes in socioeconomic factors, technical know-how, customary value, and other factors, management strategies are amended and modified occasionally. Even so, a variety of impediments are hindering sustainable forest management. Overexploitation, disorganized shifting cultivation, illegal logging, conflict of interests between forest sustainability and forest income, and policy inconsistency between the forest sector and other economic sectors including agriculture, livestock breeding and mining, are major causes of failure in sustainable forest management.

The forestry sector in Myanmar has its own annual income target to contribute to the regional as well as national GDP. Attempting to fulfill this income target more often occurs in emphasizing additional production of forest resources. This has a tendency of overexploitation. For example, annual teak production and the prescribed AAC are compared in Figure 4.

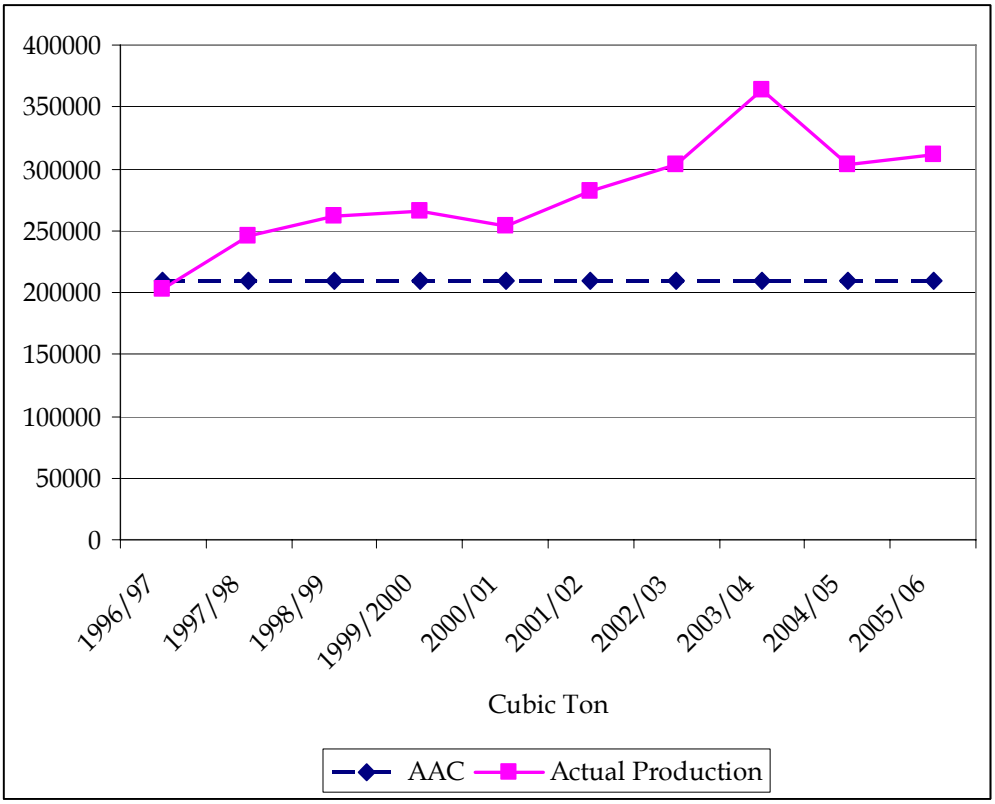

Figure 4. Actual production of teak against AAC
Source: Forest Department (2001) & MNPED (2006).

Shifting cultivation is often cited as the main cause of deforestation. It is true that slash and burn practice wipes out forest cover. The FD's 2002 release stated that 22.8 percent of the forested area in Myanmar was devastated due to the rising practice of shifting cultivation. However, an important point resulting from a research survey is that shifting cultivation, especially on a sufficient rotational basis, supports survival of natural forests, wildlife, ecosystems, and biodiversity more than the cultivation of single plants such as teak or rubber (Saung 2003). The *Taungya* method, which was in fact the fore-runner of agro-forestry and community forestry originated in Myanmar, began with shifting cultivators.

Illegal logging is usually interpreted as the exploitation of forests and woods in violation of the enacted law or without authorization. Moreover, in its essence, illegal logging in the forest sector should be understood as detrimental behavior that violates the law. Forest exploitation above the AAC, overlooking the MSS, and permission to cut trees of immature size are as harmful as illegal practices.

Like other countries, Myanmar has to attempt to meet its economic development goals that are frequently not in agreement with sustainability. Larger production from increased resource extraction leads to higher income or GDP but is incompatible with sustainable development. Focusing on increases in regional GDP, therefore, is counterproductive for forest management in Myanmar.

Sometimes, the objectives of sustainable forest management and that of other sectors are incompatible. For example, the current forest policy prescribed one of the aims as "to gazette 30 percent of the total land area of the country as reserve forest and 5 percent under protected area system" while the agriculture sector adopted one strategy for its enhancement as "development of new agricultural land". Likewise, encouraging deep water paddy cultivation and aquaculture of fish and prawns usually impacts mangrove forests while rubber and palm

oil plantation in the reserved forest area result in forest degradation. Since natural resources including land are limited, excessive needs to fulfill sectoral targets are trading off among the various sectors.

4. WHAT WILL INFLUENCE THE FUTURE STATE OF FORESTS AND FORESTRY?

Demographic change

Economists and ecologists have different views on demographic change. Economists emphasize the role of institutions and incentives, while ecologists emphasize human-environmental interactions and the far-reaching consequences of ecosystem damage. A third perspective focuses on the importance of social and cultural factors both in determining the course of population growth and in responding to its impacts. The three views are not compatible. In fact, it is essential to combine insights from all three perspectives to understand the issue and devise appropriate responses.

Responses to population growth include extensive and intensive agricultural expansion, innovation, migration, and changing fertility patterns. Population growth can stimulate innovation and increased agricultural productivity (Boserup 1981) but there are also many ways in which population growth can contribute to environmental degradation. High population growth creates pressure for out-migration, and migration typically increases cultivation on marginal lands including forested areas, creating both environmental damage and social conflict between residents and migrants.

Myanmar has a relatively low population density with 79 persons per square kilometre. Forest resources are impacted by growing population, resulting in deforestation and a decline in wildlife populations. The 1983 population census is the most recent census. Later, annual growth rates were organized by estimation based on the 1983 census and the rate was fixed at 2.02 percent in 1998/1999 and afterwards. The population in 2005/2006 was estimated at 55.40 million, an increase from 40.78 million in 1990/1991, 44.74 million in 1995/1996, and 50.13 million in 2000/2001. The population estimates of Myanmar are shown in Figure 5.

