ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY II

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THAILAND FORESTRY OUTLOOK STUDY

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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:

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1. INTRODUCTION

Background

The Asia Pacific Forestry Commission (APFC) Meeting, at its 21st session in Dehradun, India, adopted Agenda Item 10c entitled "Asia-Pacific Forest Sector Outlook Study to the year 2020, APFSOS II" which set up an outline of proposal for member countries in the region to seek specific assistance in their efforts to achieve the objectives and outputs of APFSOS II. The process of APFSOS II is to make every effort to engage all the key stakeholders in the region, for example, in meetings, workshops and conferences.

The Food and Agriculture Organization of the United Nations (FAO), along with other partners, organized the International Conference entitled "The Future of Forests in Asia and the Pacific: Outlook to 2020" from 16-18 October 2007, in Chiang Mai, Thailand. The purpose was to enhance the consultation and capacity-strengthening process of APFSOS II by airing a range of perspectives on emerging changes, probable scenarios and their implications for forests and forestry in the region.

The Royal Forest Department (RFD) and the Department of National Parks, Wildlife and Plant Conservation (DNP) sent delegates to attend the conference. After the conference, the DNP as the National Focal Point, issued an Administrative Order No. 357/2550 dated 26th March B.E. 2550 (2007) – subject "Appointment of Working Group to prepare Asia Pacific Forestry Sector Outlook Study". The Working Group consisted of DNP and RFD officers.

Objectives

The objectives of the study were to:

- Collect data on the current and present status of Thailand's forestry
- Brainstorm and exchange experiences and perspectives
- Analyze data for the future of Thailand's forestry

Methodology and conduct of the working group

The Working Group was composed of 28 members, chaired by the Director of Planning and Information Office, DNP. The Director of International Cooperation Division, DNP served as Secretary of the Working Group.

The Working Group had four main functions:

1. Collect, study, and analyze data for assessment of the present status and the future of Thailand's forestry in order to draft the Country Outlook paper and Country report of Thailand.
2. Coordinate with agencies and stakeholders to help draft the Country Outlook paper and Country report of Thailand.
3. Consider and nominate other resource persons to the Director General of the DNP to as an additional Working Group in order to participate in the aforementioned activity.
4. Consider and appoint an ad hoc working group to help undertake the activities assigned by the Working Group.

The Secretariat Group prepared the meeting agenda. It is proposed to have six meetings among the Working Group. For each meeting, the members who were representatives of the Office and/or Division concerned had to prepare the available information and existing

statistics. After four meetings, the Secretary prepared the first and second draft of APFSOS (Thailand).

After the meeting and consultation with experts and professionals, the Working Group gave a presentation of the final draft at a stakeholder workshop organized by the DNP.

The report contains first an overview of the current situation which is followed by fact finding. Then the probable scenario of the forestry sector in 2020 is presented.

2. FOREST IN THE NATIONAL CONTEXT

National context

The Kingdom of Thailand shares a common boundary with Myanmar, the Lao People's Democratic Republic, Cambodia and Malaysia.

The upper part of the country is hilly where the four main tributaries of the Chao Phraya River flow through the alluvial plan of the central part downward to the Gulf of Thailand and forms a great central alluvial plain known as the Chao Phraya Delta. A long stretch of the peninsula stretches far to the south. One-third of the upper part of the landmass forms a large plateau stretching eastwards and is known as the Northeast highland or Korat plateau sloping eastwards to the bordering Mekong River.

Administratively, Thailand is divided into five regions: Northern, Northeastern, Central, Eastern and Southern Regions, with a total of 76 provinces (*Changwat*) and 716 districts (*Amphoe*). Each district is further divided into sub-districts (*Tambons*).

The country's climate is influenced by the southwest monsoon during the wet season and northeast monsoon during the dry season. Annual rainfall amounts to 1,000-4,000 mm. There are broadly two definite dry and rainy seasons. The temperature may rise up to 40°C during the dry season and drop to 0°C in some places in the cool-dry season. An average temperature of 25°C is common throughout the year.

At present, the population totals 63 million inhabitants with an annual growth rate of 0.4 percent. The population density is 123 persons/km^2. Eighty percent of the population lives in the rural areas. Thai society comprises many groups with ethnic Thai as the majority, Chinese, Khmers, Laotian and hilltribe people as the minorities. Buddhism is the national religion.

Policy and institutional framework

Macro-level policies

Over the last four decades of national development all parties in Thai society have had to continuously adjust to changing socio-economic situations. The First and Second National Economic and Social Development Plan (NESDP) (1961-1971) emphasized economic growth through the diversification of investment in infrastructure, including road, electricity, and water supply networks. Despite achieving an impressive record of economic growth, both income distribution and the quality of life of the people in the rural areas deteriorated. Hence, the Third Plan (1972-1976) gave more attention to social development, reduction of the population growth rate, and income distribution. During the Fourth Plan period (1977-1981), political uncertainty and an energy crisis ensued, bringing about severe deficits in balance of trade and current accounts. As a response, the Fifth and Sixth Plans (1982-1991) emphasized economic stability, structural adjustment and poverty eradication. A subsequent worldwide economic recovery brought about rapid expansion of the economy, causing it to overheat. The Seventh Plan (1992-1996) subsequently began the shift to sustainable development which emphasized maintaining a sustainable level of economic growth, stability, improving income distribution, developing human resources, and enhancing the quality of life and the environment.

The Eight Plan (1997-2001) was an important turning point in the country's development planning. The plan represented new values and thinking in Thai society that gave importance to participation by all elements of society, and aimed for **people-centred**

development, deploying economics as a tool to help people achieve greater happiness and a better quality of life. The plan switched from a segmented approach to a holistic and integrated approach, in order to create a balance in the development of the economy, society, and environment. However, in the first year of the plan, Thailand experienced a severe economic crisis with great impact on individuals and society, including problems of increased unemployment and poverty. Restoring economic stability and reducing the impact of the downturn thus became a priority.

The Ninth Plan (2002-2006) adopted the **Sufficiency Economy** philosophy to guide the development and administration of the country, at the same time as continuing the holistic approach to **people-centred** development from the Eighth Plan. The plan prioritized solutions to problems arising from the economic crisis in order to build an economy with strong internal foundations and resilience to external changes, while aiming for balanced development with respect to people, society, economy, and the environment in order to achieve sustainable development and the well-being of the Thai people. The performance under the Ninth Plan can be summarized as adequately successful. The nation economy grew steadily at an average of 5.7 percent a year. The stability of the economy improved. Poverty fell, while the quality of life of people improved greatly as a result of expansion of health services, better health insurance in both quality and quantity covering the majority of the population, and a decline in drug problems. But the Thai economy remains vulnerable to external instabilities, while problems persist over poverty, income distribution, quality of education, security of life and property, and transparency in government administration. These remain priorities for solution.

During the period of the Tenth National Economic and Social Development Plan (2007-2011) Thailand will face major changes in many contexts that will present both opportunities and constraints for national development. Both people and systems must be fully prepared to adapt to future changes and reap benefits by keeping up with globalization and building resilience in all sectors, in accordance with the Sufficiency Economy philosophy.

Many important dimensions of change at the global level will affect Thailand greatly as both opportunities and constraints for development. The five major trends of such change are:

- Economic groupings and changes in global financial markets are increasing inter-country flows of capital, goods, services and people
- Leapfrog advances in technologies including communications technology, biotechnology, material technology, and nanotechnology, present both opportunities and threats to the economy and society
- Social changes
- Free movement of people
- Changes in the environment and natural resources

In the context of changes that Thailand must face in the future, a review of the country's situation with respect to society, economy, environment and natural resources, and national administration shows that Thailand has the opportunity to adapt and reap benefits from globalization, but must still develop the structure of its society, economy, and politics in many aspects for the well-being of the Thai people. The important points of the country's situation may be summarized as follows:

- Society
- National economy
- Environment and natural resources

In the past, the environment and natural resources were principally used to meet the demand for economic growth. In 40 years, 67 million rai (1 hectare = 6.25 rai) of forests were destroyed, and now forest cover only 33 percent of the country, resulting in more frequent and more severe problems of flooding, drought, and natural disasters. Marine and coastal resources have deteriorated. Mangroves have declined from 2 million to 1.5 million rai. The seafood catch has been reduced to one-third. The conditions of coral and sea grass have deteriorated. Biodiversity is rapidly being destroyed. Human activity that destroys the habitats of various loving organisms is changing the ecology and increasing the extinction of species.

The main reasons for the decline in the quality of the environment are the increase in population and inappropriate lifestyles resulting in increased pollution. Air and water quality is below standard. The volumes of refuse and hazardous wastes are increasing faster than the capacity to dispose of them. Hazardous substances used in production are being imported in increasing volumes without adequate mechanisms for controlling production processes, storage, or transport. As a result, these substances have seeped into the environment and contaminated the food chain. In addition to the complexities, deficiencies, and failures of implementation, the use of economic and legal measures has been limited.

Administration

Thailand will be a "Green and Happiness Society" in which people have integrity and knowledge of world standards; families are warm; communities are strong; society is peaceful; economy is efficient, stable, and equitable; environment is of high quality and natural resources are sustainable; administration follows good governance under the system of democracy with the King as the head of state; and the country is a respected member of the world community.

To be in line with changes that Thailand must make in future and to progress towards the desired long-term vision, development in the five years of the Tenth plan shall pursue the following principal objective and targets:

- To provide opportunities for learning combined with integrity and morality by creating linkages between families, religious institutions, and educational institutions; to enhance health services; and to improve the security of life and property
- To increase the potential of communities by linking them in networks to serve as the foundation for developing the economy and quality of life; to conserve, rehabilitate, and utilize the environment and natural resources in a sustainable fashion to achieve sufficiency and reduce poverty
- To reform the production structure for goods and services for value creation on a foundation of knowledge and innovation; to promote linkages among production sectors to increase value-added
- To build safety nets and risk management systems for the finance, banking, and energy sectors, factory markets, the labour market, and investment
- To ensure fair competition in trade and investment for national benefit; to create mechanisms for fair distribution of the benefits of development to all segments of the population
- To preserve natural resources and biodiversity, along with safeguarding the quality of the environment to be a secure foundation for national development and livelihoods for both current and future generations; to create mechanisms to safeguard national benefit in a fair and sustainable manner

- To promote good governance in government administration, the private business sector, and the public sector; to expand the role and capacity of local government bodies; to promote mechanisms and processes of participation in development; and to nurture a culture of democracy for peaceful coexistence

To meet the above objectives, development targets for the Tenth Plan have been set as follows.

- Targets for human development
- Targets for community development and alleviation of poverty
- Targets for the economy
- Targets for safeguarding natural resources and the environment

It is proposed to conserve natural resources and biodiversity by maintaining forest at no less than 33 percent of the total land area, with conservation forest at no less than 18 percent of the total land area; maintain at least 31 million rai of irrigated area for agriculture; enhance environmental quality appropriate for the quality of life and safety of the ecological system, by ensuring that the proportion of river basins and natural water sources where the water quality is rated as fair or good is not lower than 85 percent; maintain air quality above standard, particular matter (PM_{10}) not exceeding 120 milligrams/m^3 on average across 24 hours; reduce the rate of carbon dioxide emissions per person by 5 percent from the 2003 level, that is no higher than 3.5 tonnes per person per year; limit the production of waste in urban areas to no higher than 1 kilogram per person per day; ensure proper disposal of at least 80 percent of all hazardous waste from communities and industries; and establish a complete national biodiversity database.

Targets for good governance

In the context of ever faster and more complex change under globalization it is imperative to set appropriate strategies for national development in order to strengthen domestic structures for competitiveness; build a knowledge base for resilience in the face of change; spread equitable development; and promote the equality of groups in society. Also to strengthen local communities and rehabilitate and conserve natural resources and the quality of the environment as a foundation for secure development, and as the basis of livelihood for communities and society. It is also imperative to promote good governance in national administration at all levels in order to achieve development that is secure and sustainable and to retain a place of honor and dignity in the world community.

Legal framework

The Government of Thailand has established stringent laws toward the protection and conservation of forest areas including water and biodiversity. Presently, there are five main Forestry Acts:

1. Forest Act, B.E. 2484 (1941) concerns logging operations and non-wood forest product (NWFP) collection, transportation of timber and non-timber products and sawnwood production as well as forest clearing.
2. National Park Act, B.E. 2504 (1961) covers the determination of National Park land, the National Park Committee, as well as protection and maintenance of National Parks.
3. National Forest Reserve Act, B.E. 2507 (1964) includes the determination of National Reserved Forest, control and maintenance of the National Reserved Forest

4. Wildlife Conservation and Protection Act, B.E. 2535 (1992) establishes provisions for national wildlife preservation, establishment of a Protection Committee and identification of 15 species of reserved wildlife.
5. Forest Plantation Act, B.E. 2535 (1992) covers the determination of reforestation and land registration of private reforestation rights, ownership and exemption from royalty on forest products from reforested areas.

Besides the provisions for heavy penalties under these Acts, other provisions have been made to ensure that any crime or violation in the field of forestry and wildlife is effectively controlled and prosecuted. As a whole, there are more than 20 laws and a number of Cabinet decisions for forest and resource management. Under Section 39.23 of the Forest Act, 1941, whoever moves timber or forest products shall have a special pass issued by a competent officer in accordance with the terms specified in the ministerial regulations.

The most significant recent political development in Thailand has been the 1997 Constitution that recognizes the rights and roles of Thai people to participate in national policy formulation regarding resources and environmental development and conservation. The Constitution clearly notes the rights of civil societies in managing natural resources and the roles of actors.

Institutions

The Royal Forest Department (RFD) was founded in 1896 in Thailand to consolidate the exploitation of forests. As a result, the ownership and control of all forests were transferred from the feudal chiefs to the Government. The RFD was divided into three Departments in 2002: the Royal Forest Department (RFD), the National Park, Wildlife and Plant Conservation Department (DNP) and the Department of Marine and Coastal Resources (DMC). All the departments are under the supervision of the Ministry of Natural Resources and Environment (MNRE)

The RFD is responsible for forests outside protected areas that are the DNP's responsibility. The DMC performs resource management of coastal flora and fauna, including mangrove forests, through conservation and rehabilitation.

The Office of the National Economic and Social Development Board in the formulation of the Ninth Plan invited experts in economics and other fields to work jointly in compiling and synthesizing His Majesty the King's royal remarks given to his subjects on the Sufficiency Economy theory on various occasions. The synthesis of sufficiency economy was then submitted to His Majesty to His Majesty for royal consideration. His Majesty graciously made a final revision and royal approval has been granted for further dissemination.

Ministry of Natural Resources and Environment

(i) *The Office of Natural Resources and Environment Policy and Planning* develops natural resources and environmental enhancement and conservation management plans and policies.
(ii) *The Pollution Control Department* regulates, supervises, directs, coordinates, monitors and evaluates rehabilitation, protection and conservation of environment quality
(iii) *The Department of Environment Quality Promotion* carries out research, development training, public awareness, development of environment technology, natural resources and environment.

Ministry of Agriculture and Cooperatives (MOAC)

(i) *The Land Development Department* – A division of this Department is responsible for land-use planning. Several categories of forestry land uses are included in its land-use-related work.
(ii) *Agricultural Land Reform Office* – Large areas of state forest land are being declassified and turned over to this office for distribution to farmers.
(iii) *The Office of Agricultural Economics* collects statistics and conducts economic studies concerning agricultural crops, including forestry information.
(iv) *The Office of the Rubber Replanting Aid Fund* is responsible for the development of rubber plantations.
(v) *The Office of Marketing Organization for Farmers* is a possible alternative to developing markets for forest products.

Other Ministries/agencies

(i) *The Ministry of Interior:* The day-to-day operations of province and district forest officers of the RFD are supervised by the office of the Governor of the different provinces, which is under the Ministry of Interior's Local Administration Department. The Forest Policy Unit of the Police Department assists in forest protection and control of illegal activities.
(ii) *The Ministry of Industry and Ministry of Commerce* are responsible for promoting forest-based industries and their internal and overseas trade.
(iii) *The National Economic and Social Development Board (NESDB)* prepares and promotes the National Economic and Social Development Plans on a five-year cycle, formulates the policies to implement the plans and assesses the progress of forest development programmes to ensure their consistency with the plan.

There are two state enterprises in the forestry sector: the *Forest Industry Organization (FIO)* involved in reforestation, teak plantation, sawmilling, and development of forest villages. FIO′s subsidiary *Thai Plywood Company Ltd*. produces plywood and other wood products.

Land use and deforestation

In 2001, the land use of the country was divided between agriculture or farmholdings (41 perccnt), forest (31 percent) and unclassified area (28 percent). This pattern was the result of rapid expansion of agriculture on what was previously forest land. There are significant differences in the land-use pattern by region; the North still has more than 50 percent under forest cover, while the other regions are predominantly agricultural. It is noteworthy that about one-third of the total land in the other three regions remains "unclassified". This includes urban and peri-urban areas, infrastructure, etc, but obviously also degraded areas which were in the past under forest cover (Table 1).

Table 1. Land-use pattern by region, 2001

Region	Forest	Farmholding land	Unclassified
	%		
North	54.0	26.4	19.6
Northeast	15.0	55.0	30.0
Central	27.1	30.9	33.0
Southern	22.5	43.4	34.1
Total	**31.4**	**40.9**	**27.7**

Source: Based on Agricultural Statistics of Thailand, 2004.

In 1961, the total forest area of Thailand was 273,629.00 km^2 or about 27 million hectares or 171,017,812.50 rai covering over 53.3 percent of the country (Annex 1). Subsequently, forest areas were encroached for the purpose of slash-and-burn, shifting cultivation, land resettlement, dam and road construction, land reform for agriculture, etc. As a result, the share of forest area declined to 25.3 percent in 1998. From 2000 onwards the forest has been assessed from LANDSAT-5 interpretation imageries at the scale of 1:50,000, while the earlier assessments were made using imageries of 1:200,000. Due to the change of scale and method of calculation a new benchmark was established for forest area (Table 2). The annual rate of deforestation has been about 63,000 hectares per year since 2000, or higher than in the 1990s. The current forest area is estimated at 16.8 million hectares (32.7 percent)

Table 2. Forest cover, 1996-2006

Year	Forest cover	
	1,000 ha	% of the country area
1961	27,369	53.33
1973	22,172	43.21
1976	19,841	38.67
1978	17,522	34.15
1982	15,680	30.56
1985	15,087	29.40
1988	14,380	28.02
1989	14,343	27.95
1991	13,670	26.64
1993	13,355	26.03
1995	13,148	25.62
1998	12,972	25.28
2000	17,011	33.15
2004	16,759	32.66
2005	16,100	31.38
2006	15,865	30.92

Source: Charuppat (1944); DNP (2006); RFD (2007).

Forest resources

There are two main types of forests in Thailand: (1) evergreen forest and (2) deciduous forest.