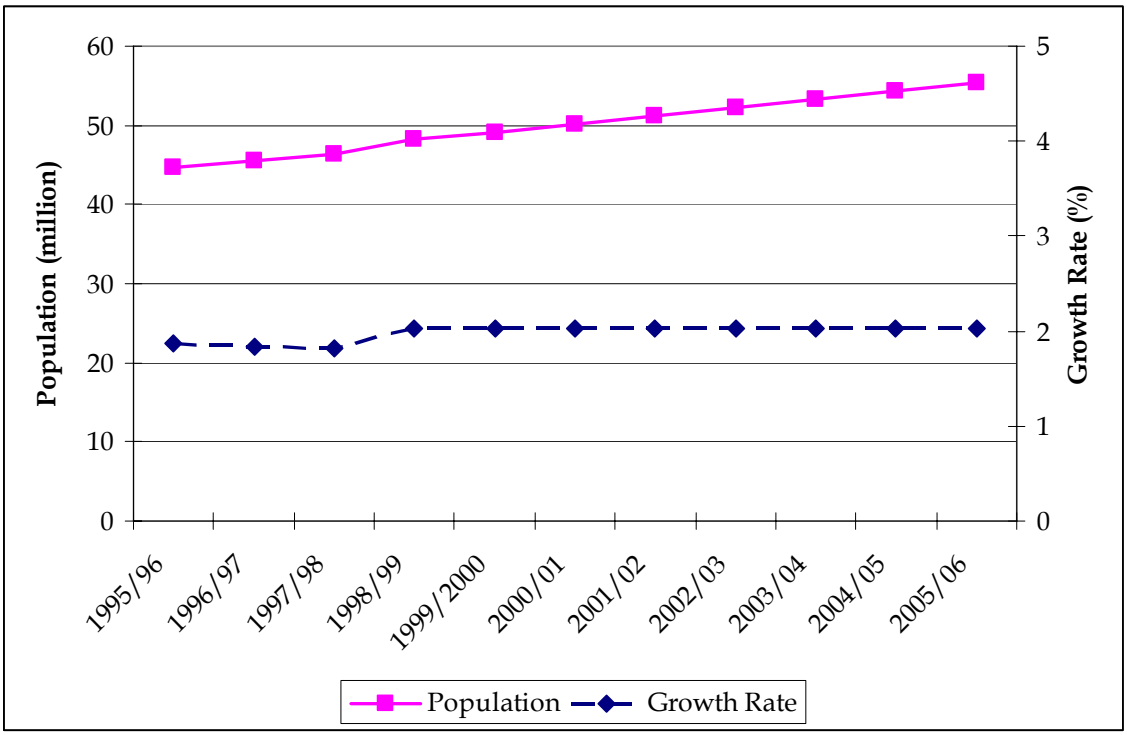

Figure 5. Population estimates of Myanmar
Source: Statistical Yearbook (2003), (2004), (2005) and (2006).

Along with the growing population, wood utilization increases. There is an endeavour to focus more on supply of electricity and natural gas to substitute for woodfuel, firewood and charcoal production (Table 16).

Table 16. Production of firewood and charcoal

Year	Firewood		Charcoal	
	Production (cubic tons)	Percentage change	Production (cubic tons)	Percentage change
1995/96	17,769	-	213	-
1996/97	17,743	-0.15	150	-29.58
1997/98	17,278	-2.62	84	-44.00
1998/99	17,616	1.96	145	72.62
1999/2000	18,383	4.35	201	38.62
2000/01	18,579	1.07	182	-9.45
2001/02	18,972	2.12	223	22.53
2002/03	19,384	2.17	260	16.59
2003/04	19,831	2.31	409	57.31
2004/05	20,165	1.68	225	-44.99
2005/06	20,544	1.88	233	3.56

Source: Statistical Yearbook (2003), (2004), (2005) and (2006).

Firewood production can be said to be generally increasing and charcoal production fluctuating wildly from time to time, because of the necessity to acquire permission and the issuance of a license. At this point, the absence of information on illegal charcoal production renders the recorded figures incomplete and understated.

Myanmar is administratively divided into seven States and Seven Divisions. As shown in Figure 6 Yangon Division has the highest population density with about 600 persons per square kilometre while Chin State has the lowest with 14 persons per square kilometre.

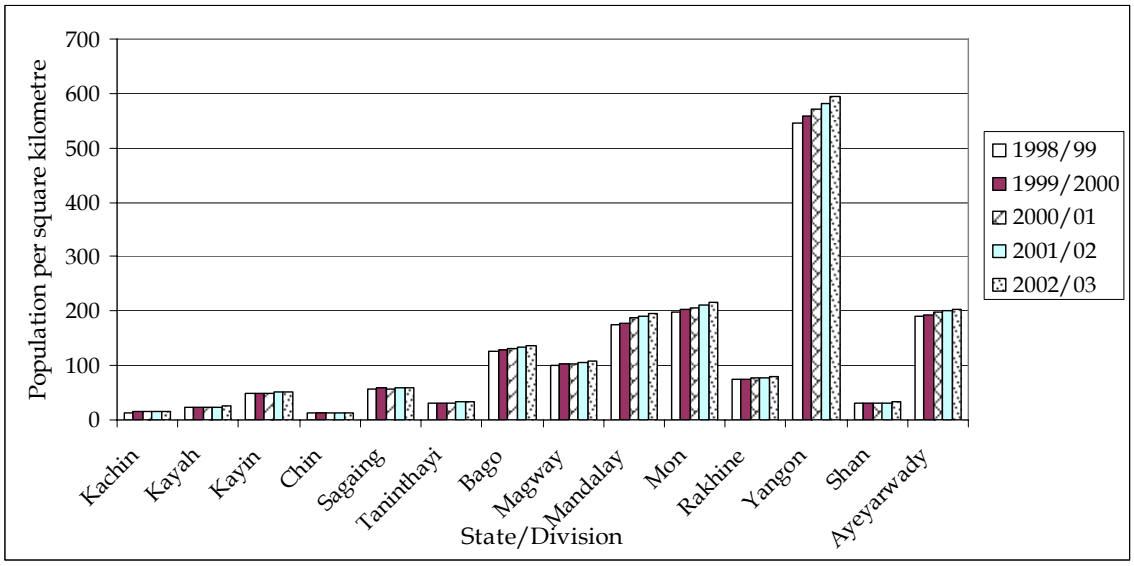

Figure 6. Population distribution in States and Divisions in terms of density
Source: Statistical Yearbook (2003), (2004), (2005) and (2006).

Because of the low population density in Kachin and Chin States, large areas of sanctuaries for wildlife species are located there: 698 square kilometres for Pidaung Wildlife Sanctuary, 3813 square kilometres for Hkakaborazi Protected Area, 775 square kilometres for Indawgyi Wetland and 11642 square kilometres for Hugaung Valley Wildlife Sanctuary in Kachin State; and 723 square kilometres for Natmataung National Park in Chin State. The highest populated area, Yangon Division, has just 6 square kilometres for Hlawga Wildlife Park.

Economic transition

There is an inverted U-curve relationship between indicators of environmental degradation and levels of income per capita, according to the Environmental Kuznets Curve hypothesis. The hypothesis advocates that at the early stage of development, rates of land clearance, resource use, and waste generation proceed rapidly. But at a higher level of development, better technology, improved environmental awareness and law enforcement, and structural economic change favouring the service sector lead to improved environmental conditions.

Myanmar is in its initial stage of development. Thus it has to rely for its economy on the primary sector such as resource extraction and exports. The country is in the transitional period to a market-oriented economic system and industrialization. Without successful transformation to industrial development, raw materials such as round logs can never become value-added products such as high quality wood-made home decoration items. Until recently, the structure of the Myanma economy has not significantly changed with high domination of the primary sector comprising agriculture, livestock and fishery, forestry, energy and mining. The secondary sector includes processing and manufacturing, electric power and construction. The tertiary sector consists of transportation, communication, finance, society and administration, rentals and other services plus trade. The economic structure of the Myanma economy is shown in Figure 7.