Evergreen forest

The ***evergreen forest*** is subdivided into tropical evergreen forest, pine forest, mangrove forest and beach forest. ***Tropical evergreen forest*** is found all over the moist part of the country. This type of forest is also subdivided into the tropical rain forest, the semi-evergreen forest and the hill evergreen forest. ***Tropical rain forest*** is characterized by very rich flora and very dense undergrowth. This type of forest is commonly found in the Southern and the Eastern regions where rainfall is above 2,000 mm. It is also found along rivers and/or in valleys in other parts of the country. The predominant species (the top storey species) are, for example, *Dipterocarpus* spp, *Hopea* spp, *Lagerstroemia* spp, and *Shorea* spp, whereas the lower storey species are bamboos, palms and rattans.

Semi-evergreen forest is scattered all over the country where the rainfall is between 1,000-2,000 mm. The predominant species are *Dipterocarpus* spp, *Hopea* spp, *Diospyros* spp, *Afzelia* spp, *Terminalia* spp, and *Artocarpus* spp. The main undergrowth species consist of bamboo and rattan. ***Hill evergreen forest*** is found on the highlands (above 1,000 metres from sea level) where the climatic condition is the humid subtropical type. The presence of

mosses and lichens on trees and rocks is the indicator of this forest type. The predominant species are oaks (*Quercus* spp) and chestnuts (*Castanopsis* spp, and *Lithocarpus* spp). ***Pine forest*** has two species of tropical pines, *Pinus merkusii* locally called Son Song Bi (the two-needle pine) and *P. kesiya* locally called Son Sam Bi (the three-needle pine). *P. merkusii* is found in the northern and the western part of the Central region where the soil is poor, lateritic and podzolic. *P. kesiya* is found only in the highlands of the Northern and Northeastern regions.

Mangrove forests occur along the coastal areas of the Eastern, Central and Southern regions. The mangrove forest is scattered along the estuaries of rivers and seashores where the soil is muddy and influenced by the tide. The predominant species are *Rhizophora* spp, *Xylocarpus* spp, *Avecennia* spp, *Bruguiers* spp, and *Nypa* spp. ***Beach forests*** occur along the sandy coastal plains especially in the eastern coast of the Southern region. The main species in this type of forest are *Diospyros* spp, *Croton* spp, *Lagerstroemia* spp and *Casuarina* spp.

Deciduous forest

Deciduous forest is characterized by the presence of deciduous tree species and is commonly found throughout the country. It is broadly subdivided according to the species composition into the mixed deciduous forest (with and without teak) and the dry dipterocarp forest.

Mixed deciduous forest is commercially among the most valuable forest of Thailand. In the Northern Region, this type of forest is called the teak forest with *Tectona grandis, Xylia kerrii, Pterocarpus marcrocarpus, Afzelia xylocarpus* and *Dalbergia* spp (rose wood) as dominant/common species.

Dry dipterocarp forest is commonly found in the dry area (rainfall below 1,000 mm) with sandy or gravelly lateritic fertile soils. The predominant species are mainly *Dipterocarpaceae* such as *Diptercarpus tuberculatus, D. obtusifolius, Shorea obtusa, S. siamensis* with the presence of *Dalbergia* spp, *Lagerstroemia* spp, *Terminalia* spp and other species.

Permanent forest estate

The area of permanent forest estate (PFE) reported in 1991 was 23.5 million hectares, much of it already without forest cover. PFE had shrunk by almost 50 percent to 12 million hectares in 2001. About 1.15 million hectares of the original PFE had been converted to agriculture, 8.3 million hectares to settlements and infrastructure, and 1.1 million hectares to other uses. The balance now available comprises about 10 million hectares of protected forest area (Table 3) and 1.9 million hectares of plantations. The production PFE now is found only in planted forests on government land. Theoretically, forest reserves should be classified as PFE, but they do not have effective protection in spite of their legal status, so many of them have lost their forest cover and there are no management plans; thus they have not been classified as part of PFE.

Table 3. Permanent Forest Estate (PFE)

Estimated total forest area	Total closed natural forests	PFE (1,000 ha)		
(mill. ha.)	(1,000 ha)	Production	Protection	Total
13.0-16.8	10,127	Natural 0 Planted 1,870	10,118.8	11,988.8

Source: ITTO (2006a), total closed forests FAO (2001); RFD (2004b).

Land tenure

Practically all the natural forests are owned by the state and managed by the RFD, DNP or the DMC. Privately owned forests are mostly plantations but are not accounted as part of PFE. The government has issued various types of tenure rights for people living in forest reserves.

Management of natural forests

In the historical perspective four stages can be identified in Thai forestry:

1. Early exploitation stage (from the mid-1890s to the early 1930s). Logging for commercial purposes started to meet domestic and export demand for teak. The RFD was established to regulate forest exploitation, particularly in the teak forests of the North.
2. Expanding exploitation and management stage (from the 1930s to the early 1960s). Logging became an important economic sector generating foreign exchange, capital for national development, and government revenue, as well as making land available for agriculture. The RFD attempted to bring forest exploitation under management by enacting forest laws, staff training, and enforcement efforts.
3. Forest exploitation decline stage (from the 1960s to the mid-1980s). Logging peaked, export-oriented agriculture expanded, and national economic development gained momentum. Coupled with inefficient control and excessive logging, often illegal, the forests continued to dwindle, at an alarming rate. As a result, a growing awareness of the link between the forest and national well-being emerged. Desperate measures were introduced to rationalize forest management but were not successful.
4. The struggle towards the sustainable management stage led to a logging ban (from 1989 onwards) as a result of widespread awareness of the adverse effects of forest exploitation. The forest had declined to a point where the government had to decide that what remained must be kept for conservation rather than for further exploitation.

The new forest management approach has had three main interventions: (i) expansion of designated protected areas, (ii) expansion of the forest resource base by plantation to substitute wood supplies from natural forests, and (iii) development of community forestry.

There are no management plans for the Reserved Forest areas. The annual operational plan of the reserved forests covers activities such as protection, reforestation, nursery activity and land allocation. There are no provisions for silvicultural treatments and aided natural regeneration. Emphasis in forest management is on patrolling, recreation and other services, and only limited research has been carried out.

Plantations

Reforestation in Thailand started in 1906. Teak was planted via the *taungya* agroforestry system. Small areas were planted annually until 1960.The reforestation programme gradually expanded after 1961. The cumulative area planted reached 13,026.47 km^2 or 7,141,543.75 rai (Annex 2). A national reforestation campaign was implemented during 1994-1996 with a target area of about 800,000 hectares or 5 million rai. The campaign embraced planting of forest trees (i) along roadsides, (ii) around school premises, governmental offices and religious places, (iii) in areas such as parks, recreation areas, dams and reservoirs, riversides, etc. and (iv) in existing degraded forests.

The government's farm forestry programme (1994 to 2001) was a response to the deteriorated wood supply situation with the target area of 1.28 million hectares or 8 million rai. The programme subsidized the private sector and farmers in tree planting costs; 80,126 farmers joined the programme but the planted area only covered 169,400 hectares or 1,056,058.24 rai. The programme is still ongoing.

The total extent of planted forests in 2000 (Table 4) was estimated at 2.81 million hectares and there were another 2 million hectares of rubber plantations (FAO 2001).

Forest protection

Forest fire is defined by the RFD (1996) as "a fire that occurs [on forestland] for any reason and in the absence of any control". Thus, controlled burning, for instance, in shifting cultivation system is not a forest fire according to this definition. Forest fires are regarded as a "serious threat" because, although many tree species of deciduous forests can survive fire, seedling and saplings are easily destroyed, and wildlife is also affected. Furthermore, losing soil fertility due to large-scale fires is regarded as a threat. (Nalampoon 2003). Each year in Thailand large areas burn during the season: In 2000, the total burned area was 197,000 hectares (FAO 2001). The RFD has established forest fire control centres in critical areas. These are, however, inadequate in controlling fire in remote areas, and the military assists in high-risk sites. In addition, extension campaigns to combat forest fires have been launched (Nalampoon 2003). The community-based approach has also been introduced to fire management.

Table 4. Plantation area by species in 2000

Species	1,000 ha
Rubber	2,019
Teak	839
Eucalyptus spp	443
Acacia mangium and other *A.* spp	148
Other broadleaved species	541
Pinus merkusii and other *P.* spp	689
Other conifers	148
Total	**4,824**

Source: FAO (2001).

Forest production

No relevant statistics exist in the country on wood production. There are two main sources of industrial wood: eucalyptus plantations and rubber plantations. Due to the logging ban, there is practically no timber production in natural forests. The total volume of industrial roundwood production is estimated at 19 million m^3/year. There is no information available on the volume of fuelwood produced

At least five million people, the approximate number of actual forest dwellers in Thailand, are critically dependent on NWFPs. These include many plant and animal products. The most important NWFPs are bamboo, rattan, lac, bee products and medicinal plants.

Conservation of biodiversity

Thailand is bestowed with rich floral, faunal and cultural diversity. It contains approximately 7 percent of the world's flora and fauna. It is considered a collective centre of botanical diversity from major regional elements: Indo-Burmese, Indo-Chinese and Malaysian.

There are approximately 15,000 plant species in the country of which approximately 12,000 are vascular plant species, including over 1,140 species of orchids. There are more than 2,154 non-vascular plant species in Thailand, including algae and bryophytes, i.e. moss, hornwort, and liverwort.

Thailand has approximately 4,600 species of vertebrates and about 83,000 invertebrate species, of which 14,000 species can be identified. Most of the identified species are insects (MNRE 2006). Many plant and animal species are endangered, rare or threatened (Table 5). Many species have also been domesticated.

Table 5. Species with status in Thailand

Status	Plants	Animals						
		Mammals	Bird	Reptile	Amphib.	Fresh water fish	Sea fish	Total
Extinct	-	2	8	1	-	1	-	12
Endangered	100	39	39	10	2	12	7	109
Rare	1,000	48	68	26	21	12	6	181
Threatened	300	12	21	4	3	3	12	55
Domesticated	1,000	7	2	33	11	37	-	90
Exotic	800	3	95	8	3	125	-	234
Ornamental (plant)	700							
Native (animals)		19	5	6	2	64	1	97
Total plants	**3,900**							
Total animals		**130**	**238**	**88**	**42**	**254**	**26**	**778**

Source: MNRE 2006.

Socio-economic aspects

Due to the logging ban the sectoral contribution to the GDP of forestry, logging and related activities has been declining since 1989. In 2003 it amounted only to US$120.5 million representing 0.1 percent of the total GDP and 1 percent of the GDP of agriculture. This does not take into account fulewood and NWFPs, which are important activities in the forestry sector. It is unclear whether rubberwood harvesting is included in the sector's statistics. The declining trend is probably changing with increasing volumes of plantation wood maturing for harvesting. Forestry's accounted GDP contribution can be expected to significantly increase in the future.

Out of the total population of 64 million, 70 percent is reported to live in rural and mountainous areas. The poverty level is low and most people living in protected areas are experiencing high or medium level poverty (46 and percent respectively). For the rural poor, fuelwood and NWFPs are important sources of livelihood. Poverty is the most significant underlying cause for deforestation in the country.

3. CONSERVATION OF NATURAL FORESTS

Forest conservation

Protected area system

Since the enactment of the National Park Act in 1961 the areas under legal protection have expanded rapidly and they presently cover about 17 percent of the total nation territory. The protected area (PA) system consists of national parks, wildlife sanctuaries or local government-controlled forest parks, wildlife sanctuaries, no-hunting areas (mostly private lands), botanical gardens and arboretums, The existing 227 protected areas amount to 11.3 million hectares and they are under the control of the DNP. National forest reserve management by the RFD is also part of the system, as logging is not allowed in them. The forest reserves have obviously less strict rules than sites with protected area status (Lakanavichain 2001, 10-11) (Box 1). In addition, the system of conservation includes watershed areas which largely overlap with protected areas.

Box 1. Key Legal Provisions of Protected Areas

The National Park Act of 1961 states that a national park is to be preserved in its natural state for the public's education and enjoyment. National marine parks have similar functions. Most former national parks have been reclassified.

The Wildlife Conservation and Protection Act of 1960 states that wildlife sanctuaries are areas for the conservation of wildlife habitat so that wildlife can freely breed and increase their populations in the natural environment. Wildlife sanctuaries are not generally open to the public but researchers are allowed. They are primarily areas for biodiversity conservation. Some are grouped into clusters and adjoin national parks.

Forest parks are forest areas that have at least one significant feature such as a waterfall, large trees or geomorphological formations. They are provided for under the National Forest Reserve Act of 1964, and their chief purpose is to provide sites for local tourism and recreation.

No-hunting areas are protected land that is open to consumptive uses such as fishing and gathering of NWFPs but from which hunting is excluded.

Although extensive, the PA system contains disproportionate amounts of upland forest but very little lowland evergreen forest. Apart from this, Mackinnon (1997) rated habitat coverage as "quite satisfactory" and reported "no obvious gaps". All biounits and subunits were represented. Already prior to the logging ban it was widely believed that the PA network in Thailand was one of the best in Southeast Asia (Parr 1996).

In 1979, Thailand had only 16 national parks covering an area of 935,700 hectares. But, by 2004, 114 national parks covering an area of 6.35 million hectares had been established. According to the DNP, there are still several national parks which have not yet been gazetted (i.e. legal status) (Table 6). All the 55 wildlife sanctuaries (conservation areas) are gazetted. In addition, 67 forest parks have been created covering an area of 87,000 hectares. There are 55 no-hunting areas covering 441,000 hectares, out of which about 17,000 hectares are on private land, and the rest on public lands, probably with more effective control for hunting risks in the latter case.

Thailand has set a target to have 25 percent of the country's total land area as protected areas. At present, protected areas declared by Royal Decrees (under the DNP's

responsibility) account for about 20 percent of the country's total land area. Table 6 lists the types of protected areas by category.

Besides taking stringent efforts in covering a total of 9.3 million hectares as protected areas, Thailand has also created 1,221 National Forest Reserves spread over 23.4 million hectares. Out of the five regions in Thailand, the North has the largest area under National Forest Reserves with 11.2 million hectares. It is highly significant for policy design that National Forest Reserves together with protected areas cover about 63.2 percent of the total area of the country. About 20 percent of the country's 56,000 villages are also located within forest reserves.

In 1989, His Majesty the King made an amendment to the National Park Act, which basically prohibited all activities in national parks and allowed the conservation of national reserve forests in national parks (Sutthisrisilapa and Noochdumrong 1998). National parks fall under group II of the IUCN PA classification, wildlife sanctuaries under group IV, and no-hunting areas and forest parks under group V.

Protected area management

The DNP has well-developed procedures for producing management plans. In 1999, a little over 30 national parks and about 20 wildlife sanctuaries had management plans. By 2005, the government had prepared master plans for 55 national parks, out of the total 103 gazetted national parks. These master plans are more general strategic plans than operational management plans. Out of these 55, 15 are approved/validated whereas 40 master plans have expired. The DNP reported that five master plans are under preparation. This clearly exhibits that master plans of 88 national parks are yet to be processed which includes 43 gazetted parks. Moreover, there is no master plan for 55 wildlife sanctuaries. It is understood that master plans for 25 sanctuaries are under preparation. There is also a plan to have wildlife corridors in two national parks.

Management plans may be produced in-house by DNP offices, by universities or by private consultancy companies, subject to terms of reference defined by the DNP. Each management plan takes about one year to complete. During this period, a steering subcommittee supervises the work especially when an external agency is being employed. All stakeholders are consulted during the planning process, including local communities, although this is said to be a relatively recent innovation (Clark n.d.).

Completed management plans are vetted by a management committee, comprising representatives of the RFD, the Tourism Authority of Thailand (TAT), universities and relevant NGOs. Those that are approved go to the Director-General for final signature and are then passed to Superintendents to implement.

People and protected areas

The conservation policy initially revolved around a "wilderness approach," which recommended the total exclusion of people from protected areas. This approach was introduced to Thailand by US experts in the 1950s. It has become increasingly evident that such an approach is no longer possible in a country where a large population dependent on forest resources lives inside PAs. There is a need to balance people's rights to land and traditional resource use within the formal conservation context. The history of conflicts over access to natural resources is rooted in the process of villagers' "encroachment" of forestland. Changes in land allocation and uses over the years have also resulted in pronounced imbalances in power relations between the state, private sector (largely through commercial farmers and land developers) and forest-dwelling ethnic minorities (Bugna and Rambaldi 2003).

Most protected areas have people living in them and all have people living nearby who harvest timber and NWFPs from within. Harvesting is not only for subsistence use. There are considerable commercial interests stimulated by middlemen. The forests are plundered for wild animals (dead and alive), timber, basket-weaving materials, medicinal plants and other commercially valuable products.

Resource harvesting in protected areas is not allowed under current legislation except by permission of the Director General, although it is occurring in the surrounding buffer zones. However, it is reported that, although there is legal justification, some park or sanctuary Superintendents may, on their own initiative, relax the rules at the local level in the interests of fostering local support.

The measures to enlarge protected areas and stop the rotational farming systems have raised concerns at the local level over people's livelihoods. In particular, the intentions to relocate villages have caused resistance for years. The solution suggested in the Thai Forest Sector Master Plan was to limit relocation plans to only a few necessary cases and instead to encourage people to find alternative livelihoods outside the protected forest (TFSMP 1993). The government has never formally endorsed this.

Table 6. Types and areas of protected areas, 2004

Categories	IUCN protected areas category	Number	Total area 100 ha	Percentage of total country area
By Royal Decrees				
National park	II	114	6,346.4	12.37
Wildlife sanctuary	Ia & IIb	59	3,675.9	7.16
Marine national park	II	27	862.8	1.68
No-hunting area	IV	55	441.0	0.86
Total		**227**	**11,326.1**	**22.07**
By Ministerial Declarations				
Forest park	III	67	87.0	0.17
Botanical garden	VI	15	5.9	0.01
Arboretum	VI	54	3.9	0.01
Total		**136**	**96.5**	**0.19**
Categories	**IUCN protected areas category**	**Number**	**Total area 100 ha**	**Percentage of total country area**
By Cabinet Resolutions				
Watershed class 1 & 2	I, II, IV & VI		9,309.0	18.14
Conservation mangrove*	VI		42.8	0.08
Environmentally protected area			..	..
Total			9,351.8	18.22
International Recognitions				
World Heritage (nature)*	II	2**		
	VI	10***	373.2	..
Ramsar Site*	VI	4	26.1+	0.05+
Biosphere reserve	II	2**		
ASEAN Heritage*				
Total			**399.3**	**0.05+**

*Total land area is not shown in overlap with other categories, e.g. national parks, wildlife sanctuaries and no-hunting areas.

**Regarding legal status, the Word Heritage and ASEAN Heritage sites are either wildlife sanctuaries or national parks

***8 out of 10 Ramsar sites are protected areas.

Source: MNRE 2006.