Figure 7. Structure of the Myanma economy

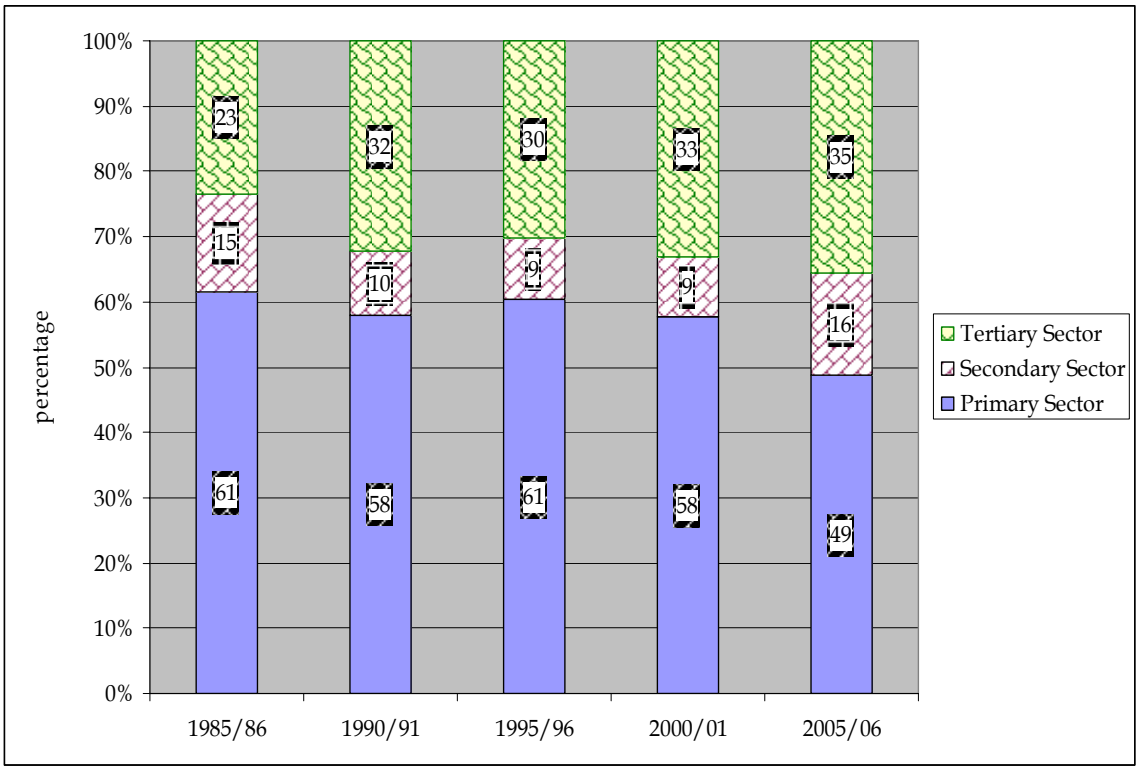

Figure 7. Structure of the Myanma economy
Source: Statistical Yearbook (various issues).

The proportion of the industrial sector in Myanmar slightly increased from 15 percent in 1985/1986 to 16 percent in 2005/2006. The share of agriculture and other primary sectors declined from 61 percent to 49 percent, and that of the service sector increased from 23 to 35 percent for the same period. The higher contribution of the service sector is due to rapid expansion of international trade with initiation of the market economy.

Forestry as part of the primary sector generates higher income from year to year. The same trend occurs in timber production. This corresponding situation indicates that progressive income generation by forestry was not because of quality orientation but because of quantity orientation. This parallel trend is shown in Figure 8.

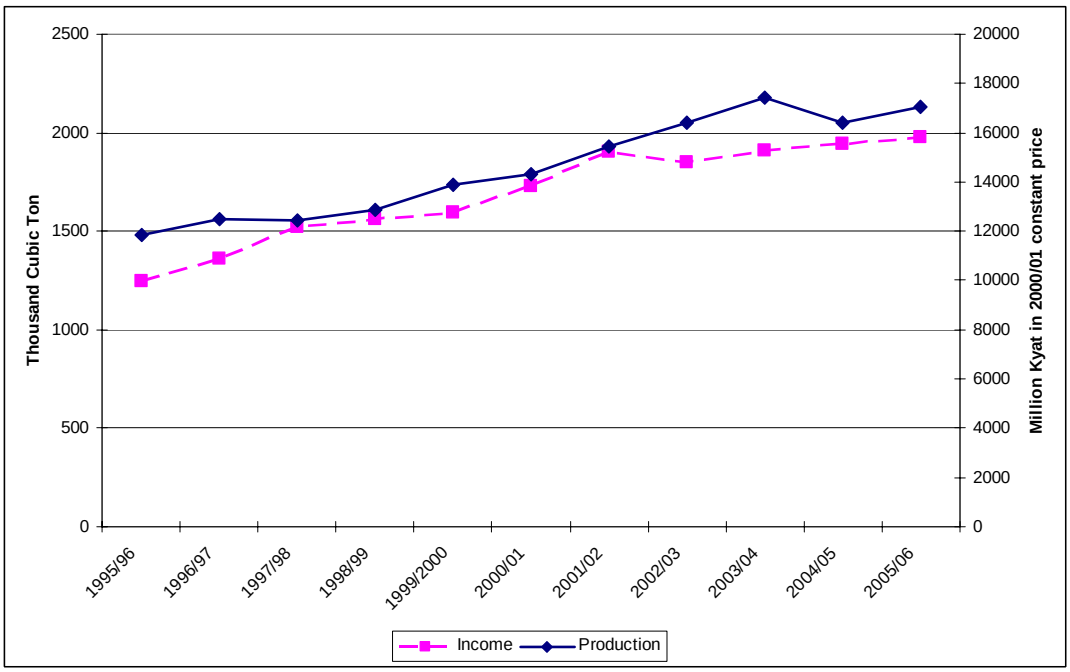

Figure 8. Parallel trend showing production of teak and hardwood and national income from forestry
Source: MNPED 2006.

In the direction of development and sustainability, maximum benefits should be generated from minimum utilization of resources. To effect this, income from the forest sector needs to increase through more production of high value-added products and extraction of primary resources needs to follow a downward trend.

Environmental issues and policies

Wide-reaching awareness and commitment on environmental issues were achieved for the first time at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in June 1992. Myanmar is one of the member countries which adopted Agenda 21 and the Rio Declaration on Environment and Development. Myanmar Agenda 21 together with the environmental policy is one of the important instruments for implementing the Myanmar Forest Policy.

Myanmar Agenda 21 specified sustainable forest resources management and raised such issues as protection and conservation of the forest resource base; reservation of production and protected areas; forest management, participatory forestry, and extension activities; sustainable utilization of resources; harvesting and utilization; and capacity building at all levels. In order to tackle these issues, various programme areas were also evolved. Identified programme areas were accelerating sustainable development of forest resources, developing

the forestry sector to meet basic needs, promoting efficiency in the production of forestry goods and services, strengthening forestry policy legislation and institutions and enhancing people's participation in forestry development and management. Each and every programme area has its basis for action, objectives and activities. The following activities are recommended with relevant measures:

- Accelerate sustainable development of forest resources
- Identify issues in forest reservation and take measures for their solution
- Prepare an integrated multiple use management plan
- Improve forest cover
- Introduce natural resource accounting in the forestry sector
- Produce better quality of seeds and their timely availability
- Conduct EIA
- Enhance income generating activities
- Develop the forestry sector to meet basic needs
- Develop strategies to balance the supply and demand of forestry resources
- Strengthen measures to minimize and promote efficiency in the use of fuelwood
- Promote efficiency in production of forestry goods and services
- Promote efficiency and minimize waste in logging operation
- Promote forest-based sustainable industrial development
- Rationalize the royalty structure and pricing policy
- Strengthen forestry policies, legislation and institutions
- Improve the institutional effectiveness of the forestry organizations
- Promote forestry research
- Implement the forestry policies and effectively enforce legislation
- Strengthen forestry education
- Strengthen forestry information and communication
- Enhance people's participation in forestry development and management
- Raise the awareness of the community
- Strengthen community participation in forestry programmes and agroforestry
- Study the feasibility of private forestry development

The forestry section in Myanmar Agenda 21 is an advanced document to guide sustainable forest and forestry development. However, proper implementation requires financial support, institutional strengthening, and political commitment.

Apart from Agenda 21, the 1995 Myanmar Forest Policy emphasized the future development process for the forestry sector and sustainability of the forests. The Forest Law (1992), Forest Rules (1995), Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law (1994), Community Forestry Instructions (1995), Myanmar Agenda 21, National Forestry Action Plan (1995), Criteria and Indicators for Sustainable Forest Management (1999), Format and Guidelines for District Forest Management Plans (1996), National Code of Practice for Forest Harvesting and National Framework for Environmental Law are major tools to realize forest policy. The 1992 Forest Law in addition focuses on awareness and participation in the conservation and sustainable utilization of forest resources, and stresses the importance of collecting and updating resource information, planning, continuous monitoring of all forest operations and maintaining the ecological balance and environmental stability.

Future energy demand

Woodfuel, agricultural residuals, hydropower, coal, crude oil and natural gas are the primary energy resources of Myanmar. Net energy consumption gradually increased from 8,714 KTOE in 1990/91 to 11,979.5 KTOE in 2005/2006. Efforts are also made to meet energy demand through hydropower generation. Indeed, Myanmar has much potential with an estimated capacity of 38,000 megawatts from which only 340 megawatts, equivalent to less than 1 percent has been generated. A survey to produce geothermal energy from 93 hot streams which have the highest underground temperature of 200°C has been conducted. Encouraging the use of waste from saw mills and rice mills as the main fuel for their own-use boilers and cultivating the physic nut on a large scale to use its oil in driving farm machinery are also prioritized for future energy supply. Likewise, oil and natural gas exploration, drilling and extraction are carried out under contract with foreign companies on a profit-sharing basis.

The Ministry of Energy worked out the domestic energy requirement and capacity to accomplish it based on three cases: base case, normal case and high case. The base case supposes an undersupply condition due to foreign exchange constraints; the normal case assumes supply condition comparable to the socioeconomic growth rate; and the high case imagines supply conditions along with rapid industrialization. Supply and demand for oil and natural gas in accordance with the base case were projected by the Ministry of Energy in its 30-year development plan (Annex 2).

With regard to the initiation of remedial measures, the Committee for Innovation and Distribution of Firewood Substitute Fuel for Arid Regions was formed to substitute wood-based fuel with alternative energy. Programmes for fuelwood substitution such as briquettes made of agri-waste and heat-saving stoves, Liquefied Petroleum Gas (LPG) for household use, natural gas for brick kilns, reintroduction of kerosene as a household fuel, and development of new and alternative sources of energy such as solar and mini hydro projects may help to reduce fuelwood consumption and consequent deforestation.

5. PROBABLE SCENARIOS AND THEIR IMPLICATIONS

Rationale for scenario definition and driving forces

Scenario analysis may be used to build a picture about the different possible paths of development that could be followed and the various consequences that may result. Scenarios envision future pathways and take into account critical uncertainties. Among the possible factors, some can be easily measured and quantified in terms of their impacts but many others are less tangible and have to be assessed qualitatively. Whether the factors are quantifiable or not, defining scenarios is important in distinguish the variety of possible directions to help prepare for future opportunities and challenges. In defining scenarios, key driving forces are identified and the system responses are described in relation to changes in these driving forces.

There are a number of driving forces that impact upon the forest sector and it has to be noted that their impact is collective. Thus, in considering probable scenarios, the focus should be on a limited number of drivers, with the other forces assumed to be constants. Forests are increasingly intertwined with economic, social, environmental, policy and institutional issues such that any changes in society affect forests and vice versa. The Myanma forestry sector is affected by environmental, technological, economic, social, demographic, and policy/institutional drivers of change (Forest Department 2007). Some of the key areas include environmental awareness, demand for forest products and forest conversion, energy demand, wood-based industry and infrastructure development (dams, roads, etc.), poverty, and shifting cultivation, transboundary issues, national economic and land-use policy, financing, capacity to manage forests, market access, and law enforcement and combating illegal logging.

Screening of these drivers led to the selection of a limited number considered to be important and yet uncertain in their future trajectory. Of these, demand for forest products and land, energy demand, infrastructure development, illegal logging, transboundary issues, national economic policy, international conventions and capacity to manage forests are expected to improve in the future. Thus, poverty and land-use policy were selected as key drivers of change for Myanma forest and the forestry sector.

As in many other developing countries, poor people in Myanmar depend heavily on agriculture, forestry and fisheries for their livelihoods and food security. Although the government claimed that average income of the people lies above the local poverty line, relative poverty is manifested especially in rural and remote areas; most of them are close to the forests and engage in shifting cultivation. Without intervention, a vicious cycle of poverty and deforestation as shown in Figure 9 would be set in motion — heavy dependence on forests due to poverty, severe deforestation due to heavy dependence on the forests, less income generation due to severe deforestation, and poverty due to lesser income.

Four policy interventions are suggested to alleviate forest poverty: transferring tenure from governments to communities, improving market access, promoting community forestry, and providing communities with payments for environmental services such as the sequestration of carbon or watershed protection (CIFOR 2007). Out of the four policy options, the activity for promoting community forest has been undertaken and activity for improving market access is ongoing but insignificant.

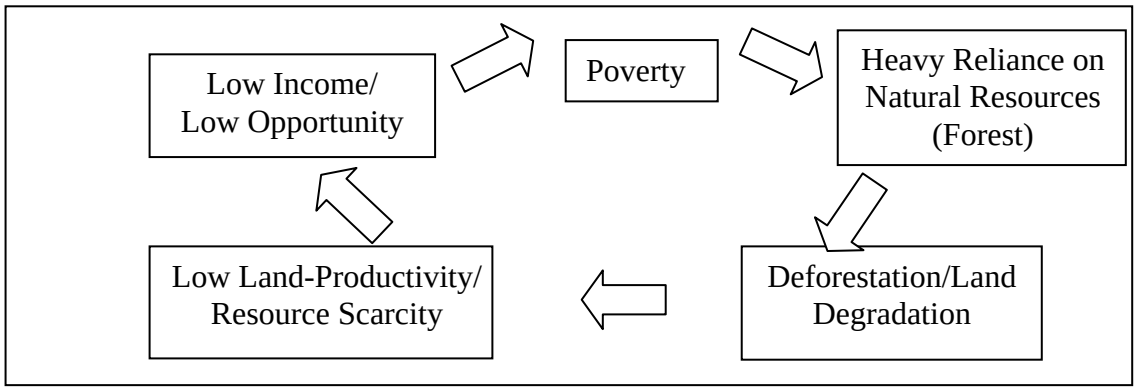

Figure 9. Vicious cycle of poverty in the context of deforestation

The second driving force is national land-use policy. Although forest policy includes statements about land-use, a nationwide land-use policy in Myanmar needs to be formulated and implemented in order to allocate the land area of the country. As mentioned earlier, the government targeted PFE to meet 30 percent of total land. On the other hand, it aimed at increasing investment to develop the cultivable land, fallow land and waste land to carry out agriculture, livestock breeding, aquaculture or other affiliated economic activities. But there is no definition given of these lands. Thus, agriculture including plantation of such perennial crops as oil palm and rubber encroached not only cultivable, fallow and waste land but also lands inside PFE (Kyaw, 2003). Within 2004/2005 alone, 2766 square miles of reserved forest area which included protected public forest were written off. Not only agricultural expansion but also other offensives such as canal and dam construction in forest and watershed areas, inclusion of mangrove forests as fishing grounds, and establishment of new military compounds in PFE explain lack of coordination among concerned institutions on proper land use.

Usual scenario and alternatives

With the assumption that impacts of drivers of change other than the two selected are invariable or minimal, the twin drivers of change — poverty and land-use policy — are combined in considering the future situation. Four future scenarios, namely, socioeconomic development stalls, unsustainable growth, asymmetric development, and sustainable development are shown in Figure 10. If the status of these two drivers of change proceeds more or less in accordance with recent trends, a stagnation of socioeconomic development may be inescapable.

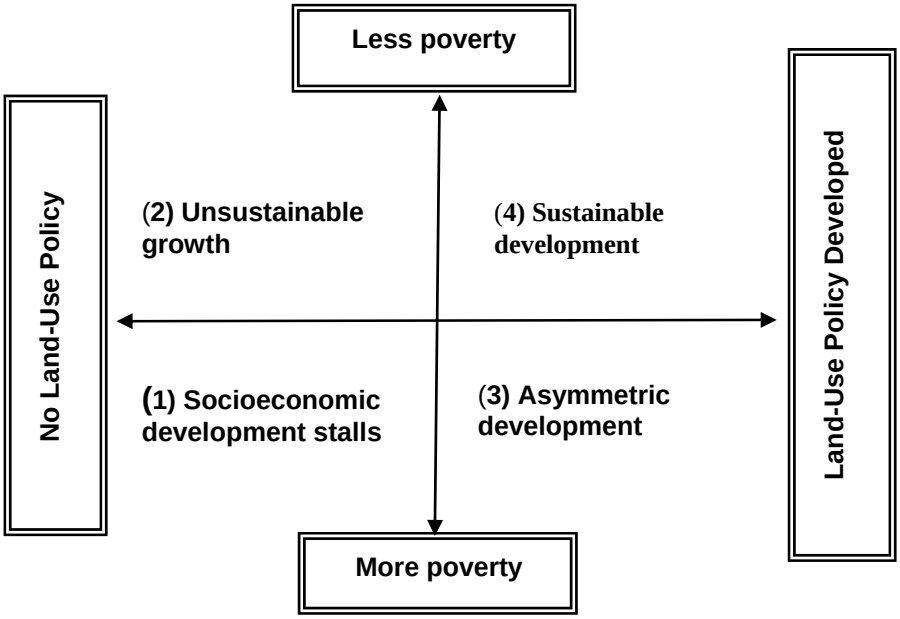

Figure 10. Probable future scenarios
Source: Model from National Consultation Workshop, FD. (2007).