Several NGOs are active in protected areas, including the Thailand Environmental Institute (TEI), the Dhammanaat Foundation, the Foundation of Education for Life and Society, Seub Nakhasathien Foundation, Promotion of Human Resources for Community Development Foundation, Village Foundation, Serving for the People Association and WWF Thailand Some NGOs indicated that the DNP does not encourage participation by communities in the management of forests or protected areas but the RFD is cooperating to find local-level solutions to the problem of population pressure. The reason is said to be

that professionals are jealously guarding their territory against those they perceive as amateurs. Nevertheless, local people continue to manage forests according to traditional skills and knowledge, albeit to some extent often illegally. Radical conservation NGOs still argue for expulsion of people who are living in PAs.

Cross-boundary issues

At least 18 protected areas lie adjacent to international borders with neighbouring countries. Thailand has recently made an agreement with Lao PDR on the common approach to the Eastern Forest Complex and it is reported that Cambodia will join this effort. ITTO's role has been instrumental in this exercise in providing support to the management plan of the zone on the Thai side and facilitating the discussions with the neighbouring countries. Informal contacts have been made with Myanmar concerning the Western Forest Complex (WEFCOM) (Box 2).

Common approaches are necessary to bring the cross-border areas under effective protection and control which also has national security implications. There is an illegal flow of NWFPs from neighbouring countries to Thailand. This includes supplies to feed a major illegal market in agarwood oil (*Aqualaria* spp) in the Middle East and Japan, where it is said to catch such high prices that illegal harvesting has all but eliminated the plant from Lao PDR.

Illegally obtained timber also crosses the border from Cambodia and Myanmar. Another market in wildlife by-products involves wild cattle – gaur, kouprey and banteng which occur on the border between Cambodia and Lao PDR. They are hunted for trophies that are exported to Thailand. Thai middlemen encourage this trade. Wildlife trade routes also enter Thailand from Myanmar by way of Tachilek and Maesod (Clarke n.d.).

Box 2. The Western Forest Complex

The Western Forest Complex (WEFCOM) is a large, hilly tract of forested land on the border with Myanmar between about 14°10' and 16°30' N. It comprises 11 protected areas that have important watersheds. There is therefore unusually high biodiversity. Tiger (*Panthera tigris*), elephant (*Elephas maximus*), gaur (*Bos guarus*) and tapir (*Tapirus indicus*) are among 153 mammal species found in the area. As many as 490 bird species are encountered. WEFCOM encompasses many waterways which supply three of Thailand's six major rivers.

WEFCOM is the largest surviving contiguous forest tract in Thailand, covering 1,873 million hectares. It is composed of nine national parks, six wildlife sanctuaries and two proposed national parks. Two of the largest wildlife sanctuaries, Huai Kha Khaeng and Thung Yai Naresuan, have been designated as World Heritage Sites by UNESCO.

A number of communities are living inside the protected area and many villages are surrounded by WEFCOM. The protected area is under pressure from agricultural encroachment, wild fires, infrastructure development, mining, illegal logging and poaching of wildlife.

All these villages need special attention in terms of outreach strategies, particularly on controlling human impacts. In addition 25 villages need special outreach strategies in order to manage resources sustainably for the well-being of local people. Continuous monitoring of human use in WEFCOM is considered essential.

Source: Emphandhu and Kalywongsa (2003).

Forest reserves

Thailand has never had a long-term silvicultural management system despite the successful experiences of development in neighbouring countries with similar forest types, particularly Myanmar. There are no records of national level forest inventories and during the logging period inventories were regional or local in scale and they contained data only on teak. However, any sustainable sivicultural management requires data on the potential of stands in terms of their future growth and yield. This information is grossly inadequate in Thailand.

Native teak, *Tectona grandis*, has been the most favoured species for commercial plantations. Other broadleaved species such as *Pterocarpus maccrocarpus*, *Dipterocarpus* spp, *Swiettenia macrophylla* and *Hopea odorata* are planted on a smaller scale. Teak trees grown in plantations on good soils may reach an average of 60 cm in diameter at breast height and 30 m in height in about 50 years. Typically, 1,200 to 1,600 stems per hectare are planted and canopy closure takes place between the third and fourth year and suppresses the development of weeds. Pruning is carried out near the time of canopy closure. This has the added purpose of reducing the chance of ground fires reaching the crowns and facilitating access to the stand.

The first thinning generally takes place when the dominant height reaches about 9 or 10 m, and the second when the dominant height reaches 17 to 18 m.

Teak is also the dominant tree in the mixed deciduous forests of northern Thailand. These forests are open, with teak trees being isolated or in small groups. Although logging in natural forests in Thailand was banned in 1989, the current National Forestry Policy states that efficiency in timber production should be increased through appropriate forest management techniques using both selection and clear-felling systems. With the logging ban in force, this provision has become irrelevant.

In theory, the clear-felling system would require cleared areas to be replanted immediately. Teak forest should be managed under a 30-year felling cycle; trees to be felled are marked and girdled for felling. The tropical evergreen forest should be managed under a similar system and the same felling cycle. The dry dipterocarp forest should be managed under "modified coppice" and "coppice with standards" systems, based on a 20-year rotation. These provision are technically sound but cannot be applied in practice.

Recent research has revealed that the growth potential of dry dipterocarp forest is about 5 m^3/ha/yr of which 1 m^3/ha/yr are crop trees. These forests have potential for silvicultural management, particularly through liberation and refinement. However, due to a long history of disturbance, a large part of these forests' growing stock levels are so low that advanced management is not justified and therefore silvicultural treatments should be targeted in areas with high growth potential. The specific uniformity of stands and the high degree of regeneration render such sites suitable for the shelterwood system which is widely practiced in the Indian sub-continent. Clearcuts would be unsuitable, opening the soil for erosion. The transitional areas would need to be managed taking into account their heterogeneity targeting mixed or dry dipterocarp forests. Selective treatments, harvesting and regeneration would depend on the characteristics of the forest and the site. This would in any case require clear delineation of management compartments based on the inventories to be carried out (Weyerhäuser 2001).

Since the logging ban, the overall management objectives of the forest policy have been geared towards conservation. For PAs this is logical but in the existing 1,221 forest reserves covering 230,280.64 km^2 or 143,925,400.00 rai (44.89 percent of the country's area) there has been lack of clarity in what the management objectives should be in practice. PAs were

established in some areas which used to be forest reserves. As large areas do not have forest cover they have become de facto common public land that is encroached by expanding agricultural activity. Lacking inventories, little is known about the growing stock, including the relatively large areas planted over the last 20 years in forest reserves. These areas would need to be managed to guarantee their health and vitality.

Silvicultural treatments such as thinning are not allowed because of the logging ban and therefore hardly any revenue can be generated from this huge state-owned asset. What is allowed is the production of NWFPs which is mainly being carried out by local people. In addition, the RFD employs them to carry out forest rehabilitation and reforestation work where available funds allow it.

Watershed management

Cabinet's resolution on watershed classification

On 28 May 1985, 21 October 1986, 12 July 1988, 7 November 1989, 19 November 1991, and 21 February 1995, the cabinet enacted resolutions on watershed classification and criteria for land use within each watershed class in Ping-Wang, Yom-Nan, and Moon-Che watersheds in the southern, eastern, western, and central parts of the country, and Pa-sak watershed, and other watersheds along the border in the northern and northeastern part of the country. The watershed classification covers altogether 25 main watersheds in the country. The main purposes of watershed classification are to increase effectiveness in land use and to reduce conflict among stakeholders who need to utilize land on watershed areas.

Presently Thailand has approximately 135,120.51 km^2 of upper watersheds, divided into watershed class 1A (84,091.50 km^2), class 1B (8,428.87 km^2), and class 2 (43,730.32 km^2). From LANDSAT satellite imagery in 2004 it was found that only 115,728.21 km^2 (85.6 percent of the whole upper watershed) was still forested watershed, the rest being disturbed upper watershed.

Watershed conservation and management strategy

Presently there are four main strategies for watershed conservation and management as outlined below. His Majesty the King's Guidelines for Watershed Conservation are shown in Annex 6.

Research and development: Highlight on study, research, and development to conserve and rehabilitate natural resources and the environment in highland and upper watersheds, including technology transfer in administration and management to rehabilitate natural resources and the environment.

Land-use planning: To clearly demarcate agricultural and community areas, separate from forested watershed areas. The agricultural areas will be based on soil and natural resource capacity and also government policies.

Legal enforcement: Legal enforcement has to be applied strictly on upper watershed areas to stop encroachment. Since there is no direct Act concerning watershed conservation and protection, at least four Acts can be applied to upper watershed areas: 1) Forest Act (1941), 2) National Forest Reserve Act (1964), 3) National Park Act (1961), and 4) Wildlife Conservation and Protection Act (1992).

Watershed community development: The strategy of "Harmonious living of people and forest" by His Majesty the King are applied to watershed community development in highlands.

Watershed network: Watersheds are not a single unit area but they are connected with other adjacent watersheds to form a bigger and larger watershed. The events that happen in one watershed will affect other watersheds. Hence a watershed network is applied to communities that have relationships with other communities in other watersheds to give them knowledge of mutual environmental effects.

Capacity building: Capacity building through training is organized for communities, for example: 1) youth training camps in nature conservation, 2) training in sustainable agriculture, 3) training in water resource development, and 4) training in careers outside the agriculture sector (weaving, silversmith, etc).

Mangroves

Resource management

Thailand has 2,600 km of coastline and 70 percent of this is under mangroves covering a total area of 276,000 hectares with 55 species, showing an increase of about 7,600 hectares per year (Table 7). The Department of Marine and Coastal Resources (DMC) is carrying out a project for the enrichment of mangroves (2004-2009). About 16,000 hectares have been planted in the last two years and the planting target for 2006 is 8,000 hectares. In total, 60,000 hectares are to be planted in a five-year period under the project. The government is also funding the People's Participation Program which includes (i) training and awareness raising, (ii) participation in planting activities, and (iii) protection and improvement of facilities.

Table 7. Mangrove forests

Region	2000	2004	Annual change
	ha		
Central	12,550	9,650	-725
East	23,390	22,750	-160
South	209,310	243,400	+8,522
Total	**245,250**	**275,800**	**+7,637**

Sources: RFD 2004b, Geo Informatics, DNP.

The TEI, a reputed NGO, is developing a mangrove information network which will be completed in three years. The TEI is operating in 80 buffer zones to improve their management to enhance protection of mangrove forests.

Botanical gardens and arboreta

Botanical gardens and arboreta comprise 7 botanical gardens, 54 arboreta, 4 literary botanical gardens and 4 special gardens. Their objectives are to:

- Collect living plants native or not to Thailand for botanical research
- Conserve and propagate native plants, particularly the rare, endemic and economically important species
- Act as collection centres of herbarium specimens
- Act as educational and recreation centres for tourists and local people, for pleasure and to raise environmental awareness.

Tree Outside Forests (TOF)

In the Thai context, "tree cover" means the area covered by a crown of trees that is too small to be delineated by digital interpretation of remote sensing data at 1:50,000 scale used for forest resource assessment. "Tree cover" differs from the concept of "Trees Outside Forests" (TOF) which means all tree crops outside recorded forest area (forest and other woodland). About 18.9 million hectares comes under the category of "others", i.e. outside recorded forest areas, which may be interpreted as potential TOF areas.

TOF is an important element of landscape in the whole country but particularly in the Central Region where the relative forest cover is lowest. Trees are grown for a variety of products such as fuelwood, construction poles, NWFPs, shelter, fencing etc. Trees are also part of land-use systems such as agroforestry or silvipastoral techniques. The open areas with TOF resources are also important for biodiversity conservation. Data are, however, badly lacking on the biological and socio-economic importance of TOF as a strategic natural resource. Knowledge on their contribution to meeting farmers' various needs could lead to adjustment of reforestation programmes and extension services.

4. COMMUNITY FORESTRY

Evolution of the government Community Forestry Program

Forest resources have been an integral part of Thailand's rural life, involving all aspects of local people's activities, thereby contributing to their social, economic, cultural, environmental and political objectives, At present, some 1.2 to 2 million people are reported to be living in and around protected areas (national parks and wildlife sanctuaries) and rely on forests for livelihoods. In addition, another 20 to 25 million people are reported to live near national forest reserves and use them for forest products both for household consumption and to sell them in markets for cash income (Wichawutipong 2005; Pragtong, pers. comm.)

As early as the 1970s, the RFD recognized community (or village) forestry as a strategy for sustainable management of the nation's forest resources (FAO 1978; Pragtong 1991). In 1991 a Community Forestry Division, now renamed as the Office of Community Forest Management, was created with a mandate to plan and promote community forestry, and to involve local communities, local organizations, NGOs and other civil society organizations and various other institutions in local forest management. The Thai Forestry Sector Master Plan of 1992 recognized community forestry as one of the main strategies (TFSMP 1993).

In 1993, drafting of a legislative framework known as the Community Forestry Bill, was initiated to provide a legal framework to promote community forestry in the country. Since then several versions have been drafted but approval has been on hold due to difficulty in reaching a consensus among politicians and stakeholders (Table 8). In particular, views differ on a clause that would allow community forests in protected areas.

According to Wichawutipong (2005), the establishment of government-supported community forests is at present allowed in two types of legally categorized forests: (i) national forest reserves, under formal management by the RFD, (ii) other forests (i.e. any forests not yet occupied or developed for any use by Thai citizens, according to the Forest Act of 1941).

According to the draft of the Community Forestry Bill (1993 version, cited in Wichawutipong 2005), community forest would not be allowed in the following categories of land: (i) where use permits have been given to individuals and/or any government agencies for residential purposes, afforestation and other types of use, (ii) government afforestation areas, state parks and botanical gardens, and (iii) protected areas declared by the Cabinet.

Table 8. Key events in the development of community forest legislation in Thailand

Date	Event
1991	The RFD began a process to develop a Community Forestry Act to involve local communities in managing community forests, and developed a draft Community Forestry Bill.
1992	The concept for a draft Bill was approved by the Cabinet.
1992-1995	The draft bill was revised and reconsidered through committees and public hearings.
1993	A draft Bill was developed by the RFD and another version by NGOs.
1994	NGOs and grassroots groups campaigned for the government to accept the people's version of the Bill.
1996	As a response to the grassroots and NGO pressure, the government assigned the NESDB to organize and draft a new version of the bill, with the participation of representatives from the government, NGOs, academics and grassroots communities.
2000	Nationwide community forestry networks announced their intention to collect 50,000 signatures to submit a people's version to Parliament according to Article 170 of the 1990 constitution. The Bill was approved by the Lower House.
2001	A new government confirmed its intention to consider the Bill.
2002	The Senate's revision deleted the most crucial clause of the Bill which would have allowed community forests in protected areas. The Bill was sent to the Joint Committee of Senators and Representatives. The Bill was sent back to the House to consider the Senate's revision.
2005-06	The consideration of the Bill in the Joint Committee continued.

Sources: Kalyawongsa (1997); Witchwutipong (2005).

Present status of the Community Forestry Program

Extent of community forests

Some 11,400 villages (or 15.5 percent of all the villages) (Wichwutipong 2005) are involved in managing community forests in the country, of which about a half (5,331 villages) are reported to have formally registered their community forest with the RFD (Table 9). These community forests are reported to cover an area of 196,667 hectares in both national forest reserves (112,869 hectares) and other forest areas (83,798 hectares), accounting for about 1.2 percent of the total forest area (Wichawutipong 2005). It can extrapolated that if all the villages were involved in community forestry, the total area covered could be in the range of 1.1 million hectares.

The majority (72 percent) of existing community forests is concentrated in the Northeast and North regions where most natural forests are located. Moreover, these two regions are also where the majority of the poor people is reported to live (IUCN 2004). Interestingly, the Northeast, which is the poorest region, is also reported to be the least indebted region, with US$1,128 per household, compared to figures for the rest of the country (IUCN 2004). On the other hand, in the Northeast the average size of community forest is the smallest.

In the North and Northeast regions, the landless forest-dependent population is dominated by so-called hill tribe people. Furthermore, a significant proportion of the hill tribes live in and around protected areas, especially those bordering neighbouring countries. Many are reported to be illegal immigrants. They have no formal land rights and their land-use

practices have been criticized by authorities and NGOs as being one of the main causes of deforestation.

Table 9. Number of community forests by region and selected socio-economic variables

Region	North	Northeast	Central	East	South	Total
Population (1,000 inhabitants)	10,479	22,315	18,172	2,449	9,004	62,418
Total forest area (1,000 ha)	9,206.8	2,809.	2,124	824.0	1,794.3	16,759.
Villages with CFs	3,359	6	3	563	1,059	1
Size of CF (ha)	28.7	4,809	1,621	15	26.7	11,411
CFs registered with the RFD		5.5	13.2			14.9
Areas under formal CFs (1,000 ha)						5,331 196.7
Population living in poverty (%)	12.2	28.1	5.4	NA	11	NA

Sources: Ministry of Interior, 2005; RFD 2004a; Wichwutipong, 2005; IUCN, 2004: Mission estimates.

Benefits from community forests

At present, due to the logging ban of 1989, villagers are not allowed to fell or harvest any kind of living trees ("green wood") from natural forests for household or commercial purposes. They may, however, use the plantation forests to harvest timber and fuelwood but for teak and other reserved species a permit is required from the RFD.

Villagers are allowed to use community forests to collect dry dead wood free of charge for subsistence needs (e.g. fuelwood and construction timber). With no other source of energy, the amount of fuelwood used each year by these millions of people for cooking and heating is significant.

In addition to fuelwood and construction wood, villagers are allowed to use, free of charge, NWFPs such as mushrooms, rattan, bamboo and bamboo shoots, wild vegetables, flowers, fruit and nuts, and medical plants. These are used mostly for household consumption to supplement diets, especially during the time of food shortage but also for supply to local markets for cash income. The types of NWFPs collected from community forests vary from place to place, and their volumes can be locally highly significant. For example, in 2004, villagers reported collecting about 13 tonnes of NWFPs from Nong Song Hong, Khon Kaen and Dong Keng community forest (a dry dipterocarp forest covering 287 hectares) (Witchawutipong 2005).

Relatively few households are reported to be engaged in marketing of NWFPs, but the cash generated through forest product trade in local markets can be quite substantial. For example, in Dong Keng in 2004, NWFPs sold in the local market accounted for 5.25 percent of the average annual household income (Witchapwopitong 2005). According to the Thailand Environment Monitor Series, in 2004, a village generates, on average over US$25,000 per year by selling NWFPs. Thus, with 73,467 villages in the country, this would amount to up about US$2 billion per annum from the NWFP trade in the local market alone.

In addition community forests have an important cultural and religious significance for rural people. Tens of thousands of monks are reported to reside inside the forests often

cooperating with forest authorities to encourage villagers to protect the forest. Many NGOs and authorities see forests to be important for watershed protection and are therefore actively engaged in the promotion of planting trees and protecting forests for watershed areas through community involvement.

Public support to villages

According to the Office of Community Forest Management, RFD provincial and district staff help demarcate community forest areas and prepare operational plans. They provide villagers with basic forestry skills, such as nursery establishment, planting and maintenance and fire protection. The RFD also provides planting materials, such as seeds and seedlings (mainly eucalyptus). Almost all the villages with registered community forest have a nursery and tree-planting programme. The RFD also organizes study tours for community forest group members to visit successful community forest sites, both within and outside Thailand. They also provide training on networking among community forest groups.