(1) Socioeconomy Stalls: This is the most terrible situation for the future caused by more poverty and no clear-cut land-use policy. Both of these drivers cause persistent forest degradation and depletion, low economic growth, and environmental degradation.

(2) Unsustainable Growth: Under the circumstance in which the poverty level is diminished but a desirable land-use plan is not endorsed, there will be some growth but rather weak. Less poverty leads to the improvement of economy but lack of appropriate land-use policy constrains forest depletion and environmental degradation. However, lessening the extent of poverty could ease reliance on forests. Environmental impact assessment (EIA) and social impact assessment (SIA) must be conducted before any development project or programme is initiated and it should proceed according to EIA and SIA recommendations.

(3) Asymmetric Development: Less poverty reduction means low economic growth and/or more income inequality and consequently it is unsafe for the forests. Even though degradation of forest and environment takes place to some extent, the severity is less than the state of unsustainable growth. It is the result of adoption of a proper land-use policy which ensures sustainable management of forest resources.

(4) Sustainable Development: The uppermost situation is the significance of less poverty and developed land-use policy. The scenario guarantees stable growth of the economy as well as minimal forest degradation and environmental deterioration.

6. THE VISION IN 2020

Forest resources in the next two decades

Based on the template of four future scenarios, there are three alternative forecasts envisioned for forest resources in 2020: (i) a continuation of current circumstances, (ii) the MSS alone is followed, and (iii) in line with systematic conservation as outlined in the Myanmar Forest Policy 1995 and National Forest Master Plan.

With greater poverty and lack of a clear land-use policy, forest deterioration will continue according to recent trends. If FAO's estimation of 1.4 percent deforestation rate is authentic, the country's forested area will reach 27.49 million hectares or 40.6% of the total land area in 2020.

Either elimination of poverty or introduction of a nationwide land-use policy could ease overlogging and illegal logging. Pursuing no more than the MSS could maintain the existing level of forest coverage at around 50 percent and existing forest structure compositing with around 35 percent of closed forests and 15 percent of open forests. To meet this level, Myanmar needs efforts not towards further expansion of forest but to ensure maintenance of the current level of growing stock.

The best case scenario is achieved through integrated strategies. Poverty is reduced and a proper land-use policy is developed. Once prescriptions including the MSS and forest plantation establishment targets[3] have been implemented, the current AAC of 2,010,000 tonnes for the sum of teak and hardwood would be derived from 20,351 hectares of forest plantation (0.405 hectare plantation equivalent to 40 tonnes) (Annex 3). After deducting plantation area for local supply and the net casualty of plantation forests, net annual increment should remain at nearly 500 hectares; it enables an increase of 0.7 percent forest coverage in the total land area. If so, the 2020 vision is quite satisfactory. In fact, however, it is extremely difficult to expand forest covered area. Thus, the highest case can be expected to maintain existing forest coverage with improved forest quality. Forest resources in different scenarios are shown in Figure 11.

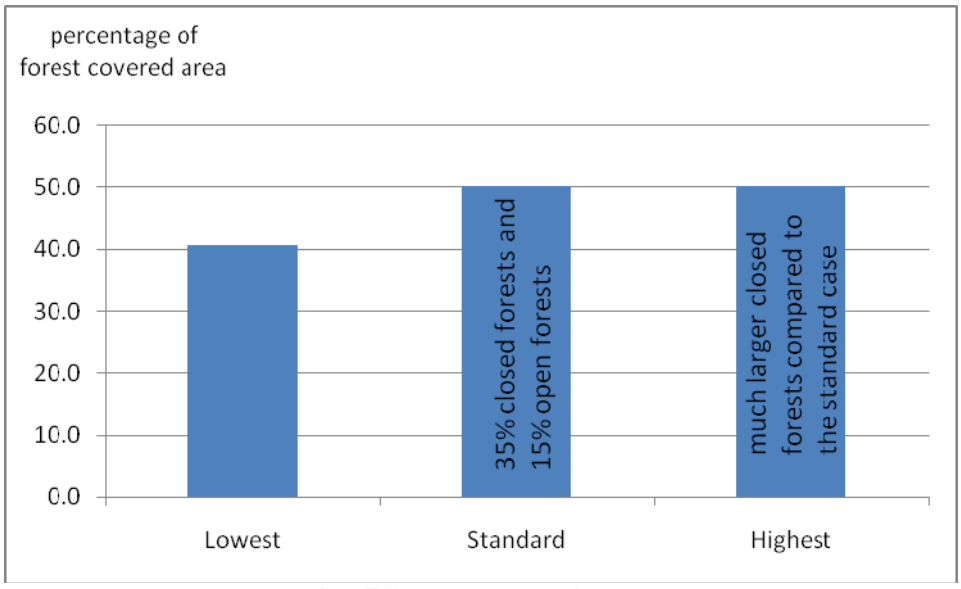

Figure 11. Forest resources in different scenarios
Source: Self compilation based on the MOF and FAO.

[3] The targeted annual plantation area is 30,375 hectares from 2001/2002 to 2010/2011 and 24,300 hectares from 2011/2012 to 2020/2021.

Wood and wood products

As nationwide timber harvesting, milling and downstream processing, and marketing of forest products are solely controlled by the MTE in Myanmar, the capability for domestic supply and export of wood and wood products depend on the MTE. The enterprise has laid down its objectives to reduce round log export gradually and terminate it in 2030/2031. On the other hand, teak logs are to be distributed progressively to the local wood-based industries.

In the Myanma Industrial Sector Development 30-Year Plan, the MTE stated its objectives about production and distribution of teak and other hardwood (Table 17).

Table 17. Projected teak and hardwood production and distribution (thousand cubic ton)

Description	2001/02	2006/07	2011/12	2016/17	2021/22	2026/27	2030/31
Teak Log							
Production	220.0	240.0	260.0	280.0	300.0	320.0	320.0
Distribution							
Mill	71.0	71.0	71.0	71.0	71.0	71.0	71.0
Wood-Based Industries							
State owned	30.0	36.0	40.0	50.0	60.0	72.0	76.0
Private	0.0	15.6	55.0	81.0	99.0	112.0	116.0
Local sales	6.0	37.4	47.0	50.0	54.0	57.0	57.0
Exports	113.0	80.0	47.0	28.0	16.0	8.0	0.0
Hardwood							
Production	950.0	970.0	990.0	1010.0	1030.0	1050.0	1050.0
Distribution							
Mill	473.0	476.0	454.0	435.0	413.0	396.5	380.0
Wood-based industries							
State owned	67.0	60.0	60.0	60.0	60.0	60.0	60.0
Private	80.0	80.0	80.0	80.0	80.0	80.0	80.0
Local sales	0.0	33.0	126.0	159.0	179.0	150.5	122.0
Exports	210.0	189.0	111.0	65.0	40.0	25.0	0.0
Transfer to JV	120.0	132.0	159.0	211.0	258.0	338.0	408.0

Source: MOF (2001).

The Ministry has projected to produce progressively from 220 000 cubic tons of teak and 950 000 cubic tons of hardwood in 2001/2002 to 320 000 cubic tons of teak and 1 050 000 cubic tons of hardwood in 2030/2031. However, actual production has already exceeded targets since 2003/2004 for teak and the early 1990s for hardwood (MNPED 2006). More importantly, actual production surpassed AACs during recent years. Since the AAC is based on a 30-year felling cycle, overexploitation tends to decrease future production and it is less possible to meet projections.

Besides overall wood production, types and quality of wood are also predisposed to change in the future. As shown in Table 1 regarding exports of Myanmar forest products, average prices of both teak and hardwood exported by Myanmar have a tendency to decrease. The main cause was evaluated in the NFMP as lowering of the quality of wood. It might be true because first class and second class veneer logs have no longer been produced since 1997/1998, and lower grade teak logs (assorted) contributed 67 percent of total teak export in 1999/2000 (MOF 2001 p.355). Table 6 about growing stock composition in Myanmar forests also supports the clarification. A survey by the Forest Department in the last decade indicated the

teak and hardwood component ratio per acreage in different States and Divisions; it revealed that the ratio of teak and important hardwoods had become smaller. Most were those from the hardwood group and lesser-used species. So, product diversion such as wood and wood products produced from lesser-used species is to be on the front line in the future.

SWOT analysis for the future of the country's forests and forestry

Assessing the country's Strengths, Weaknesses, Opportunities and Threats (SWOT) provides not only the capability to capture future prospects but also to counter or minimize pressure and limitations. Currently with more interdependence and a constantly changing environment, creating and sustaining future potentials are possible only when the country's capability portfolio is driven forward in the right direction. Therefore there is a need to identify major strengths, weaknesses, opportunities and threats in the Myanmar forestry sector in order to forecast its future.

Strong points for the Myanma forestry sector are fair climate and soil, relative extent of forest cover, explicit forest policy and law, and underlying practices in forest management such as the MSS. Abundant rainfall and traversing river systems by four major rivers contribute to the growth of various types of forest and to conserving varieties of biodiversity. The covering of almost half of the country's total land area with forest indicates that managing the forestry sector's sustainability is crucial. Moreover, Myanmar already has the improved Forest Law 1992 and Forest Policy 1995. Both the law and policy encourage reservation and preservation of natural forests as well as forest plantation. Additionally, with the aim to achieve sustainable yield, the MSS which focuses on the importance of harvesting the annual yield on a sustainable basis has been implemented since 1920.

Limitations confronting the forestry sector are lack of proper land-use policy, difficulty in implementation of the management system due to deficiencies in law enforcement, insufficient resource statistics, budgetary constraints, inability to follow the MSS completely, imperfection in the MSS itself and inadequate technology and capital investment in wood-based industry. Unless a clear-cut land-use plan is endorsed in the country, conflicts between forest conservation and other different and unlimited aspirations will continue. Chapter XII of the Forest Law 1992 included an item which imposed that "Whoever commits trespassing and encroaching in a reserved forest shall be punished … …". In reality, there are many violations including gardening, camping, and firewood collection. Not only forestry data but also accurate demographic, social, economic and environmental data are necessary for timely modification of plan schedules. In Myanmar, there has been a failure to produce the right data base and available data other than the source data are diverse, scanty and inadequate for effective recommendation. One can only utilize these data to make rough estimates. Similarly, budgetary allocation for the forestry sector is too low to preserve and regenerate forests.

Allocation of current expenditure to forestry was 4.3 percent and that of capital expenditure was 0.2 percent in 2006/2007; State investment for the forestry sector was estimated at 0.2 percent of the total State investment (MNPED 2006). The MSS has been well established in forest management but absolute adoption is out of practice, for instance actual teak harvesting over the AAC. Indeed, the MSS itself is also insufficient for sustainable forest management as it is applied uniformly to all types of natural forests regardless of species composition, forest conditions, management objectives, etc. Constraints including policy, economic, financial, social and environmental factors also prevent the practice of the MSS. Pre-harvesting, harvesting and post-harvesting technologies in the forestry sector are still low compared to other developing countries such as Malaysia. This causes higher wastage and lower value-added production. This is a consequence of the shortage in capital investment including FDI. Total investment of permitted enterprises in the forestry sector under the foreign investment law is almost zero.

Significant opportunities for the forestry sector are sizable international markets to supply forest products, prospects to induce FDI, and application to monopoly practice. Myanmar is located between two growing and giant markets, China and India. Both are log-hungry countries. Forest products demanded by China are enormous and expected to continue. Moreover, other inter-regional countries such as Thailand, Republic of Korea, Australia and Japan are major Asia-Pacific importers of solid wood forest products (FAOSTAT). Myanmar has vast forestry resources but investment in capital and advanced technology within this sector is quite low. There is room to invite foreign investment in value-added product production. Another potential benefit for the Myanma forestry sector is exercise of monopoly practice especially in teak export. Teak is recognized as one of the most valuable timbers in the world, and Myanmar produces the best quality teak. Controlling supply could create maximum earnings with minimum use of resource.

Threats to sustaining the Myanma forestry sector are poverty levels, global competition, current economic sanctions by western countries, and both illegal and legal overexploitation. As mentioned earlier, the unit price of Myanmar's teak and hardwood exports is much lower than that of Malaysia. Such competition from technologically advanced countries hampers (finished product) technology development of natural-resource rich countries like Myanmar and encourages only the export of raw forms of forest products. Although economic sanctions imposed by the USA and some western countries may not directly influence timber exports as supply to those countries is limited, indirect pressure does tend to flatten export prices and stimulate illegal dealings. Besides, due to economic sanctions, shrinking potential export sectors like garments force the forestry sector to conduct more extraction and export for necessary foreign exchange. Another challenge in sustainable forest management is overexploitation. Illegal logging as well as shifting cultivation in uncontrollable areas is the most important concern in deforestation. What is worse is that the authorities have little or no vision for the future. The outdated concept of top-down governance should be changed or new/forward looking concepts should be adopted. Otherwise, it will be too late to change.

7. HOW TO CREATE A BETTER FUTURE

An economically sustainable system must be able to produce goods and services on a continuing basis. Likewise, an environmentally sustainable system must maintain a stable resource base while a socially sustainable system must achieve fairness in distribution and opportunity (Jonathan 2001). To assure an overall sustainable system, inter- and intra-generational efficiency and equity are essential. Building a better future is thus necessary in the forestry sector as well. Problem recognition, policy applicability and consistency, plan implication, cooperation and coordination within and among internal and external bodies, paying attention to stakeholders' voices and public participation are core factors to create a healthier outlook in Myanma forests and the forestry sector.