Some community groups are reported to receive financial assistance through the tambon (sub-district) administrations (TAO) under the decentralization programme while the RFD at present has no provision for direct financial support to villages for community forestry activities.

The RFD has identified and promoted a variety of means to support local communities to manage their forest, albeit at pilot scales, so that these could be scaled up once the Community Forestry Act is passed. These support projects and programmes include:

- ***Community Forestry in buffer zones***. This is being tested with pilot projects in forest reserves that surround national parks and wildlife sanctuaries. The aim is to develop understanding of local processes and tools for developing collaborative management arrangements between local organizations and the RFD to manage buffer zones
- ***Small-scale forest plantations to support TAOs*** in their role as a primary local institute to promote small-scale enterprises and employment; areas of 10 to 20 hectares are allocated to a TAO for reforestation and planting of trees such as eucalyptus and teak
- ***Involving TAOs in forest management*** in all 75 provinces, with the aim to develop procedures for local forest officers to work with the TAO administration to manage forestland in their territories. TAOs are encouraged and assisted to develop forest management plans and activities (for TAO forests or community forests/village groups), while officers play a crucial role in providing extension services to plan and implement activities that will ensure wise use of forests by villagers for their own benefit
- ***One Tambon One Product (OTOP)*** is a government programme that supports local communities to develop value-added products that have potential for commercialization; for example, products from forest trees and plants, such as wine, juice, honey; medicines are produced by many villages in the Northeast region
- ***Forest and forest fire protection*** involves local people in controlling forest fire. The RFD has supported TAOs in developing forest fire control plans to reduce the impact of forest fires on local economies and forests, especially in national parks and wildlife sanctuaries.

Issues and constraints

In two decades, only about 1.01 percent (Wichawutipong 2005) of the total forests has been brought under community management. Therefore, with the current approach and slow speed, the government's Community Forestry Program will have limited positive impact on the livelihoods of forest-dependent people and the country's forest resources. Key issues and constraints facing community forestry development are discussed in the following sections.

Trust and confidence in local communities

The authorities and many vocal NGOs have little trust and confidence in local communities as custodians of forests. They see people living in and around the forests as the main cause of forest degradation, and fear that community forestry might contribute to further degradation of the remaining forests. Both the DNP and some influential NGOs like Dhammanaat Foundation strongly believe that community forestry should not be allowed in protected areas; even in the national forest reserves, where community forestry activities are allowed, the RFD has retained control over almost all of the well-stocked forests, leaving only degraded sites for community forests to be established. Communities are expected to rehabilitate these marginal lands.

As Kalyawongsa (1977) pointed out there are conflicting interests among stakeholders on which land should or could be allocated for community forestry. It is not only a matter of having differences between the groups but also within the groups which made it complex to development common views through a broad-based dialogue both at national levels.

Illegal immigrants

The number of illegal immigrants, especially in the protected areas bordering Myanmar, Lao PDR and Cambodia, is reported to be increasing, continuously driven by better living conditions in Thailand (including possibilities for off-farm income) and the fact that the same ethnic groups are found on both sides of the border. According to Dhammanaat, the number of people living in and around protected areas in 1994 was less than 1 million but the population has now more than doubled, mainly due to the illegal immigrants. Some existing local communities are reported to encourage people from across the border (who are usually their own relatives) to come, clear forests and settle down. This is one of the main reasons for objection by the DNP and NGOs to allow community forestry in protected areas. It is feared that not only would community forestry give illegal immigrants use rights to forests, but would also serve as a means for the immigrants to obtain Thai citizenship.

Privatization of land ownership

Individual land grant programmes are well justified to provide people with a more stable social situation as the delineation of granted holdings is a basis for effective controls against misuse. The downside is that titling may be expanded to areas that would be otherwise assigned to community forest. There are presently on-going programmes to transfer some land to individual households both in protected areas and national forest reserves. In 1997, H.M. the King declared the need to recognize the forest-use rights of people living in and around the forests, regardless of protected areas or national forest reserves. Consequently, this particular year became a basis for determining which households would be eligible for land grants (i.e. families living in a site prior to 1997).

According to the RFD, in the national forest reserves, a household is entitled to a minimum of 1 hectare, whereas, in the protected areas this has now been reduced to a maximum of a little over 1 hectare per household.

There seem to be no proper guideline laid out for what can or cannot be done on such land, especially in the protected areas. In principle families can use the land to grow crops, vegetables and fruits, etc., but they are not allowed to sell the land. However, in practice some villagers/farmers are reported to have informally sold their land to people from cities without having a formal land title, Payment of land tax is used as a proxy to demonstrate that the land is occupied by its claimed holder.

Tenure and use rights of forest and forest products

All the natural forests – regardless of their status as protected area or national forest reserves – are owned by the state and controlled by two government agencies, the DNP and the RFD. In protected areas, local communities have no formal use rights (although they are allowed to collect free of charge some basic forest products, such as dry fuelwood and some NWFPs for household consumption). All decisions related to the use management of protected areas are made by the DNP authorities.

In the national forest reserves, local communities are reported to have usufruct rights to forest resources (but not to the forest land). The RFD attempts to control the forests and local communities are engaged in protecting and patrolling the resource. Villagers are allowed to collect free of charge dry and dead wood for use as fuelwood and construction timber, but felling of any living tree species in natural forests is prohibited. In plantation forests, felling of reserved tree species, such as teak, for household use or for village development activities may be allowed but requires a permit from the RFD. Villagers are also allowed to collect free of charge various NWFPs for both household consumption and sales. Thus, from the villagers' perspective, apart from use rights of selected forest products (which are allowed in non-community forest areas anyway) a formally registered community forest seems to bring no additional direct benefit to them. Instead, it would bring more responsibilities for forest protection, management and other activities.

Financial support

There is no financial support to community forestry. The RFD provides some assistance to villages (e.g. forest demarcation, operational plan preparation, planting materials, etc.). The current approach to community forestry typically focuses on planting trees and protecting forests, and sees the utilization of forests mainly from the perspective of subsistence needs. On the other hand, local people are involved in collecting NWFPs from forests, within and outside community forests and are trading them in local markets. At present, there seems to be little support and assistance for local people in marketing of forests products or setting up community-based processing enterprises for commercial purposes. Such enterprises are, however, in the interests of TAO councils.

According to RFD staff, TAOs are supposed to allocate funds for forest management, but the local budget allocation procedure has yet to formally include community forests. Some TAOs have started to do this and, for example, in Don Keng, Nong Song Heng and Khon Kaen a TAO can allocate up to US$1,500 a year as wages for forest protection groups. Forest guards receive up to US$12.50 per month for patrolling forests two to three times a week (Wichawutipong 2005). However, it would probably be appropriate for TAOs to provide such support through community forest groups.

Legal framework

The Community Forestry Bill was approved by the National Legislative Assembly on 21 December 2007 and now is under the process of Royal Endorsement. Regardless of the Bill's endorsed, local communities in many villages are actively engaged in managing

forest resources, even though the delay in approval has slowed down the progress. The lack of an appropriate regulatory framework has also resulted in the misunderstanding of what can and cannot be done in a community forest, often contributing to frustration among, and even frictions between, the concerned parties. Field forestry staff often have to take personal risks in promotion of community forestry as later on it may be found out that such activities were against the letter of law in force.

Concerns over illegal immigrants have been cited as a major reason for holding up the Community Forestry Bill. However, the number of illegal immigrants in the protected areas has increased over the years independent from legal control. Thus, the issue appears to have more to do with the immigration policy than the Community Forestry Bill. Another risk involved is, as pointed out by some conservation NGOs, that community forestry may be used as a means to giving land out to individuals which could possibly be later on privatized or would be converted to other uses.

Without a Community Forestry Bill in place, it has proved difficult to develop proper, formal administrative procedures and guidelines for field implementation of community forestry. The proposed process of the establishment of a community forest is outlined in Box 3. Formally it would be up to local people to decide whether they want a community forest and to form a group and fill in an application.

However, the planned system is rather complex, bureaucratic and time consuming. For example, each community forest has to be approved by the Director General of the RFD before a villager is formally given a use right of forest. This responsibility could be delegated to the concerned provincial authority. In addition, some conditions, such as the need to form a group with at least 50 households, may not always be applicable for every village. Management plans in the past have considered mostly technical details (forestry and environment) and very few social, economic and cultural aspects and this should be rectified.

Goals and strategy of the Community Forestry Program

The final constraint relates to the lack of definition of the overall goal and long-term strategy of community forestry. The Thai Forestry Sector Master Plan of 1992 clearly described the objectives and roles of community forestry, but they were never formally endorsed

The situation with the Community Forestry Bill shows that the government's Community Forestry Program has been trapped in a political stalemate. The lack of overall policy goals corresponding to today's realities in environmental degradation, inappropriate resource use, imbalance between demand and supply of forest products, a long-standing ban on logging, uncertainties in the utilization of plantations, etc. do not provide an adequate strategic framework for community forestry. It is unclear whether community forests should become commercially viable economic undertakings or just a means to meet subsistence needs and generate some additional revenue for the most disadvantaged groups in the community who do not have other resources. It is also important to clarify the role of agriculture as a source of livelihood in forest communities be they located in or outside protected areas (cf. Walker 2005).

This situation undermines the government investment already made in promoting community forestry. Important lessons have been learned to avoid top-down and bureaucratic approaches and to generate awareness and willingness to manage and conserve forest resources sustainably. These lessons however, cannot be put in practice due to the lack of clarity in policy and strategies.

If community forestry is not allowed in protected areas in the future, the government should also make it clear what kind of livelihood strategies are offered to the 1-2 million people living in the these areas (relocation, long-term subsidization, engagement in PA management activities, etc.).

Box 3. Proposed Procedure to Establish Community Forests

A number of steps will have to be completed before a community forest is officially in the name of a group.

1. Local people organize themselves into a group of at least 50 people (18 years or older).
2. They discuss and agree on a set of Community Forestry Programs and activities, fill-in and sign a community forestry application form (CF Document 1), and submit it to community leaders(e.g. Tambon leader – Kamnan and/or village headman – Poo Yai Ban), who in turn submits the form to the concerned District Administration Authority.
3. The District Mayor, District General Secretary and District Forestry Officer review the application form (CF Document 1), check if all the supporting documents are included, and forward the application to the concerned Provincial Authority.
4. The Governor, with authorized Forestry Officers from the Provincial Office of Natural Resources and Environment (i) appoints a responsible Forestry Officer for field investigation; (ii) the Officer carries out the field investigation, together with the Kamnan and/or Poo Yai Ban and authorized community members, and writes a field site investigation report (CF Document 2); (iii) the local group/institution develops a proposal for community forest (CF Document 3) with technical assistance from forestry officers; (iv) together with a recommendation from the TAO, the group submits the proposal to the Provincial Administration; and (v) the concerned provincial officer reviews the proposal and submits to the RFD for final approval.
5. The Director General of the RFD approves or disapproves the proposal, informs the provincial officers of the decision and issues instructions to implement the decision. Upon the approval of the CF proposal, the authorities start the process for registration of the community forest, as follows:
6. The Provincial Governor declares an area of the approved community forest according to the National Forest Reserve Act 1964 (Decree 15) and informs the District Mayor, Kamnan and/or Poo Yai Ban, Forestry Officers, and Provincial Agricultural and Cooperative Officers. These officers are responsible for monitoring and evaluation of the programme. Forestry and Agricultural/Cooperative Officers develop a CF monitoring and evaluation report (CF Document 4) and submit it to the RFD at least once a year.
7. The local group, with the help of forestry officers, demarcates boundaries of the forest, places community forest signs with information on rules and regulations, sanctions and restricted forest products. The community forest group (a) develops a CF operational plan for plantation, enrichment planning, community forest development, etc., (b) establishes forest patrolling groups, (c) monitors CF activities, (d) informs community members of the plan, and (d) provides progress reports to forestry officers.
8. Forestry officers work closely with the local CF group as technical assistants to ensure programme effectiveness and forest sustainability

Source: Witchawutipong 2005.

Towards effective community forestry

From the experience and insights of planning and implementing community forestry in and outside Thailand, a set of key building blocks for effective community forestry development have been devised, which are described in the following sections.

Community forestry policy and strategy

There is a need to recognize the key role of community forestry in the overall strategy to achieve sustainable forest management in Thailand. Local communities should be seen as assets or human capital for improving the country's forest condition (rather than as the cause of forest resource degradation) (Box 4). There are numerous examples from different parts of the world (including Thailand) that demonstrate local communities' understanding

and knowledge of forests and forest products as well as their successful efforts in managing and regenerating forests and trees in their villages.

The rational and good practice is relevant to Thailand's forestry situation. The knowledge and understanding of forest-dwelling people on forest conservation have been well demonstrated and documented (e.g. Heares 2006). Community forestry fits well into the government's current development objective of poverty reduction and the philosophy of development through decentralization. Not only would community forestry mobilize millions of people to participate in the management of the country's forest resources, but the government's financial and administrative burden for forest management would also be reduced.

Box 4. Rational and Good Practice of Community Forestry

Community involvement in forest management has been justified on the following grounds:

1. Proximity to the resource: those in contact with the forest are best placed to ensure its effective husbandry.
2. Impact: those whose livelihoods depend on the forest should be involved in its management.
3. Equity: Forests should be managed so as to ensure adequate resource flows to the rural population.
4. Multiple needs: single-purpose management for timber may be incompatible with the livelihood needs of the rural population.
5. Capacity: forest-dwelling communities may be better forest managers than the government agencies.
6. Biodiversity: multiple purpose management of forests by communities can lead to better conservation of biodiversity than management for timber alone.
7. Cost-effectiveness: local involvement in management may be an important way of cutting costs to the state.
8. Government: community involvement introduces important checks and balances in relation to state services, which tend to be mismanaged.
9. Sustainability: local participation, decentralization and subsidiary assistance can ensure sustainability

Source: Adapted based on Brown (1999).

It is important to have clear targets as to how much forest should be under community management and within what time period this should be achieved. Such targets would give the planners clear goals and strategic direction to strive and plan for, and for seeking and mobilizing the necessary resource. Targets would also serve as a useful basis to measure progress and assess the overall impact of community forestry over time as experience in other countries demonstrates.

Benefits and costs of community forestry

Actual or perceived benefits are a key to attract local people for active participation in community forestry activities. Most government programmes, including in Thailand, tend to place emphasis on meeting local people's subsistence needs. However, many villagers, especially the poorer members, do not have access to other means of livelihoods and therefore find such programmes irrelevant. These poor villagers are interested in forestry activities that would help them get out of the subsistence economy. Therefore, community forestry must consider production of good and services beyond the subsistence needs, i.e. development of commercial operation including collection and sales of NWFPs and supplying wood to processing industries. This would help raise the income of poor households while adding value to forests for society at large.

Unfortunately, community forestry has yet to find its way to benefit the poorer villagers in Thailand. Specific pro-poor activities are needed to reach this social group (e.g. providing scholarships to children, interest-free loans for income-generating activities, and providing necessary skills by training) (Kanel and Niraula 2004).

Community forestry's contribution to conservation objectives is equally important. Many case studies from different parts of the world have highlighted regeneration of forest resources, improved watersheds and return of wild animals and birds, following the implementation of community forestry programmes. Community forestry has a huge potential for contributions towards the objective of sustainable forest management, thereby enhancing the role of forests for society through improved ecosystem services (i.e. biodiversity conservation, watershed management and carbon sequestration, etc.).

As well as benefits, it is equally important to consider costs caused by community forestry activities. According to Malla (2006), local communities, once they are in control of community forests, can start making substantial investment of their resources (money, time, energy, knowledge and skills) in regenerating, protecting and sustainably using resources. The long gestation period of forestry investments makes it impossible for the poor to engage in tree planting without external support. Appropriate incentive structures have to be tailored to the operational environment and they have to address power sharing, information sharing and issues (Castrén 2004).

Apart from the direct costs of management and production there are also transaction costs which are often disregarded (Adhikary 2005; Malla 2006). Through community forestry programmes, the authorities impose many demands on local people's time and other resources. They are required to organize meetings among themselves and with forest authorities. They need to fill in forms and submit periodic reports. When forest officers pay visits to a village, they expect to be entertained with organized visits to community forest sites, all free of charge. Indeed, in some places, some community members are reported to have started to use the village fund to cover such costs. There is a need to consider all benefits and costs (direct and indirect) when planning forestry and carrying out financial analysis.

Tenure and use rights of forest and forest products

Another important factor for community forestry lies in the "ownership" and "secured use rights" of forest and forest products. For this, two actions are critical. First, it is important to clearly define the boundaries of the resource that will be allocated as community forests and identify which households are users of the forests (Gilmour and Fisher 1991). The draft Community Forestry Bill requires a minimum group of 50 people to commit to the activity before a community forest can be established. Second, the local communities should be vested with both "authorities" and "responsibilities" (not just responsibilities) for the protection and management of community forests, including authority to protect the resource from outsiders and action against the community members who breach the forest management rules (Moore 2005). This would involve the establishment of clear internal rules for use rights, protection of the resource, sharing of benefits and penalties, Most community forests, where these elements are present, are found to be very effective. Table 10 provides a tentative outline for how local communities' use rights of forests could be defined in the Thai conditions.

In Thailand in general, it appears that most community forests have loosely defined resource boundaries and users and villagers have unclear responsibilities for protecting and regenerating forest, but with no effective control over the resource. It is important to provide a clear set of conditions for what is not possible for community members, i.e.

resource boundaries and users, use rights (both authority and responsibility) as well as sanctions (Table 10).

The present Thai policy to grant/lease reserve forest land to private individuals and private companies for commercial tree plantations may represent a limitation to community forestry development. Therefore, other options should be considered in situations where communal management can better achieve the sustainable management objectives.

An appropriate regulatory framework is critical to enable community forestry activities in the field (Moore 2005) and for their mainstreaming beyond the pilot sites. Indeed, in countries such as India, Nepal and the Philippines, community forestry expanded rapidly once a regulatory framework was put in place. On the other hand, in Thailand, the delay in approving the Community Forestry Bill has been one of the limiting factors for the expansion of community forestry.

Organizing communities and forest-based community enterprises

Community forestry is about both forests and people (communities), and it can only move ahead if the people concerned are interested in acting together. A community is made up of individuals and groups with different interests and means of livelihoods. Different interest groups see forest resources from the viewpoint of their own specific needs. Many Thai forest communities are ethnically and socio-economically diverse. Community members need to organize themselves to be able to manage the forest and to ensure that different forest goods and services are available in a sustainable and equitable manner.

Community-based forest management and related enterprises have been expanding dramatically in the world with the recognition of historical tenure rights and the transfer of responsibilities to local levels (Molnar et al. 2005). Yet, a major weakness of most government community forestry programmes, including in Thailand, is that they concentrate resource and effort mostly on forest protection and regeneration activities. The reason is that these programmes have been initiated largely in response to the environmental concerns. Forest industries and market promotion have been viewed negatively as expanded production is feared to accelerate the deforestation process.

It is time that policy makers and stakeholders realize that community forestry is not about just planting and protecting forests, or producing forest products for subsistence purposes only. Communities can generate revenue to reduce poverty while contributing to meeting broader societal needs of forest goods and services. It has been demonstrated that people are willing to pay for such goods and services. Both domestic and international markets for timber and NWFPs have expanded dramatically and as a new opportunity payment schemes for environmental services have been put in place in many countries. Financing is available through various financing institutions and private sector sources which are providing credit and other services to support small- and medium-scale enterprises.

Table 10. Tentative definition of use rights of forests in Thai conditions

	National forest reserve	Communal land	Protected area
Resource boundaries of forests (area, restricted area, etc.)	Yes	Yes	Yes
Users (h/holds numbers & names)	Yes	Yes	Yes
Ownership of land Ownership of forests/trees	State Community	Community Community	State State
Responsibility for: • Protection • Regeneration • Monitoring	 • Yes • Yes • Yes	 • Yes • Yes • Yes	 • In designated areas • In designated areas • In designated areas
Authority to community for: • Controlling/protecting resource • Imposing fines and sanctions	 Yes Yes	 Yes Yes	 Within FMP provisions Possible through internal rules
Forest resource use: • Subsistence purposes • Commercial purposes • Set aside core conservation areas	 Yes Yes If necessary	 Yes Yes If necessary	 Yes No Yes
Forest land grants/leases: • To a defined community or group for tree planting • Use of products for subsistence need by a defined group or community • For planting trees by individual households(disincentive to CF)	 Yes Yes No	 Yes Yes No	 Within FMP provisions Within FMP provision Within FMP provision
• For cultivation/building house by individuals • To clear forests for other uses by a community or group • To a company/corporation	No No Yes	No No No	No No No
Benefit sharing arrangements: • 100% to community (group) • 100% to Tambon/provincial govt. • Share b/w community & govt.	 No No Yes	 Yes No No	 Within FMP provision No Yes
Utilization of income • For forest management • For village development • Sharing among group/community members (loans, etc.)	 Yes Yes Yes	 Yes Yes Yes	 Yes Yes Yes
Operational or working plan	Yes	Yes	In designated areas
Agreement with government authority	Yes	Yes	Yes

On the other hand, local people are already extensively involved in collecting NWFPs, within and outside community forests, trading them in local markets. In Thailand, the Bank of Agriculture and Agricultural Cooperatives (BAAC) provides loans to groups of farmers for various types of processing, including NWFPs, and even for export market development. Various initiatives, such as the Royal Project Foundation and H.M. the King's Initiative Projects have been designed to help the poor people, especially hill tribes, living in and around the forests to improve their livelihood base. These Royal projects provide training and financial support to the villagers. Similarly, the government programme One Tambon, One Product (OTOP) is specifically designed to encourage villagers to become more business oriented. Support and infrastructure for forest-based community enterprises already exist in the country but they do not reach the target groups

in the communities. It is necessary to link community forest groups with these various initiatives through training, communication and eventual adjustment of financing instruments.

Networking and association of community forest groups

Community networks

As the number of community forests increases and more experience is gained, local communities need to develop networks among themselves, share experiences and learn from each other. In particular, communities, which have yet to establish community forests, could benefit from visiting the existing ones. As community forest groups expand both in number and area, the RFD staff will find it increasingly difficult to meet the information demands of the community groups.

In some parts of the country, especially in the North and Northeast regions, some groups have already started networking often assisted by donor projects and NGOs. The RFD can build on these community networks as channels of information and assist in expanding them in an organized and systematic manner.

Association of community forest groups

As well as networking among community members, another major task of community forestry practitioners should be to assist in the establishment of associations of community forest groups. This concept has been applied in some other countries (e.g. in Nepal, see Bhattarai (2005) for details). Such associations could operate at different levels – from Tambon through to the national level. Just as government authorities need to inform community groups on new programmes or changes in policy instruments and regulations, local communities need to provide feedback on the extent to which public programmes are relevant. Community forestry associations could play roles in facilitating this communication by:

- *Acting as an interest* group in dialogue with the government and market actors, including on policy and market issues ensuring that the concerns of community forest group members are taken into account
- *Acting as a link* between community group member and other stakeholders (government forest authorities, industries, etc.) for communication on new knowledge and information, including changes in forest regulations
- *Acting as an agent of change* by educating and motivating different groups of community member (children, men and women), using a variety of media communication tools and techniques, for awareness raising and sustainable use of forest resources
- *Acting as a service provider* to community members on the management of community forests, including hiring necessary technical expertise

Community forest groups should be charged a membership fee to make the operating of such associations financially sustainable. For technical services community groups should pay fees which can be initially nominal and subsidized. Over time they may take responsibilities for extension and campaigning activities, and associations may raise funds from various sources.

5. PLANTATIONS

Rubber plantations

Rubber planting

The rubber tree (*Hevea brasiliensis*) is native to the equatorial tropical zone in the Amazon Basin in South America. It was first introduced in 1900 in south Thailand and in 1908 in eastern Thailand. Rubber planting has been actively promoted by the government since the 1960s and the total area reached 1,959 million hectares in 1996. The international rubber markets experienced a period of excess supply in the mid-1990s and the expansion of the area was discontinued. Since 1999 the international prices of rubber have more than doubled (Table 11) and a new promotion programme was launched in 2004. The current rubber area is 2.019 million hectares of which 84 percent is found in the Southern region and 11 percent in the Central region. Thailand, together with Malaysia and Indonesia, is one of the bigger rubber producers in the world.

Rubberwood, also called parawood in Thailand, is a medium density hardwood with relatively low shrinkage, and compressive and bending strengths for its hardness. It is highly susceptible to fungal attack and dries well. It machines easily, but latex tends to clog the saw's teeth. Glueing and finishing pose no problems. It has become a very popular timber for use in furniture, parquet flooring, wooden household articles and toys. It is also used as a raw material for the production of particleboard, MDF and plywood. Rubberwood has thus become the lifeline of the Thai wood industries and the country has been a forerunner in the development of rubberwood utilization.

Growing of the rubber tree and the production of latex fall under the Ministry of Agriculture and Cooperatives, productivity improvement is the responsibility of the Rubber Research Institute (RRI) under the Department of Agricultural Extension, and the promotion, financing and control of the replanting are the responsibility of the Office of the Rubber Replanting Aid Fund (ORRAF), reporting to the Department of Agriculture. The conversion of the logs into manufactured products is promoted by the RFD.

Rubber as a crop

The rubber tree is generally planted for its latex, which can be harvested from the age of seven years onwards. Good drainage and suitable soil are required. The most common technique for rubber planting is stump budding with improved varieties or clones. The RRI has promoted a special approach for production of high quality rubber. Earlier they used to provide free seedlings but now, high quality seedlings are being provided at the rate of US$0.38/seedling. The planted area, harvested area, yield of latex, farm price and farm value for the period 1995 to 2004 are given in Table 11.

Table 11. Rubber plantation area, latex production and farm value 1995-2004

Year	Planted area 1,000 ha	Tapping area 1,000 ha	Latex production 1,000 MT	Yield/ha kg	Farm-gate price of latex US$/kg	Farm value US$ million
1995	1,870	1,572	2,062	33.6	0.78	1,605
2000	1,988	1,524	2,378	40.0	0.54	1,279
2004	2,083	1,657	3,005	46.4	1.10	3,315
2005	2,019	1,602				

Source: Agriculture Statistics of Thailand, 2004; Centre for Agricultural Information, Office of Agricultural Economic, Ministry of Agricultural & Co-operatives, Bangkok, Thailand; data for 2005 from the Office of Agricultural Economics.

Ninety-three percent of rubber plantation belongs to smallholders, the average size of the plantation being only 2.08 hectares. The medium-size plantations are larger averaging 9.6 hectares but they represent only 6.7 percent of the total area. The rubber holdings represent a major source of income (about US$3.3 billion per year) for over 800,000 rural households or 2.4 million people and their social importance is therefore strategic. The average family income from rubber is US$4,125 per household.

Rubberwood supply

The rubber plantations are the main source of industrial timber in Thailand. The theoretical potential of wood supply was estimated to be about 21 million m^3/year (Table 12). The sawlog share is estimated to be 7.9 million m^3 while the rest (13.1 million m^3) would be small-sized logs for wood-based panels, fuelwood and other purposes.

This theoretical supply potential is calculated based on regular replanting of mature rubber plantations as after 25 years of age their latex productivity starts to decline rapidly. In practice the annual replanting is only 48,000 hectares or 57 percent of the theoretical long-term potential. During the last few years when the latex prices peaked as a result of oil price increases, farmers have continued exploiting their mature plantations as the lower yield is well compensated by the current high sales price of latex. As a result, the rubberwood supply has dropped and it is estimated that only about 35,000 to 40,000 hectares are being currently harvested and replanted releasing only 8.7 to 10.0 million m^3 of rubberwood for the market. This has seriously influenced the wood supply of the sawmilling and panel industries.

Revenue from wood sales is additional to that from latex and helps farmers finance replanting cost. While the average annual revenue from latex is US$2,000/hectares, the wood sales at the end of the rotation period can only generate US$1,000-1,500/hectares (stumpage). At the national level, the total stumpage revenue of the smallholders from rubberwood is estimated at US$35-60 million but it could be much higher if plantation management was based on regular output. Wood production can be a particularly attractive option for the North and Northeast regions where latex productivity is well below the national average (Table 12).

Table 12. Potential rubberwood supply 2005-2010

Region	Total planted area	Tapping area	Annual wood harvesting area†	Annual wood supply‡	Rubber tapping productivity index
	1000 ha -			1000 m^3	
North	1.9	1.6	0.1	25	64
Northeast	94.4	53.4	2.8	700	83
Central	222.2	160.5	8.4	2,100	87
Southern	1,699.4	1,386.2	73.0	1,820	102
Total	**2,019.0**	**1,601.7**	**84.3**	**21,075**	**100**

†Assumption: 25-year rotation, even age structure
‡Based on standing volume of 250 m^3/ha

Source: Planted area based on remote sensing data from Office of Agricultural Economics, June 2006.

Improvement of genetic material

It is apparent that in the current situation farmers prefer those clones which are for latex only; RRI's research has also targeted developing clones that yield most latex. Strong rubberwood demand has, however, created an interest in developing clones which combine both latex and wood, or which are targeted at wood production only (as in Malaysia). RRI has three types of clones available for farmers:

(a) Only for latex – RRM 1 is the most popular clone in this category, but PB 225 is also used.
(b) Only for wood – BPM 1, Charchensao 50, AVRS 2037 and PBM 1; these clones are not tapped.
(c) Combined latex and wood – PB 255, PB 235, PB 260, RRI 110.

Apart from the strong market for rubberwood, the other reason for interest in planting rubber trees for wood production is limited labour supply for tapping work. In the Southern and Central regions labour can be attracted on the basis of benefit sharing as the standard minimum wage (US$4/day) cannot mobilize a sufficient labour force for tapping. In a typical arrangement, skilled workers get 40 percent of the output value which results in a daily wage of about US$12-14. It is common to employ immigrant labour in rubber tapping as the working season is only about 100 days per year and no permanent employment can be offered.

The Malaysian experience suggests that timber clones of the rubber tree can have a mean annual increment (MAI) of about 26 m^3/hectare which can represent an attractive investment opportunity for the landowner if regular annual revenue is not needed and skilled labour for tapping is not readily available. This contrasts with the best Malaysian latex clones where the MAI is 20 m^3/hectare and the 9^{th} year latex yield was 2,675 kg/hectare (Hassan 2000).

In planting rubber solely for its wood, no tapping would be involved, and the rotation period can be significantly shortened. For medium-sized farmers with other income or absent landowners this investment option is likely to become attractive.

Harvesting methods and organization

Rubberwood harvesting is a simple operation (chainsaws or bulldozers are used for felling, bucking is by chainsaws and loading is often manual onto a truck directly on the plantation site without skidding) where the focus is on the volume rather than optimizing the potential value of the tree as a raw material for industrial processing. This labour-intensive approach has worked well in the past when manpower was available and the industrial capacity was below wood supply. In the long run, semi-mechanized harvesting is likely to become attractive and loading, as enduring and accident-prone manual work, should be the first phase for mechanization. The industry's involvement in the harvesting of rubberwood is limited as it is usually contracted out or organized by middlemen. Transportation is mainly with small-sized trucks (10 to 14 tonnes) which can easily access the plantation site and circulate in narrow rural roads but their use also results in high transportation cost.

Due to rubberwood susceptibly to fungal attack, the harvesting-transportation process has to be fast as logs cannot be stocked for more than a few days. There is no information available on wood quality loss due to deficiencies in the wood supply system. There is a need to carry out analysis of this issue as well as other means to improve value-added of the log output through improved bucking. The short log length makes manual loading practical but longer log lengths would be desirable for productivity improvement both for transportation and industrial processing. Silvicultural aspects (e.g. pruning techniques) could be integrated into management prescriptions for rubber plantation to maximize timber value while not losing the productivity of latex at the same time.

Most harvesting is carried out by contractors who usually work for intermediaries. Some large sawmilling-furniture companies and panel producers have a few harvesting crews fully informed about the production cost. Long-term planning of the wood harvesting operations has not been given due attention in the past (Bassili 2000).

Other benefits

Rubber plantations are largely established at the spacing of 3×7 m as recommended by the RRI. In the initial years, farmers plan other annual cash crops such as tea, coffee, pineapple or chili to gain some additional income during the first three years. There are also other options which have not yet been tried in Thailand. In Mexico, a shade-tolerant ornamental palm tree (*Chameodora elegans*) was introduced in the rubber plantations. Its leaves are regularly harvested to be used for providing green material in flower bouquets, mainly for export markets (notably the US). This has become economically so attractive that palm leaves can generate more revenue than latex tapping. An optimum utilization of the rubber resource can therefore have several diversification opportunities, and various option could be considered in Thailand, which is a world leader in flower exports.

Role of the Office of Rubber Replanting Aid Fund (ORRAF)

ORRAF was created in 1960 with responsibility to provide rubber plantation technology to farmers and promote high-quality rubber production ORRAF subsidizes the cost of replanting rubber. The funding source is a cess of US$0.475/kg of latex which is collected from producers. The subsidy covers the initial period of replanting and it amounts to US$1,441/hectare to cover the cost of seedlings and labour. The subsidy is paid in seven installments after milestones of implementation. The subsidy has proved to be necessary to keep farmers replanting and not switching to other crops. Recently other crops (including 28 tree species, mostly fruit trees but also teak and dipterocarps) have, however, been included in the support programme. The subsidy can also be used for replanting with oil palm.

Together with the Bank of Agriculture and Agricultural Cooperatives (BAAC), ORRAF is also providing small loans for the establishment of new rubber plantations. The loan amount can be up to US$750 with an interest rate of 3 percent. ORRAF is also important in improving the efficiency of the market mechanism. It assists farmers in collecting production volumes in strategic locations for supplying the rubber industry. Information on available sales volumes is disseminated for bidding by interested buyers, and farmers are informed on market trends. ORRAF does not buy any rubber as its role is just to collect and disseminate information and facilitate trade.

ORRAF is fully aware of the importance of wood revenue for farmers but it is seen as a complementary element in the replanting phase. There is no coordination with Thailand's important rubberwood industry although information on plantation areas has been made available to the wood industry. The wood production depends practically entirely on the latex market and therefore represents a significant market risk factor for the wood processing industry.

Timber plantations

All forests in Thailand are owned by the state whereas all trees established on private lands are private property. Since logging in natural forests is banned, timber production in Thailand has shifted from natural forests to planted forests, particularly teak and rubberwood and non-forest sources supplemented by imports. But planting of timber species has progressed slowly due to a series of constraints. Most farmers are poor and indebted and therefore they have to obtain quick returns and even a five-year rotation with eucalyptus is often too long for them. This has led many farmers to apply only 3-4 year rotations with resulting loss of timber yield. Thus, they prefer to raise agricultural crops for seasonal regular revenue and tree crops are usually complementary to these sources of income. Only rich and large-scale farmers can wait for the returns at the maturity of the timber species.

Farmers hesitate in investing in timber plantation because: (a) no proper credit facility is available, (b) forestry species are competing with other cash crops such as cassava, sugar cane etc. which are being actively promoted, (c) the registration problem of reserved species at the time of harvesting represents a source of uncertainty, and (d) some species such as neem have no market.

In order to overcome the problem of diminishing forest resources and achieve the target to bring 40 percent of the country's area under tree cover, both the private and public sectors have initiated plantation promotion schemes. Teak, eucalyptus and rubber are the main plantation species though bamboo, *Acacia mangium*, *Albizzia lebbeck*, *Leucaena leucocephala*, *Gmelina arborea*, *Pinus* spp, *Acacia* spp and *Azadirachta indica* (neem) have also been planted.

After the initial trials by the Forest Industry Organization (FIO), the private sector also initiated teak plantations. The long rotation period (about 30 years) and lack of initial cash flow, however, curtails teak's attractiveness. Teak is mostly planted in agro-forestry systems and on some commercial block plantations. The initial experience indicates that the plantations are able to provide medium-quality raw materials for wood-working industries.

Data on private plantations is scarce. Available figures are biased upwards as they refer to the planting carried out, not the trees survived. No detailed inventory of the existing plantation area has been carried out. The estimates of the survival rates range from 33 to 57 percent. Thus, even at best, the net plantation area would be only half of the cumulative area reported as planted. On the other hand, there is estimated to be a significant area which has been planted without any government involvement; but no reliable data are available.

Government programmes

The government-supported plantations in Thailand have been established mainly through the following six agencies: (a) afforestation by government budget, (b) concessionaire's reforestation, i.e. the reforestation camping in commemoration of the Royal Golden Jubilee, (c) the Forest Industry Organization (FIO) and its current subsidiary Thai Plywood Co. Ltd., both parastatal companies, (d) reforestation according to the Ministry's Regulations, and reforestation by concessionaire budget. These plantation areas from the outset to 2007 have amounted to 13,026.47 km^2 or 7,141,543.75 rai (Annex 3).

In 1992-2004, the JICA Reforestation and Extension Project (REX) in the Northeast promoted planting by local people, through a social forestry approach in order to restore environmental conditions and to improve living standards in the region (JICA 2004). The project included four components: (i) forest management information, (ii) forest management techniques, (iii) training and extension, and (iv) monitoring. In 1998 the project concluded with remarkable outputs such as 89 million seedlings produced by four large-scale nurseries, seedling distribution to 2,444 villages in the region, 143 training courses, 6,093 hectares of demonstration plantations, research reports and various other activities contributing to the promotion of tree planting activities by local people in the region. The main species were selected based on the farmers' preferences, including eucalyptus, neem, *Pterocarpus macrocarpus*, *Acacia mangium* and teak. Trees are generally planted on marginal lands by small farmers often intercropping with other cash crops, particularly on boundaries of agricultural fields. The main objective is to get quick returns. Marginal lands have been usually used, except on saline soil. The bushland mostly belongs to the community, which means that plantation activity needs be decided by the community. Villagers have formed community forest centres which provide seedlings. The promotional activity is concentrated on marginal farmers who do not have other economic options. Most of the trained villagers are spreading the knowledge and therefore, work as

informal extension agents. The main objective of the community forest may be NWFPs whereas private forest owners aim to produce timber which gives them quicker and better economic returns.