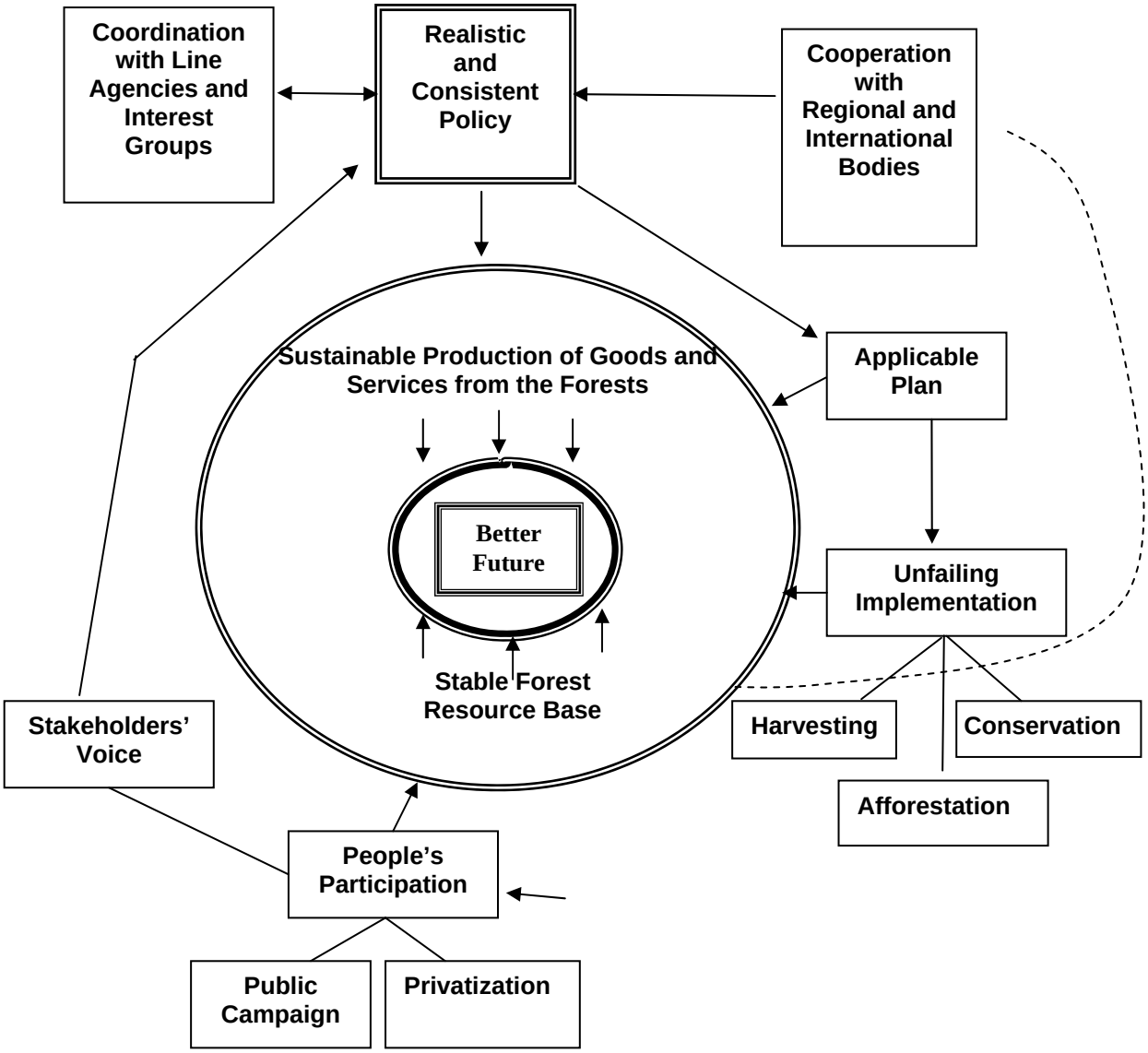

Figure 12. Mechanism to create healthier forests in the future

For each and every management process, ratifying the real situation and problems are the very first steps to seeking solutions. Thus the extent of deforestation, soil erosion, desertification, loss of biodiversity species, watershed deterioration and environmental degradation are to be examined in an accurate way. The results are very important not only in drawing past trends and predicting future prospects, but also in adjusting existing policies in order to meet a sustained basis. EIA and SIA must be conducted by reliable bodies or agencies before any development plan or programme is implemented including dams, factories, harbours, and communication networks.

The National Forest Master Plan is the guideline for forestry sector sustainability and the Forest Policy 1995, Forest Law (1992) and Forest Rules (1995) play important roles to realize the master plan. Although their main frames are fixed, many items are to be synchronized with changes in political, economic, social and environmental circumstances. Additionally, active law enforcement is a necessary condition in effective forest management.

In some cases, planning and realization are incompatible with each other. The AAC is a type of plan to achieve sustained production yield. If ground extraction is higher than the AAC, future yield will have a decreasing trend. Moreover, due to difficulties in full-scale application

of the MSS as mentioned earlier, the system needs to be applied effectively to improve the value and quality of forests and to increase valuable species currently lacking due to inadequate natural regeneration. So, a realistic plan after conducting Cost-Benefit Analysis, EIA and SIA, and unfailing implementation in production, conservation and afforestation could support building a better future for forests and forestry.

There are conflicts of interests in many corresponding areas especially in the use of limited resources such as land. Lack of a clear-cut land use policy, for example, is harmful to the safety of forestry or agriculture or livestock breeding or urbanization. This may be addressed by means of coordination among interest groups. Cooperating to control illicit logging with neighbouring countries such as China and Thailand, and cooperating to attain technology, managerial skill, information, experts and financial resources with regional organizations including ASEAN and GMS, and international organizations such as FAO and ITTO are bonuses for forest resource preservation.

Frequently, many problems related to resource depletion and environmental stress arise from disparities in economic and political power. A forest may be destroyed by excessive felling because timber contractors generally have more influence than forest dwellers. In such a case, the voices of grassroot stakeholders should be acknowledged to review existing policies and practices.

Raising public awareness about the importance of forests and inducing public participation in forest resource management are crucial themes. Encouraging people's participation in planting trees in degraded forests, barren lands, village tracts, farm yards and household compounds for fuelwood and other forest products is desirable. Further to public campaigns, permission for private forest ownership is an option to expand the forested area and to manage forests in an efficient way. In fact, private sector involvement in forestry sector development is to be prioritized.

8. SUMMARY AND CONCLUSION

Forestry's contribution to the country's export earnings was 30 to 40 percent before the boom in natural gas and 10 to 15 percent subsequently. Average export prices of both teak and hardwoods are sluggish or at times decreasing due to mostly insufficient capital and technology, and low value-added products. Nevertheless, the economy and the subsistence needs of forest dwellers from rural and remote areas have to continue relying on forests.

Although Myanmar is still relatively rich in natural forest resources, its deforestation and forest degradation rates are assessed at the critical point with a change of -10.3 percent of total forest during 1990 to 2005. Woodfuel remains the major source of energy with more than 75 percent for 2000 and almost 70 percent for 2010 (estimated). Even though the proportion of woodfuel consumption tends to decline, the absolute amount will rise along with the growth of the population.

To realize sustainable forest management, systematic harvesting methods such as the MSS, forest conservation bodies such as Forest Management Units, and forest plantations are carried out by the MOF and its affiliated departments. Additionally, forest policy, law and rules have already been spelled out in the commitment towards the conservation and development of forests, the environment and socio-economic circumstances. On the other hand, inconsistent habits, shifting cultivation, illegal logging and imbalances between economic growth and ecosystem sustainability are constraints in the management process. The main driving forces that have affected the forest sector in the past and are likely to affect the sector in the future are demographic change, the transitional stage of the economy, environmental policy awareness, and energy demand.

Among the possible drivers of change, poverty and land-use policy are concluded to be the key concerns for the future situation of forests in Myanmar. Poverty in Myanmar, like other developing countries, is directly related to forest degradation. There are limitations in tackling poverty reduction through policy options and some recommended options are merely in the conceptual stage. Likewise, lacking a clear-cut land-use policy endangers forest conservation. Even the PFE areas are under attack for multiple land-use purposes. Consideration of the twin drivers of change suggests four probable scenarios i.e. socioeconomic development stalls, unsustainable growth, asymmetric development, and sustainable development.

With regard to the vision in 2020, forest resources are considered in three different scenarios: the status under the current trend, that under the prescribed management system (MSS) and under an integrated strategy. Based on forest cover of 33.97 million hectares or 50.2 percent of the total land area in 2005 and a current estimate of 1.4 percent deforestation the forest area in 2020 would reach 27.49 million hectares or 40.6 percent of the total land area. Continuing with the MSS could maintain the present 50 percent forest cover. In contrast, plantation establishment in line with stated plans and tracking the prescribed AAC could lead to an upward trend in forest cover and improvement of forest quality with much larger coverage of closed forests in 2020.

The country's strengths such as fair climate and soil, relative extent of forest cover, explicit forest policy and law, and forest management practices support a brighter view but deficiency in law enforcement, budgetary constraints, incompatibility in fundamental management practice, and low technology and capital investment are constraints to forest conservation. Thus the country must make the most of its opportunities including a sizable international market to supply forest products, prospects to induce FDI, and application of monopoly practice. The potential risks for the Myanma forestry sector are global competition, especially in terms of technology, current sanctions by western countries, and both illegal and legal overexploitation; alleviating or minimizing risks is a must for a brighter outlook for Myanma forests.

Building a concrete future needs a sound policy foundation which clearly defines integrated goals and properly reflects the existing situation to draw up possible plans. The master plan has to adjust inter- and intra-departmental plans to cater to diverse objectives which often conflict with one another. Smooth and continuous running of planned schedules is essential for sustainable forest management and creating better prospects.