Eucalyptus and *Leucaena leucocephala* have been raised on private lands for making charcoal and wood vinegar (alcatra). Mushrooms and some NWFPs such as bamboo shoots, jungle spice and medicine herbs are also grown and they offer large potential for economic benefit to the farmers.

In order to meet the increasing demands for wood, the Ministry of Agriculture and Co-operatives, upon the initiative of the RFD, proposed the budget to the government to implement a farm forestry programme. The Private Tree Farm Incentive Plantation Promotion ran from 1994 to 2002 (except 2001), with the target area of 1.28 million hectares. The programme encouraged the private sector and farmers to plant the specified economic tree species on their lands at 1,250 seedlings/hectares. The purpose was to make use of all unutilized marginal farmland and areas for environmental benefit, and to reduce rural poverty. Planting was subsidized by the government at US$469/hectare. The farmers are free to harvest or manage the standing stock on their own decision after the deal ends at the beginning of year six.

About 80,126 farmers joined the programme. The planted area covered 1,056,058.24 rai or 169,400 hectares which means that only 13 perecnt of the target was achieved (Annex 4). The reason is claimed to be attractive subsidies offered for rubber but the inherent obstacles of investing in tree crops discussed above have obviously been important as well. The programme is still ongoing even though it was officially planned to end in 2002.

In addition, the RFD, DNP and DMC have issued a Four-Year Action Plan (2008-2011) in which the visions, missions, targets and key performance indicators are presented (Annex 5).

Teak

Teak forests occur naturally in the Asia-Pacific region over an area of about 23 million hectares in India, Laos, Myanmar and Thailand. Asia constitutes 94 percent of global teak plantations. The natural distribution in these countries ranges from sea level to mountainous areas of 800 m and in exceptional cases, up to 1,300 m above the sea level. Teak can survive and grow under a wide rang of climatic and edaphic conditions. The rotation period is 60-120 years. Shorter rotations of 20-30 years for both veneer and sawlog production for relatively quick returns are now being employed in many countries. Since teak is basically a long rotation tree species, its carbon sequestration potential is also significant (Bhat et al. 2005).

The area of natural teak forest in Thailand decreased from 2,324,300 hectares in 1954 to about 150,000 hectares in 2000, mostly due to the demand for agricultural land and construction wood by the increasing human population. Overexploitation, often illegal, was also an important factor. Up to 2000, both private and public sectors in Thailand had established only 836,000 hectares of teak plantations (FAO 2001). Thailand, therefore, has to import teak wood, especially from Myanmar, Laos and Indonesia, with an average value of about US$50 million annually. However, small logs from domestic teak plantations are used for furniture, carving, building construction, household utensils, toys, poles, etc. for domestic consumption as well as for export. The Forest Industry Organization (FIO) has obtained two FSC certificates for its sustainable teak plantations and is still trying to get additional certificates for other areas (Kijkar 2005).

Teak planting in Thailand started in 1906, by applying the *taungya* system with modifications to suit the surrounding circumstances, both economically and socially. From 1994 to 2000, the RFD has already assisted the private sector to establish teak plantations of about 100,000 hectares. Spacings are typically 2×4 or 4×4 m whereas the MAI is reported as 13.52 m^3/hectare.

The long-term production potential of existing teak plantations has been estimated at about 0.9-1.0 million m^3/yr. This level of production would require timely implementation of thinnings which is to some extent lagging behind due to limited markets. As teak planting has mostly taken place in forest reserves, it is unclear whether they can be effectively managed for timber production due to the logging ban.

Teak plantations have increased since 1993 after the Government of Thailand started to promote private sector investment in this business through the provision of subsidies. However, the enactment of the Forest Plantation Act, 1992 is presently considered an obstacle for private planting. Teak plantation establishment is likely to increase when the Act is amended which is foreseen by the RFD. The FIO has played an important role in teak plantation establishment and utilization.

Lack of domestic supply of teak is a major concern among the wood-based industries. Legal harvesting is only possible with a special license and the volume of confiscated illegal teak logs (about 10,000 m^3/yr) is only a fraction of what was produced in the 1980s.

More and more farmers and other landholders are planting teak in rotations of 20-30 years. Recent research findings indicate that short-rotation teakwood is not significantly inferior in density and strength compared to natural-grown teak, but its lower heartwood makes it less durable and attractive. The outlook for plantation growers, including smallholders includes:

- Without altering timber strength, plantation managers can aim to produce logs with higher yields of naturally durable heartwood by accelerating tree growth in short rotations with judicious fertilizer application and genetic improvements on suitable sites. Irrigation during the early years of the rotation period can also be justified
- The MAI for teak plantations is generally relatively high in short rotations of 20-25 years. However, yield tables indicate that the MAI usually peaks within 20 years of plantation establishment
- Teak can produce timber of optimum strength in relatively short (e.g. 21-year) rotations
- Fast-growing provenances/clones can be selected for teak management without reducing the wood's specific gravity. However, matching the provenances for specific site conditions and product requirements appears to be crucial in tree improvement programmes and therefore on-site testing is useful

Some research has been conducted in Thailand into teak breeding through pollination among selected trees. However, the seed orchards have not given satisfactory open-pollinated products. Controlled pollination trials have therefore been initiated and seed production areas have been established to support field operations. The Teak Improvement Centre (TIC) has operated in Lampang since 1965, in collaboration with DANIDA, to improve plantations, especially using genetically improved materials. Techniques to propagate teak vegetatively have been developed and have been commercialized and are at present used for superior clonal multiplication. Other main results of the TIC include:

- 480 elite trees selected (Gavinlervatana 1995) for further multiplication and propagation. Out of them, 357 plus trees have been vegetatively reproduced for clone banks and clonal seed orchard establishment (Sumantakul and Sangkul 1995)
- Both local and international provenance trials have been established and studied for their appropriateness to suit different conditions and sites
- About 1,120 hectares of seed production areas and 1,831 hectares of seed orchards have been established and maintained for immediate seed production. However, seed productivity of these areas is rather low, i.e. about 10 kg/hectare (Meekaew 1992)
- Controlled pollination in teak has been successfully developed for breeding programmes. The research outputs from this exercise are still underway
- Vegetative propagation techniques have been developed. Buds are commonly used for cloning; a tissue-culture technique was developed in 1987, which became commercial in 1992. Annually, about 500,000 plantlets are produced (Gavinlertvatana 1995)
- Utilization of small-sized teak logs from thinnings is under study

The availability of relevant information on water use and the carbon sequestration potential of teak trees and suitable teak provenances/seed sources for quality timber production can help preparation of sustainable plantation management plans. Standardized cost-effective vegetative propagation/clonal multiplication techniques are envisaged with the establishment of decentralized nurseries and clonal orchards to supply genetically superior planting material to teak growers.

In spite of the extensive research effort, wood production has not yet benefited much from such improvements. The main problems of teak plantations in private land are as follows: (a) planting on unsuitable sites where growth is poor, (ii) delays in thinnings, (iii) lack of market for thinning wood, and (iv) lack of definition of key silvicultural parameters, including the targeted rotation period, thinning densities, pruning schedules, etc. The relatively large areas planned in the Northeast region are now reaching the age of thinning and timely execution will be crucial for the economic returns to the investment made (JICA 2004).

Pterocarpus macrocarpus

There are some plantations of *Pterocarpus macrocarpus* in the Northeast of Thailand but only limited information is available on their characteristics. The species is suitable for the region as it can grow on sandy soil in lowlands. The available data suggest that *P. macrocarpus* grows first more slowly than teak but at about 15 years it becomes taller. Seedlings can be propagated from cuttings and the first gene bank of this species is reported to exist. Basic knowledge on nursery techniques has also been developed. Once established with proper site preparation and fertilization, Pterocarpus stands require effective tending to avoid growth losses and pruning is also recommended (JICA 2004). Further research is required on the economic potential of this species as a strategic option for plantation programmes.

Eucalyptus

Because of their astonishing growth characteristics, climatic adaptability and wide ranging usefulness, eucalyptus trees are increasingly being regarded as amongst the most important species available for economic utilization. Eucalyptus wood is versatile and can be used for multiple purposes including transmission poles, posts, fuelwood, pulpwood, particleboard, plywood and sawnwood. Minor forest products obtained from eucalyptus include oil distilled from leaves, tannin from bark, alcatra from charcoal burning, etc. Many eucalyptus

species have decorative flowers used as ornamentals; others are used for windbreaks and shelterbelts. It is also a common species in housing and furniture making.

In Southeast Asian countries, eucalyptus acquires maximum strength at about 13-14 years whereas the yield can be up to 50-60 m^3/hectare/year. In the existing private plantations in Thailand, the recorded MAI tends to average 25 m^3/hectare in good sites but only 8 m^3/hectare in poor sites. However, even with the current relatively low MAI rates on good and medium sites, planting is clearly profitable (JICA 2004) and spreading fast on farm lands, however with suboptimal techniques.

The quality of seedlings is a key issue. Pulp and paper companies are selling improved seedlings at US$0.06 to 0.11 each while ordinary seedlings cost only US$0.04. Selling improved seedlings by the pulp and paper company is a win-win option as it increases wood supply reducing upward pressure on pulpwood prices while the nursery operations of companies are highly profitable. Strong demand for improved seedlings (sometimes in short supply) demonstrates that farmers are aware of their net benefits as well. As two to three coppice rotations are usually applied, the yield impact should be considered over a period of 15 to 20 years.

In Thailand, 70-80 percent of eucalyptus produced goes to the paper and pulp industry, 10-15 percent is used for charcoal and 5 percent is used for construction poles, etc. Manufacturing of MDF, hard-board and particleboard from eucalyptus has been taken up by some companies. Moreover, it is also used by the Electricity Department as a source of biomass energy.

Eucalyptus has some problems in sawing. Surface cracking and splitting, warping and collapse are common seasoning defects for both air and kiln seasoning. However, these defects can be reduced considerably through air drying before kiln seasoning and using appropriate drying schedules with low temperature (Vermaas 1998). The Saw-Dry-Resaw process also improves the sawing quality of eucalyptus. Eucalyptus hybrids season well when sawn radially compared to tangentially. Improved peeling after boiling or adequate soaking and glueing techniques have made it possible to use plantation grown eucalyptus in plywood and veneer in many countries. Eucalyptus could be a prime species for plywood manufacture also in Thailand. As the country is in short supply of saw logs, eucalyptus can improve the situation if its use is promoted in sawnwood and plywood manufacture.

There is an ongoing debate on the environmental impact of eucalyptus throughout the world and in Thailand the public perception is also generally negative. Eucalyptus has been seen as incompatible with soil water retention and local people's livelihoods. This is partly due to past top-down programmes to plant eucalyptus where people did not want it. Eucalyptus plantations were also seen as a means to transfer land, which was used by local people, to private investors (Carrere and Lohmann 1996).

However, among farmers the negative perception has apparently faded as it has been demonstrated that there is no adverse effect either on the productivity of the land or on the agricultural crops if plantations are established and managed properly. About 20 years of regular plantation in dry farming areas has proved that there is usually no adverse impact in this respect. Instead, with the plantations, increased production of rice has been reported when eucalyptus has been planted in paddy fields. *E. camaldulensis* has been largely planted at the spacing of 3×3 m. It gives an MAI of up to 50 m^3/hectare in short rotations. The selling price of eucalyptus pulpwood at the mill gate is about US$17-35 (average US$30)/m^3 whereas the cost price for five years is about US$780/hectare resulting in an attractive positive margin with even lower MAI rates.

One of the biggest consumers of planted eucalyptus wood is the Advance Agro Group. The company consumes about 2 million m^3 of eucalyptus wood annually for the production of bleached chemical pulp. The company encourages farmers to plant trees and seedlings are also provided under contract farming as the company wants to ensure sustained supply of raw material to the mill. Similar approaches are practiced by other pulp producers.

According to FAO (2001), eucalyptus plantations covered 443,000 hectares in 2000 in Thailand. The current area is estimated at 480,000 hectares of which 10 percent is in paddy fields. Wood production is estimated at 7 million m^3/yr (Table 13). The rotation period of eucalyptus is 3-5 years and spacing is 1×1 or 1×3 m. Productivity varies by province. Many small farmers prefer to sell standing trees through contract farming to be sure about the income whereas other prefer to cut trees on their own and sell the wood by weight to the company.

Table 13. Eucalyptus wood supply from existing plantations

Indicator	Current situation	Potential
Area, 1,000 ha	480	480
MAI, m^3/ha/yr	4.6	
- Medium term		25
- Long term		40
Wood supply, mill.m^3	7.0	
- Short term		12.0
- Long term		19.2

A study of eucalyptus plantation with cassava has shown that the benefit-cost ratio is 1.85 whereas the net present value (NPV) is US$1,086/hectare (JICA 2004).

Economically viable tree planting initiatives

The promotional planning of economically viable trees emphasizes: short-rotation tree growing in order to produce raw materials for the wood products industry, especially the furniture industry and associated wood based accessories; increasing the value of exported wood products to remedy the loss in balance of trade from the forest sector; increasing income to the local community.

The important issues of this management plan comprise:

- The evaluation of the domestic demand for wood as raw material and the sized of the targeted area for reforestation using economically viable tree species
- Determining the promotional zone for economically viable tree planting
- Identifying the most suitable tree species for inclusion in the associated extension programme
- Developing the guiding principles for the development of an extension organization and its extension strategies
- Impact evaluation.

Demand for wood in Thailand

Demand for wood in Thailand can be evaluated from an analysis of the industrial wood sector which may be classified into five main groups, namely: 1) pulp and paper production, 2) furniture and furniture accessories production, 3) sawmilling, 4) construction industry, and 5) plywood and veneer production.

Table 14. Annual wood consumption by industry type converted to timber equivalent

Industry type	Timber equivalent (m^3)		Total	Percent
	From timber	From lumber		
Pulp and paper	10,488,022	-	10,488,022	47.8
Furniture and accessories	121,533	6,160,618	6,282,151	28.6
Sawmills	(5,728,590)	-	(5,728,590)	(26.1)
Constructions	-	4,283,086	4,283,086	19.5
Plywood and veneer	909,799	-	909,799	4.1
Total	**11,519,354**	**10,443,704**	**21,963,058**	**100.0**
Percent	52.4	47.6	100.0	

Source: Master Plan for Economically Viable Tree Planting 2006
Note that the bracketed sawmilling figure is excluded from the total wood consumption.

From Table 14, the annual domestic wood utilization in 2003 was 21,963,058 m^3, with the pulp and paper industry group being the largest user (47.8 percent), followed by furniture and accessories (28.6 percent), construction (19.5 percent) and plywood and veneer (4.1 percent).

The pulp and paper industry utilized almost all the Eucalyptus species wood harvested over 10 million m^3), with most of this purchased from farmers who participated in private company extension programmes.

The furniture and accessories industry utilized lumber that was produced either from domestic sawmills or was imported. Most of the lumber was from *Hevea brasiliensis* plantations being 98.7 percent of the total domestic lumber consumption or 5.3 million m^3.

The construction industry utilized lumber. The study indicated that lumber imported from foreign countries was 92.8 percent or 3,973,588 m^3. The majority was natural hard wood including *Dipterocarpus alatus*, *Shorea leprosola* and other species from the family Dipterocarpaceae.

The plywood and veneer industry utilized only a small amount of timber, with most coming from rubber plantations (93.6 percent), some Eucalyptus timber (5.8 percent) and the rest was imported timber (0.6 percent).

Based on the above analysis, Thailand currently uses 21,963,058 m^3 of wood, with the major timber species being Eucalyptus (48.2 percent), rubber (para) (28.2 percent) teak (tectona) (0.3 percent) and other various hard wood species (23.2 percent).

This suggests that a priority for any reforestation project involving economically viable species should focus on increasing wood production to meet the lumber requirements of the furniture and accessories industry because it does not have the integrated approach evident for example in the pulp and paper industry. At present, there are almost 8,000 furniture factories in the country, with wood utilization of about 6 million m^3. The study indicated that this type of industry could have a demand for up to 11 million m^3, which would require an area of about 15 million rai under sustainable tree management.

Area for promotion of economically viable tree plantations

Based on the National Forest Policy, the areas to be used under this project for the expansion of plantations should be on land that is owned or managed by the private sector.

The study indicated that the economically viable extension zone should be based on areas that are already covered with trees in the upper reaches of each sub-catchment consistent with the principle of land use being compatible with topography – an important consideration. Thus, the project classified suitable areas based on approximately 100 km^2 units with zones being developed from the top of catchments with about 40 percent of the zone considered suitable for potential development under this project. The total area considered suitable for use in the project was 45.2 million rai.

Current land use in the zones is paddy fields (40.7 percent), agronomy (19.7 percent), fruit tree orchard (14.6 percent), forest plantation (15.5 percent) and others (9.5 percent). Consequently to encourage a successful change in land use to achieve the desired conversion to plantation will require an extension service that includes incentives.

Maps of the promotion zone were also produced digitally using a geographic information system (GIS) which would be very useful for effective planning in each region.

Economically viable tree species for extension

The project recommends that only tree species that are economically viable should be promoted, with the associated extension being mainly conducted by the wood buyer group or the wood user group. This will encourage the tree growers to have confidence that their trees will have a market at harvest time.

To date, there have been many tree species used for processing by the aforesaid industry types that have come from fruit-based species such as coconut, mango, durian and giant ipil ipil wood or from imported hard wood species with long rotation, such as wood from *Pterocarpus marocarpus*, and those in the Dipterocarceae family.

Tree species that would be recommended through extension should have a rotation of not longer than 20 years, with established and economically viable markets. Four appropriate tree species that satisfy these requirements are: *Tectona grandis*, *Hevea brasinsis*, *Eucalyptus* spp and *Acacia mangium*.

The appropriate tree species for each area should be determined taking into account local environmental factors, including moisture, temperature and soil properties. The project has produced a Capability Map identifying zones for economically viable tree growing incorporating these criteria.

The Capability Map has eight zones, with each zone having different recommended species. In addition to allocating the four species recommended for extension, the Capability Map could also be used for indicating the capability of five other groups of forest trees as follows.

Tree group 1 including	*Azadirachta indica, Afzelia xylocarpa, Pterocarpus indica, Dalbergia cochinchinensis, Dalbergia oliveri, Xylia kerrii, Peltophorum enerme*
Tree group 2 including	*Dipterocarpus alatus, Hopea odorata*
Tree group 3 including	*Intsia bakerii, Azadirachta excelsa*
Tree group 4 including	*Casuarina junghuhniana, Casuarina equisetifolia*
Tree group 5 including	*Pinus merkusii, Pinus khasya, Pinus caribaea*

Organization guidelines for economically viable tree extension

The analysis of the stakeholders involved in economically viable tree extension identified three groups namely: a government organization group, a raw material producer group and a raw material user group.

The government organization group led by the RFD will have responsibility for creating stability in the supply of domestic forest produces, an increase in economic productivity whilst maintaining sustainable environment outcomes, policy control, and acquisition of funds to underpin planning of approved species in the promotion zones by the raw material producing group.

The raw material producer group comprises a government enterprise organization (the Economic Tree Organization) with a private company (the Economic Tree Extension Company) contracted for tree growing extension in the promotion zone. The private company will lease land on a contract basis from the land owners or farmers in the extension zone. The farmer or land owners may be involved with the tree growing and tending under the management of the private company which in turn has a contract with the government. The company will also manage the harvesting of both thinnings and clear felling and the associated replanting extension. The wood production from harvesting will be transported to the raw material user group which will be made up from any component of the wood industry that has shares in the Economic Tree Extension Company.

The raw material user group will be encouraged to form a single entity (the Economic Tree Extension Company) to enter into contracts with the Economic Tree Organization to guarantee that the raw material will be transported directly to users. This will increase the certainty of supply of raw wood material to the industry sector as well as encourage further expansion, so that the government could increase its forest sector taxation returns, with this extra revenue used to underpin the budget for ongoing funding of economically viable tree growing.

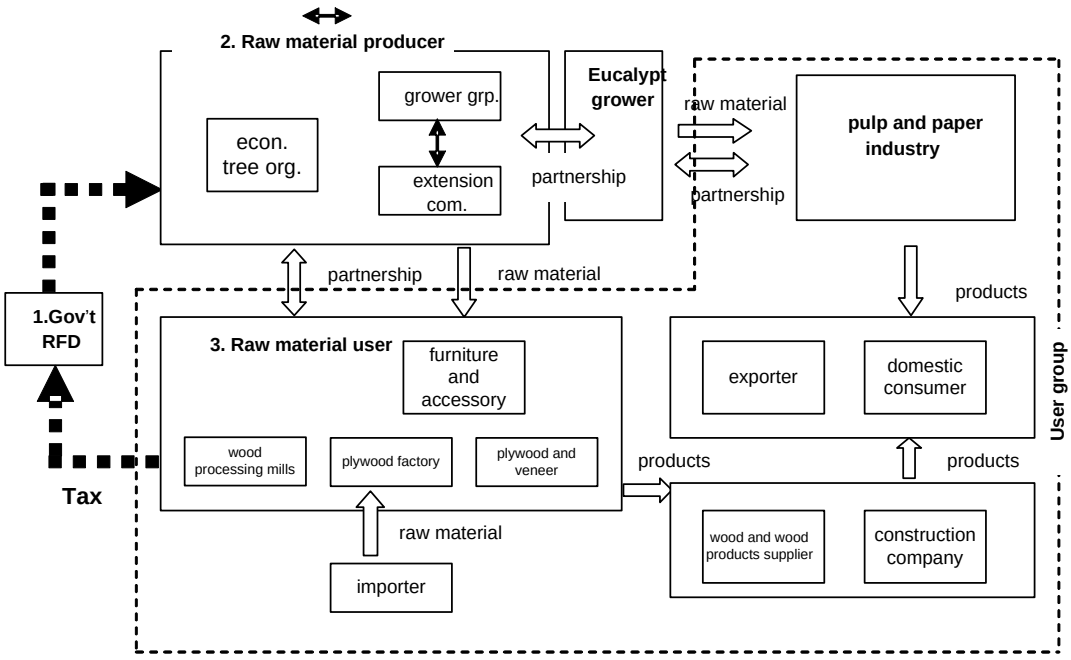


Figure 1. The interaction between organization development tax circulation and economic tree budget

The RFD has a very important role to play in the establishment of the Economic Tree Organization and the registration of the Economic Tree Extension Company. The primary requirements for the Economic Tree Extension Company are to provide personnel with demonstrated expertise in successful reforestation and to facilitate the active involvement of wood industry group representatives as shareholders to guarantee markets for the wood produced.

The strategic plan for economically viable tree extension

The strategic plan for economically viable tree extension involves: setting up the Economic Tree Organization; registration of the extension company; setting up the economic tree grower group in the promotion zone; supporting economic tree planting in the promotion zone; production of high quality seedlings; and supporting tending, thinning and wood harvesting in the promotion zone. The plan has a lead up period of ten years, with substantial revenue from the project commencing in subsequent years.

Table 15. Strategic plan for promoting economically viable tree growing

Objectives	Strategies	Duration	Responsible agency
Improving efficiency of the government administration and management system in doing timber business	Setting up the Economic Tree Organization	1 year (yrs 1-2)	RFD
Increase efficiency of economic tree business	Registration of the Economic Tree Extension Company	2 years (yrs 1-2)	RFD
Generating support by people in the establishment of economic tree planting promotion zones	Setting up economic tree grower groups in the promotion zone	10 years (yrs 1-10)	RFD
Increasing timber production in the promotion zone	Supporting economic tree growing in the promotion zone	10 years (yrs 2-11)	RFD Economic Tree Organization and private company
Increasing productivity of economic tree plantations in the promotion zone	Production of high quality seedlings	10 years (yrs 1-10)	RFD and related agencies
Improving growth rate and timber quality of the plantation in the promotion zone	Tending and thinning operations for the economic tree plantations	10 years (yrs 1-10)	RFD Company and members
Obtaining sustainable economic return from economic tree plantations	Timber harvesting in the promotion zone and replanting	1 year (yr 11)	RFD and related agencies

Source: Master Plan for Economically Viable Tree Planting 2006.

For the implementation of the above strategic plan, the government will have to prepare a budget of 170,131,444,500 baht over the life of the project. It is expected to gain break-even point after 15 years of project implementation.

Table 16. Summary of implementation plan and budget unit harvesting

Activities	Implementing year	Baht
Project promotion to targeted group (by television programme)	1	1,800,000
Produce promotion to mass media via 1-minute television slots	1	300,000
Establish Economic Tree Organization	1-2	-
Register the economic tree growing extension company	1-2	844,500
Preparation and audit of economic tree growing control in the extension zone	1-10	3,500,000
Budget allocation for economic tree planting fund	1-11	56,250,000,000
Seedling production for four main species	2-10	13,500,000,000
Budget allocation for tending activities	3-11	93,175,000,000
Plantation stocking inventory and thinning contract in six-year-old plantations	7-11	5,625,000,000
Harvesting trees in 10-year-old plantations in the promotion zone	11	1,575,000,000
Total		**170,131,444,500**

Source: Master Plan for Economically Viable Tree Planting 2006.

Project impact

The national economically viable tree growing extension project will have positive economic, social and environmental impacts.

Positive economic impact will occur from the commencement year of the project, through project expenditure of up to 100,000 million baht per year. When the rotation age is reached, the value of harvested wood production will be almost 50,000 million baht.

Positive social impact will result through employment by the establishment of the Economic Tree Organization and the Economic Tree Extension Company. This will increase demand for up to 6,000 or more personnel with qualifications of at least a B.Sc. degree, providing stimulus for a new generation of graduates. Reforestation extension and seedling production will need an annual budget of over 1,000 million baht and this will absorb over 500,000 labourers in rural employment.

The project will generate a positive environmental impact through the successful reforestation in the targeted area of approximately 1.5 million rai per year or over the whole project of approximately 15 million rai. The extension zone will have a consistent overarching principle of conservation of land use through the linkage of planted areas between the sub-catchments, providing a distribution of trees and vegetation cover in each sub-district and province. This will increase water absorption down to the lower soil level and reduce the surface run off. In addition, it will be a source of carbon sequestration to help mitigate the green house effect and global warming. It may also result in deriving some benefit from trade in carbon credits.

6. INDUSTRY AND MARKETS

Supply and demand

Roundwood

There is not enough information on the production of roundwood in Thailand. What is known is (a) the small volume of illegally harvested confiscated logs that are sold to the domestic market by FIO and (b) the limited volumes of licensed harvesting of dying or decaying trees in natural forests or areas cleared for road construction and other infrastructure. The total volume of these items used to be about 30,000 m^3 but it has now declined to a few thousand cubic metres (Table 17).

Table 17. Recorded industrial roundwood production, 2000-2004

	Licensed felling of reserved species	Felling of nonreserved species	Confiscated timber	Total
	1,000 m^3			
2000	5.5	20.6	20.2	46.4
2001	4.5	17.1	19.8	41.2
2002	5.8	10.2	17.6	33.6
2003	2.7	10.7	6.8	20.2
2004	1.2	0.5	0.5	2.1

Source: RFD 2004b.

Lacking reliable data, the wood supply situation on the basis of industrial production by sector and typical conversion factors of processing by type of raw material were estimated. The timber from natural forest is only a small fraction of the total roundwood supply, which was estimated to be about 19.2 million m^3 in 2003 (Table 18). About 98 percent of the total industrial roundwood supply comes from plantations, 10.6 million m^3 being eucalyptus and 8.2 million m^3 rubberwood.

The largest consumer of roundwood is the pulp and paper industry accounting for 54 percent of the total, followed by the sawmilling industry (30 percent). Particleboard is estimated to absorb 11 percent as it mainly relies on sawmill residues (Table 18). MDF production is based on small-sized logs that are debarked before processing while many particleboard mills also use unbarked raw material.

Table 18. Industrial roundwood supply and consumption, 2003

End-use sector	Source of supply					
	Natural forest	Plantation wood			Imported roundwood	Total
		FIO	Private eucalyptus	Private rubberwood		
	1,000 m^3 (r)					
Roundwood						
-Sawmilling	20.2	3.9	-	5,348.4	356.1	5,728.6
-Veneer & plywood	-	-	53.3	851.6	4.8	909.8
-Particleboard & fibreboard	-	-	190.3	2,000.0	-	2,190.3
-Pulp & paper	-	-	10,332.9	-	19.1	10,351.1
Total	**20.2**	**3.9**	**10,576.2**	**8,200.0**	**380.3**	**19,179.5**

Source: Partly based on RFD/KU 2005.

Wood products

In spite of its limited economic forest resource base, Thailand has been able to develop an extensive forest industry, which can meet most of the country's domestic demand (Table 20). The largest segments of the industry in terms of production volume are pulp and paper, sawmilling and particleboard. With the exception of plywood and veneer, the Thai industry is a significant export supplier in all products in spite of rapidly increasing domestic demand. A particular element in the Thai domestic timber demand is the consumption of the export-oriented furniture industry, which is a major consumer of sawnwood, particleboard and MDF.

Imports play a key role in meeting the demand for sawnwood and plywood. About two-thirds of sawnwood consumption is imported, mostly for building construction as this end-use market cannot be served by rubberwood, the mainstay of the Thai sawmilling industry. The limited supply of good quality large-sized logs is a constraint for the plywood industry and therefore imports account for 28 percent of the apparent consumption. Log imports (Table 19) have been necessary for keeping the country's present plywood production level as the domestic raw material, rubberwood, is only applicable in mills which have been designed for this purpose.

Table 19. Wood residue balance, 2003

	Domestic logs	Imported logs	Total
	1,000 m^3 (r)		
Wood residue availability			
♦Sawmilling			
- rubberwood (65%)	3,476.5	-	3,476.5
- other (55%)	10.2	178.0	188.2
Sub-total	3,486.7	178.0	3,664.7
♦Plywood and veneer	452.5	2.4	454.9
Total availability	**3,939.2**	**180.4**	**4,119.6**
Wood residue utilization			
Particleboard and fibreboard production†			3,120.0
Energy generation			999.6
Total utilization	**3,393.2**	**180.4**	**4,119.6**

†Assuming that all other residues not used for panel production are used for energy generation

Table 20. Production and apparent consumption of wood products, 2004

Product	Production	Imports	Exports	Consumption
	1,000 m^3 (s)			
Sawnwood†	2,700-3,000	1,835	1,789	2,746-3,046
Veneer & plywood	455	176	4	627
Fibreboard	914	25	638	301
Particleboard	2,600	11	867	1,744
Woodpulp†	900	457	167	1,190
Paper & board‡	3,600	560	819	3,341

†FAO (2005c) reports sawnwood production as 288,000 m^3 which is likely to cover only part of the domestic supply (probably based on non-planted timber).
‡1,000 tonnes

Source: Sawnwood production: based on interview data; imports and exports, Table 20.

In particleboard and fibreboard the country is a large export supplier as 33 percent and 70 percent of the total production is exported, respectively. Thailand also exports 23 percent of its paper production and 19 percent of pulp output. About 1 million tonnes of virgin fibre is

imported either in the form of wood pulp or paper and board to complement the local supply.

Thailand has no systematic data collection on the production and trade of sawnwood and processed products. So sawnwood production had to be estimated. This is a major gap in the current information system that should be addressed.

Foreign trade

Imports

The total trade balance of wood-based products (including pulp and paper) is positive amounting to about 3.4 million m^3 in wood raw material equivalent (WRME) (Table 21). Apart from reconstituted panels, Thailand is also a significant exporter of wood chips (about 800,000 m^3/yr), which are mainly produced in eucalyptus plantations. In all other wood products the country is a net importer.

The sawnwood trade is strategically important as it accounts for 90 percent of the total wood product imports and 54 percent of total exports. This must be reviewed in the context of log imports. The combined imports were in the 1980s relatively stable (about 1 million m^3 WRME per year). The imports expanded exponentially as a result of the logging ban, first in logs but later on in sawnwood. Sawnwood production based on imported logs gradually declined and was less competitive compared to imported sawnwood. The peak level of combined imports was reached in 1994 (7.1 million m^3 WRME). In the second half of the 1990s imports declined, partly due to the economic crisis and associated decline in demand. However, in 1999 the import started showing an upward trend which has been continuing since then, driven by the strong demand in the building construction sector. At the same time log imports have gradually declined and they represented no more than about 10 percent of the total combined imports in 2004.

Table 21. Recorded trade in wood and wood products in Thailand, 2004

Products	Imports	Exports	Balance
	1,000 m^3		
Logs (wood in the rough)	381	1	-380
- coniferous	0	0	0
- non-coniferous	381	1	-380
- wood chips	-	800	+800
Sawnwood	1,835	1,789	-46
- coniferous	50	-	-50
- non-coniferous	1,785	1,789	+4
Veneer sheets	35	2	-33
Plywood	141	2	-139
Fibreboard	25	638	+613
Particleboard	1	867	+858
Sub-total	**2,047**	**3,298**	**+1,254**
Wood pulp†	457	167	-290
Paper & board†	560	819	+259
Total wood raw material Equivalent (WRME)‡			**+3,371**

†1,000 tonnes
‡Different conversion factors have been used for imported coniferous and non-coniferous sawnwood and exported rubberwood sawnwood.

Source: UN/FAO/EUROSTAT/ITTO Thailand's Forest sector Questionnaire.

The recorded imports do not cover all the trade in sawnwood. There is unrecorded trade with neighbouring countries, particularly Myanmar and Laos. It has two components: legal imports of small amounts for non-commercial purposes and illegal imports. The volume of these flows is not known. There is a general perception that illegal imports have been declining drastically compared to what they used to be. However, unrecorded and unlicensed importation by private individuals has become in some border towns a lucrative semi-organized activity. It takes place not only in the form of sawnwood but also in pre-cut furniture components or rough pieces of squared wood to be processed into value-added products in Thailand.

The main sources of recorded log imports are Malaysia and Myanmar (130,000-140,000 m^3 each) (Table 22). Two-thirds of sawnwood imports come also from Malaysia, mainly various dipterocarp species. The next largest source is Laos (mainly planted teak) while the balance is mostly temperate hardwoods from North America and Europe. Malaysia is also the main source of supply for veneer sheets and plywood, which are also imported from China and Indonesia. The Chinese imports are representing tough competition for traditional suppliers and their market share has been increasing rapidly.

The imports from the neighbouring countries represent distinctive patterns (Table 23). Thailand imports logs mainly from Myanmar, as the share of sawnwood is still only a quarter of the combined volume (on WRME basis). With Laos the situation is reversed: most imports are sawnwood and log trade is limited. The imports of sawnwood from Cambodia are marginal (2004) but there is some furniture trade with Laos and Myanmar. Differences in labour costs make furniture trade profitable and it is likely to expand in the future.

Imports of wood products are influenced by tariff escalation. While logs have only a nominal import duty of 1 percent, in further processed products the duty can be up to 30 percent. Also wood-based panel imports face a duty of 2 or 12.5 percent.

Table 22. Sources of recorded imports of wood and wood products in Thailand, 2004

Source	Logs	Sawnwood	Veneer sheets	Plywood	Particle board	Fibreboard
	1,000 m^3					
China	1	9	4	29	3	1
Indonesia		41	1	24	1	
Laos	27	290	5			
Malaysia	142	1,187	16	83	1	8
Myanmar	127	18	1	3		
Asia total[†]	**298**	**1,556**	**28**	**141**	**6**	**11**
Oceania	63	93	-	-	5	10
Africa	13	2	-	-	-	-
Europe	4	25	5	-	-	3
North America	3	106	1	-	-	-
Total	**381**	**1,835**	**35**	**141**	**11**	**25**

[†]Including all Asian countries

Source: UN/FAO/EUROSTAT/ITTO Thailand's Forest Sector Questionnaire.

Table 23. Recorded imports from neighbouring countries in 2004

Products	Myanmar	Laos	Cambodia
	1,000 m^3		
Logs	127,419	27,400	-
Sawnwood	18,208	290,158	5,260
Parquet panels	-	670	-
Furniture (pieces)	62,416	33,906	27,777

Source: RFD 2004b.

Exports

Thailand's main export items in wood products are sawnwood, particleboard and fibreboard. In the 1990s the sawnwood trade was rather stable varying within a relatively small range of 45,000 to 96,000 m^3 per year. In 1999 the situation started to change and volumes increased rapidly reaching the level 1.6 million m^3 in 2002. There was a dip in 2003 when the exports dropped to 1.1 million m^3 but picked up again in 2004 reaching 1.8 million m^3. This quite phenomenal development is a result of the growing interest of Chinese furniture producers to procure sawn rubberwood from Thailand. About 97 percent of the total sawnwood exports in 2004 were rubberwood and China represented 80 percent of this. Most of the balance (15 percent of the total) was rubberwood exports to Peninsular Malaysia which has been suffering from shortage of sawn rubberwood.

Discrepancies between trading partners have also been noted in export data. Sawnwood imports from Thailand to China (including Hong Kong) were 510,000 m^3 less than the reported Thai exports; in the case of Malaysia the same difference was 130,000 m^3. A possible explanation is that these volumes could have been re-exported directly from the importing countries. However, there is clearly a need to investigate why such significant differences exist; i.e. a third of the reported Thai sawnwood exports is not recorded in the importing countries.

Particleboard exports have been increasing since 2002 as the volume more than doubled in 2002-2004. The entire exports go the regional market in Asia where the principal outlets have been the Republic of Korea, China, Malaysia and Taiwan POC (Table 24).