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10. ANNEXES

Annex 1. Sanctuaries for wildlife species (2007)

Name/Location (State/Division)	Category	Area (Sq Km)	Year of Establishment	Wildlife species for which sanctuary is offered
Pidaung Wildlife Sanctuary (Kachin State)	Terrestrial	700.33	1918	Elephant, gaur, banteng, sambar, tiger, leopard, bear, hogdeer, barking deer, wild boar, wild dog, Himalayan, peacock, pheasant, jungle fowl, quail, partridge
Hkakaborazi Protected Area (Kachin State)	Terrestrial	3825.73	1996	Takin, musk deer, civet, wild boar, butterfly, red goral, black barking deer, bear, serow, tiger, otter, pangolin, porcupine, monkey
Indawgyi Wetland Bird Sanctuary (Kachin State)	Wetland/ Lake	817.83	2004	Elephant, tiger, sambar deer, leopard, bear, serow, gaur
Hukaung Valley Wildlife Sanctuary (Kachin State)	Terrestrial	6393.54	2004	Elephant, gaur, wild boar, sambar, serow, bear, tiger, leopard
Kahilu Wildlife Sanctuary (Kayin State)	Terrestrial	161.11	1928	Rhinoceros, serow, mouse deer, hogdeer, sambar, barking deer, gaur
Mulayit Wildlife Sanctuary (Kayin State)	Terrestrial	139.02	1936	Barking deer, tiger, leopard, wild boar
Namataung National Park (Chin State) * proposed	Terrestrial	725.12	1997	Hog badger, gaur, serow, goral and avifauna, hornbill, tiger, leopard, bear, mythum, deer, wild boar, porcupine, pangolin, wild cat
Kyauk Pan Taung Wildlife Sanctuary (Chin State)	Terrestrial	133.07	2001	Sambar, wild boar, wild cat, leopard, serow, barking deer, goral, clouded leopard
Chathin Wildlife Sanctuary (Sagaing Division)	Terrestrial	270.30	1941	Eld's deer, sambar, barking deer
Minwuntaung Wildlife Sanctuary (Sagaing Division)	Terrestrial	206.59	1972	Barking deer, avifauna.
Htamanthi Wildlife Sanctuary	Terrestrial	2158.21	1971	Rhinoceros, elephant, gaur, tiger.

Alaungdaw Kathapa National Park (Sagaing Division)	Terrestrial	1603.17	1989	Tiger, elephant, bear, sambar, gaur, leopard, serow, wild bird, barking deer and unspoiled nature forest
Moscos Island Wildlife Sanctuary (Tanintharyi Division)	Island/ Marine	49.36	1927	Barking deer, sambar, swiftlet, wild boar
Lampi Island Marine National Park (Tanintharyi Division)	Marine	205.55	1996	Coral reefs, mouse deer and Salon ethnic culture
Moeyingyi Wetland Bird Sanctuary (Bago Division)	Wetland Reservoir	103.96	1988	Migratory birds
Wethikan Bird Sanctuary (Magway Division)	Wetland	4.42	1939	Wetland birds
Shwesettaw Wildlife Sanctuary (Magway Division)	Terrestrial	554.63	1940	Eld's deer, sambar, barking deer, gaur
Shwe-U-Daung Wildlife Sanctuary (Mandalay Division and Shan State)	Terrestrial	207.92	1918	Rhinoceros, elephant, gaur
Pyin-Oo-Lwin Bird Sanctuary (Mandalay Division)	Terrestrial	127.69	1918	Barking deer, pheasant, jungle fowl, quail, partridge
Popa Mountain Park (Mandalay Division)	Terrestrial	128.99	1989	Barking deer, leopard, wild boar, wild dog, geomorphological features, gibbon, rhesus macaque, hill birds, wild cat
Lawkananda Wildlife Sanctuary (Mandalay Division)	Terrestrial	0.47	1997	Avifauna, cultural diversity
Minsontaung Wildlife Sanctuary (Mandalay Division)	Terrestrial	22.69	2001	Barking deer, rabbit, dhole, reptiles, land tortoises, wild cat, snakes
Kelatha Wildlife Sanctuary (Mon State)	Terrestrial	24.56	1942	Serow, avifauna
Kyaikhtiyoe	Terrestrial	156.54	2001	Tiger, goral, gaur,

Wildlife Sanctuary (Mon State)				sambar, monkey
Hlawga Wildlife Park (Yangon Division)	Terrestrial/ Lake	6.26	1982	Essentially enclosed wildlife park, sambar, barking deer, hogdeer, Eld's deer, mythum, migratory water birds
Taunggyi Bird Sanctuary (Shan State)	Terrestrial	16.11	1930	Avifauna
Inlay Wetland Bird Sanctuary (Shan State)	Wetland/ Lake	6442.51	1985	Wetland and migratory birds
Parsar Protected Area (Shan State)	Terrestrial	77.29	1996	Pangolin, jungle fowl, tiger, leopard, deer, bear, monkey, wild dog, wild boar, green peafowl, pheasant, Chinese pangolin
Loimowe Protected Area (Shan State)	Terrestrial	42.99	1996	Tiger, bear, pheasant, pangolin, jungle fowl, wild cat, Chinese pangolin, quail
Panlaung Pyadalin Cave Wildlife Sanctuary (Shan State)	Terrestrial	334.96	2002	Elephant, tiger, leopard, gaur, banteng, golden cat, clouded leopard, serow, gibbon.
Rakhine Yoma Elephant Range (Rakhine State)	Terrestrial	1761.81	2002	Elephant, gaur, leopard, jackal, bear
Thamihla Kyun Wildlife Sanctuary (Ayeyarwady Division)	Marine	0.88	1970	Marine turtle
Meinmahla Kyun Wildlife Sanctuary (Ayeyarwady Division)	Marine	137.18	1993	Crocodiles, mangroves, birds, turtles, otter
Hponkanrazi Wildlife Sanctuary (Kachin State)	Terrestrial	2706.05	2003	Barking deer, avifauna, red goral, gibbon, wild dog, mongoose
Bumhpabum Wildlife Sanctuary (Kachin State)	Terrestrial	1855.37	2004	Elephant, gaur, serow, deer, clouded leopard, golden cat, jackal, goral, macaques, civets, bear, leopard, pheasant, hornbill
Taninthayi Nature Reserve (Taninthayi Division)	Terrestrial	1701.31	2005	Gurney's pitta, tiger, elephant, tapir

Source: Courtesy of Forest Department.

Annex 2. Supply and demand for oil and gas

Year	Crude Oil (million barrel per year)		Natural Gas (million cubic feet per day)	
	Supply	**Demand**	**Supply**	**Demand**
2001/02	5.55	12.38	120	292
2002/03	6.99	12.38	165	318
2003/04	7.85	12.38	220	347
2004/05	9.73	12.38	240	378
2005/06	10.31	12.38	265	412
2006/07	11.84	30.45	570	449
2007/08	14.55	33.19	630	490
2008/09	15.44	36.18	655	534
2009/10	18.25	39.43	675	582
2010/11	20.00	42.98	885	634
2011/12	22.08	42.51	930	672
2012/13	25.00	42.51	1005	713
2013/14	27.05	42.51	1065	755
2014/15	31.17	42.51	1200	801
2015/16	33.43	42.51	1255	849
2016/17	36.32	54.38	1345	887
2017/18	37.49	56.56	1385	927
2018/19	39.89	58.82	1445	968
2019/20	41.87	61.18	1515	1012
2020/21	44.97	63.62	1615	1058

Source: Ministry of Energy.

Annex 3. Types of forest plantation and area (acre) for the planned period (2001/02 to 2030/31)

Type of plantation and tree	Target area in terms of type of plantation within 10-year periods			
	2001/02 to 2010/11	2011/12 to 2020/21	2021/22 to 2030/31	Total
Commercial Plantation				
Teak (Ordinary)				
Teak (Special)	100,000	40,000	-	140,000
Pyinkado				
Padauk	200,000	200,000	200,000	600,000
Pine				
Other				
	50,000	40,200	33,500	123,700
Industrial Plantation	50,000	40,200	33,500	123,700
Watershed Plantation (Special)	200,000	159,600	133,000	492,600
Local Supply	150,000	120,000	100,000	370,000
Total plantation area	750,000	600,000	500,000	1,850,000
Annual Average	75,000	60,000	50,000	61,660

Source: Table (5-8), National Forest Master Plan, MOF (2001).