Table 24. Exports of particleboard and fibreboard, 2004

Market	Particleboard	Fibreboard
	- % -	
Korea Rep.	29.8	8.2
China, incl. Hong Kong	26.4	31.6
Malaysia	17.0	9.7
Taiwan POC	12.3	12.8
Viet Nam	5.9	7.5
Indonesia	3.9	1.3
Korea Dem. Rep.	2.7	-
Philippines	0.6	1.4
Other Asia	0.7	14.3
Other	0.7	27.5
Total	**100.0**	**100.0**
Total 1,000 m^3	**869.6**	**705.5**

Source: RFD 2004b.

In fibreboard the export growth has been limited, i.e. during the last few years only 3-4 percent per year. The market distribution is different from particleboard as the sub-regional market has less importance. China is the biggest outlet absorbing almost a third of the total followed by Taiwan POC, Malaysia, the Republic of Korea and Viet Nam. The main export

item is MDF which many countries have low or no capacity in. Fibreboard is exported in significant quantities also to the Gulf States.

In further processed products, a significant item is parquet panels, the exports of which reached about 7,800 m^3 in 2004. This was 41 percent less than in 2000 indicating difficulties in competing internationally with laminated MDF flooring. The main markets for this niche product were Japan, Germany, the US, Denmark and Italy.

Thailand is one of the world leaders in rubberwood furniture exports and the trade expanded rapidly in the 1990s. The value of exports in 2004 was about US$562.8 million. The small bamboo and rattan furniture market has expanded vigorously, 30-40 percent per year during the last two years.

The main export market for Thai rubberwood furniture is the US (50 percent of the total), where most of the volume is sold on the basis of price and the quality is at the low end, but still strictly controlled. The second largest outlet is Japan (26 percent) which represents the high end of the furniture market. The quality requirements, particularly for finishing are significantly higher in Japan than in the US. Europe takes another 12 percent of the Thai exports. All the markets are highly competitive, being supplied by traditional rubberwood furniture exporters (Malaysia and Indonesia) as well as new suppliers (particularly China and Viet Nam, often based on imported Thai rubberwood). The sawn rubberwood exports are partly in the same hands as furniture exports as the larger companies are all integrated. There have been calls for restricting sawnwood exports to ensure competitiveness of the Thai furniture markets that buy their raw material in the open market.

Wood industries

Overview

According to industrial statistics, there are about 2,500 establishments in the wood-based industries of which two-thirds are furniture producers (Table 25). They employ about 260,000 people representing 11.2 percent of the total manufacturing industries. The sector paid US$560 million in wages and salaries, or US$2,150 per employee on average. The wood-based sector generated a value-added of US$1.5 billion in 2000 or about 8 percent of the total manufacturing. The figure could presently be at least about US$1.8-2.0 billion taking into account the output growth during the last five years. In 2000 the value-added by employee was US$5,724 or 70 percent of the average in all manufacturing. However, the wood-based sector's wages and salaries were less than 80 percent of the average in all industries. These indicators illustrate the significant direct economic contribution of the wood-based sector even though they do not take account of the indirect upstream and downstream effects.

Table 25. Economic indicators of forest-based industries, 2000

Indicator	Wood and wood processing	Furniture†	Pulp and paper and converted products	Total
Number of establishments	797	1,671	487	2,555
- Employment	52,482	163,182	44,260	259,924
- Employee remuneration US$mill.	99.8	321.0	138.4	558.8
- Remuneration/ employee US$.	1,902	1,967	3,126.9	2,149.8
Value added US$mill	222.8	703.1	561.9	1,487.8
Value added % of gross output	24.9	29.2	22.8	--
Value added/employee US$	4,246	4,309	12,695	5,724
Relative indicators (total manufacturing = 100)				
- Employee remuneration	69	72	114	78
- Value-added/ employee	51	52	154	69
Share of total manufacturing				
- Employment	2.3	7.0	1.9	11.2
- Value-added	1.2	3.7	2.9	7.8

†Furniture and manufacturing n.e.c.

Source: Based on data of the National Statistical Office (www.nso.go.th)

The industrial statistics do not include the smallest scale operators. According to another source in 2004, there were reported to be 242 sawmills and 5,318 woodworking plants, half of which were in the Bangkok area. The wood-based panel sector has 22 particleboard mills, four hardboard units and seven MDF plants.

In addition there were about 3,000 timber traders, lumberyards and similar operations and another 3,800 wood product retailers selling timber and timber products. The formal timber trade can be estimated to generate an additional employment of 30,000. The informal operations are likely to be even more important as a source of employment.

Of total employment of the wood and wood-processing sector (260,000), 45 percent are women. The industry relies heavily on unskilled labour (only 39 percent). This is a cause of concern and is reflected in low labour productivity and problems of quality control, and, in general, inefficiency in the organization of work. Particularly, maintenance teams are often overstaffed while production operations are better organized.

Sawmilling and panel industries

The sawmilling industry has been under a major restructuring as most of the teak and mixed hardwood mills have been closed down due to lack of raw material. Most of the rubberwood sawmills are medium sized but there are also large units with up to 25 band saws. These mills are typically owned by furniture companies and produce mainly for the corporate needs. Mills are labour intensive and the layout is simply tailored to the rapid throughput of rubber logs which cannot be stocked for longer periods. Most of the equipment is locally made and tends to be old. The recovery rates vary depending on the level of technology and production management, varying in the range of 20 to 35 percent. Operators appear to be skilled and have only had on-the-job training. The processing system is targeted at maximizing the throughput rather than at high conversion rates, or even less at optimization of the potential log yield.

The common length of rubberwood logs in the South is 1 m, while in the East it is 1.3 to 1.5 m. Logs with diameter below 15 cm (in length of 1.8 m) are used by MDF mills while particleboard mills buy branches and thinner logs with minimum diameter of 5 cm and minimum length of 0.9 m, using them with bark. The largest logs (diameter of over 30 cm) are destined for plywood production if there is a mill within economic distance, while the balance goes to sawmilling. As the logs are short (from 1 to 1.3 m), the number of pieces to be handled is huge even in medium-sized mills, which lowers labour productivity. Furthermore, possibilities to produce longer lengths for applications where finger-jointing is not desirable are limited.

In the action plan for the rubberwood industry developed with ITTO support (Bassili 2000), it was highlighted that the value of sawn rubberwood could be increased through a higher quality of sawing, operating at lower speeds to select the best open face, sawing for grade and not only for volume. Other possible measures included grading of logs and applying smaller diameters in the headsaw to increase recovery rate. The quality of saw-doctoring is still weak in many mills. These conclusions are still valid.

As much of the sawnwood market is integrated with furniture production, there has been little incentive to introduce grading systems. Some mills selling to third parties are applying their own classification system but there is no national standard like in the case of Malaysia.

The Thai plywood industry has been declining due to the changing raw material situation, especially after 1989 when the logging ban was introduced and practically no local logs were available. It is estimated that there are still about ten veneer and plywood mills in the country. Many rely on the use of rubberwood as a raw material for core veneer. The largest unit is state-owned Thai Plywood. The future development of the industry will depend on the availability of large-sized logs from plantations, including eucalyptus.

The reconstituted wood-based panel industry has many modern world-class production units which are relatively well organized as regards the processing and handling of products. Woodyard operations could however often benefit from improvements. Of the four hardboard mills, three utilize eucalyptus as raw material but in the case of MDF only one mill has been relying on eucalyptus. All the others use rubberwood. Most particleboard mills use rubberwood and only some smaller mills use either eucalyptus or bagasse. There are several investment projects either decided or in the planning stage and at least two new MDF lines are going to be installed by 2008. They represent a challenge to the already tight wood supply situation.

Markets for wood and wood products

Roundwood

The current market mechanism for plantation-based roundwood is characterized by the strong demand-pull in the southern and central parts of the country where most of the processing industry is located. The sellers are small producers and they are poorly organized. In logs the number of buyers is large and competition between them is intensive while in small-sized logs there are fewer buyers and they are well organized. The roundwood prices (Table 26) appear to be rather uniform over species. The sawlog market is limited to teak thinning logs which are sold at higher prices depending on the size.

Intermediaries play a significant role. Large buyers have small logging operations mainly to be fully informed about the real costs of harvesting. No systematic information is available on intermediaries and contractors but field data suggested that their margins can be significant, typically 10 to 30 percent of the sales price. Large buyers appear to have a

policy to favour larger contractors capable of implementing medium-term commitments in their deliveries. Contractor management and wood supply/purchasing planning appear to be based on simple principles of quick, short-term deliveries rather than long-term win-win partnership.

Wood purchasing is either based on area (rai) or weight. Both are inaccurate measures for wood trade. In area-based deals the buyer makes a lump sum offer for the standing stock and the seller does not necessarily have a sufficient idea of the potential value of his crop. Weight-based deals are not measured in purchasing and they are estimated by truckloads. In weight-based deals the log size and log quality are not considered and the sole criterion is minimum diameter. The intermediary, often the contractor, carries out log sorting and makes the profit when selling different assortments to the industry, this time by actual weight. In rubberwood, weight-based measures work better than in eucalyptus as logs cannot be left at the site for more than a couple of days while in eucalyptus drying on the ground takes place quite quickly and influences the owner's revenue if paid by weight. Storing is not however practiced widely due to the tight supply situation.

Table 26. Examples of roundwood prices in April-May 2006

Type of wood	Location	Price US$/m^3	Comment
Stumpage - Rubberwood	 Rayong Prachinburi Southern Region	 21.40-35.70 25.00-41.70 20.00-50.00	THB10,000-100,000/rai depending on the quality of growing stock
- Eucalyptus	Nakon Ratchasima Northeast	 12.50-23.75 40.00	Low end for small logs, high end for large logs
- Teak thinning logs	Northeast	50.00-112.50	Low end for first thinning, high end for second thinning
Delivered mill price - Rubberwood	 Rayong Southern Province	 33.25 40.00-47.50	Low end for less than 6" and high end for more than 8" in diameter
- Eucalyptus	Prachinburi	30.00-40.00	
- Teak planted, from Laos	Chiang Mai	125.00-150.00	

The current market mechanism is far from being balanced and is strongly influenced by the small number of pulpwood buyers. They have also contract farming schemes where they provide seedlings, technical advice and other support in the establishment stage while committing themselves to buy the output at "market prices". Many farmers living in their properties have been reluctant to embark on this type of contract being unsure about their true benefits. Strong demand for wood is contributing to this cautiousness for long-term commitments from the owner's side. The formula fits better for absentee landowners who do not have the capacity to manage their plantations.

The delivered mill wood costs of pulpwood vary in the range of US$30 to 40 which is significantly higher than in Indonesia but lower than in Europe or North America. In addition, for foreign pulp mill investment, Thailand is not among the most attractive locations due to lack of reliable information on the raw material source and the weak organization of the timber market.

Wood products

The distribution channels of sawnwood and panel products are relatively well established. All the bigger consumption centres have their own private lumberyards that compete with

each other in selling to builders and professionals. In addition, small wood shops both in urban and rural areas sell to individual customers, often providing resawing, drying, and even cabinet or furniture making services to buyers.

Typical current prices in the Thai timber markets (Table 27) indicate that the market is highly competitive and relies on imported natural timbers in the sawnwood trade. The imported sawnwood goes largely to the building and construction sector, which cannot be supplied by domestic timbers. There is a heavy emphasis on hardwoods for traditional reasons and the consumption of coniferous species is marginal. Only radiata pine is used in small quantities for utility purposes. In the construction sector there is potential to substitute high-value hardwoods with lower-cost good quality softwoods which would result in economic gains for the users. Strong teak tradition has however kept such transition marginal.

Of particular social importance as a timber use is the strong small-scale enterprise sector dominated by the carving industry which is suffering from the non-availability of Thai teak. An associated market segment is the traditional hand-made furniture industry which thrives in the North serving both the domestic market and high-valued export market niches, especially in Europe. Imported teak is expensive and prices are high. Planted Thai teak still comes in small dimensions which limits its use for large-sized objects.

About 75 percent of plywood consumption is in building construction (including doorskins), 20 percent in furniture and 5 percent for packing crates, advertising and other uses. Particleboard, MDF and hardboard are mainly used for furniture and cabinet making, laminated flooring, etc. The use in construction for ceilings, fittings, interior walling etc. is less important.

Table 27. Wood product prices, April-May 2006

Product	Location	Price US$/m^3	Comment
Sawnwood			
- rubberwood	Bangkok	211	Furniture grade
- rubberwood	- " -	132	Utility grade
- Thai mixed hardwoods	- " -	268	
- Malaysia hardwoods	- " -	357	
- meranti	Chiang Mai	483	
- radiata pine	Bangkok	210	
- teak natural (from Myanmar)	Chiang Mai	7,500	25 x 300 mm, KD
- teak planted (from Laos)	Chiang Mai	720	Green
Plywood			
- teak veneered	Chiang Mai	713	
- utility grade hardwood	Bangkok	365	
- construction grade (from China)	Chiang Mai	295	
Recycled wood			
	Bangkok	44	Sales price for residues
	Bangkok	90	Purchase price

The Thai panel market is competitive due to the presence of many strong domestic suppliers and some imports. A large share of sales goes directly business-to-business and the balance is marketed through the same distribution channels as sawnwood. There are established practices for grading of the product unlike in sawnwood.

Furniture industry

Thailand's wooden furniture industry can be divided into solid rubberwood furniture (60 percent), hardwood furniture (10 percent) and furniture made of wood panels such as particleboard, MDF and plywood, 90 percent of which are also made of rubberwood. Thus, the industry is almost entirely dependent on rubberwood for its raw material. There are about 1,700 wooden furniture factories in the country (cf. Table 25) which produce for the domestic and export markets; 200 are considered larger factories employing over 200 people. However, the bulk of the exports is created by about 10 to 15 large-scale enterprises which have been able to develop reliable regular export trade with the US, Japanese and European customers.

The manufacturing of rubberwood furniture and parts has been the fastest-growing sub-sector within the furniture industry accounting for the bulk of production for exports. The exports are still growing but at a significantly slower pace than in the past. The Thai exporters are presently under a heavy competitive pressure from Chinese producers with ample supply of low-cost labour and who import a significant part of their raw material from Thailand. Addressing this issue through export regulation based on the protection of domestic industries does not, however, appear feasible.

In the larger companies equipment and process layout are, by and large, up to the international standard. Lines are not yet fully automated, as the labour force is still available at reasonable cost. Working conditions are generally good in large- and medium-scale mills. Internal transportation of intermediate goods is sometimes haphazard. Surface finishing skills are good and can meet, if needed, the highest Japanese standards. Investment needs are mostly in improving the bottleneck equipment. Management system standards are also high allowing easy monitoring of production and costs. The situation in the small mills is different as plants suffer from problems with inadequate layout, weak maintenance standard and only a basic level of planning and quality control (Bassili 2000).

Certification as a tool to meet market requirements

Certification has been one of the key market drivers in several major importing countries over the last five years. Large buyers of wood, wood products and furniture have been under pressure to issue their own responsible purchasing policies and many traditional customers of Thai exports in North America and Europe are now taking brisk action in this field. Furthermore, many governments have turned to using public procurement policies as a tool to give preference to products which are legally and sustainably produced. These policies are now in place in Japan, Denmark, Belgium, France, the UK and New Zealand while many others like Germany and Spain are in the process of finalizing similar provisions. The ultimate objective is to phase out illegally produced timber from the market and give a boost to implementation of forest certification as a tool to ensure that products come from sustainably managed legal sources.

The Thai export industry has already taken some action to respond to these market demands which are likely to be more pronounced, particularly when China as an in-transit further processing country will have to meet the same requirements. Household furniture markets have still been quite immune to these market pressures but in garden furniture certification is almost a basic requirement in many markets. Some Thai companies have obtained an FSC chain-of-custody (COC) certificate and a few company-owned plantations have also been certified. With the relatively well-developed management systems in place, larger companies have no problems to obtain a COC certificate but certifying the wood source has proved to be problematic.

Only a few rubberwood plantations in the whole world have been certified under the FSC and practically all of them are large-scale plantations which are rare in the Thai context. Rubber is planted in 99 percent of cases for latex not for timber. The whole latex management concept has little to do with sustainable forest management. The other issue is plantation sustainability as rubber may be replaced by other crops when trees reach maturity. Similar issues are likely to arise also with eucalyptus when grown in agroforestry systems in paddy fields, which is typical in the Central and Northeast regions.

Fuelwood and charcoal

Since 1990 no reliable surveys have been carried out on the consumption of woodfuels in Thailand. It was then estimated that the household sector uses about 20 million tonnes of fuelwood and charcoal annually. According to the National Energy Agency (NEA 1991), the per capita annual consumption in rural households in 1990 was 0.410 m^3 (97.1 kg).

FSMP (1993) estimated that 92 percent of the wood energy is used in the countryside and 1 percent and 7 percent in Bangkok and other urban centres, respectively. In rural areas, the per capita demand of fuelwood has been estimated at 0.6-0.7 m^3 (or significantly higher than the NEA estimate). The rural population of Thailand (47 million) may be estimated to consume 28-33 million m^3 of woodfuel annually.

The FSMP further estimated that only a fifth of fuelwood supply (6 to 7 million m^3) comes from forests and the balance from other sources, such as tree crops and agroforestry (37 percent) and non-forestry crops (18 percent). It was also estimated that the supply potential could be in the range of 40 million m^3.

Since the early 1990s the energy situation has radically changed. The average monthly expenditure of household on woodfuels was then 16.4 percent of the total expenditure on all fuels but in 2000 the figure had dropped to 3.9 percent. However, in absolute terms, the consumption levels have slightly increased (Table 28). Calculated based on energy equivalent, it has been estimated that fuelwood represents 60 percent of the total wood-based energy while the balance is charcoal. It is noteworthy that the consumption of other biomass energy sources has increased faster and bagasse is now a more important source of energy than charcoal. There are also some imports of charcoal which amounted to 34,000 tonnes in 2004 or 62 percent more than in 2000.

There are many industries that still depend on wood-based fuels as their main source of energy. These industries (agro-processing, food processing, brick making, pottery and ceramic production, etc.) have experienced shortages of energy, which has led to calls for government investment in fuelwood plantations. This is paradoxical when it is considered that the Thai forest resources could easily produce more than double the current demand.

Table 28. Biomass-based energy consumption, 1999-2003

Type of energy	1999	2003	Change
	Ktoe		%
Fuelwood	3,279	3,493	+4.6
Charcoal	2,218	2,357	+6.3
Paddy husks	733	996	+35.9
Bagasse	2,092	2,905	+38.9
Total biomass	**8,322**	**9,751**	**+17.2**
Share of total national energy consumption %	17.7	17.3	-

Source: Thailand Energy Situation 2003.

Several measures to improve the situation have been taken including the development of fuel briquettes, promotion of agricultural residue stoves, improved cooking stoves and improved charcoal kilns (Panunumpa 2004). The REX project demonstrated that charcoal production can be highly profitable, particularly as alcatra (wood vinegar) from eucalyptus can generate more revenue than charcoal. The problem to develop this activity is the availability of labour and the limited number of investors who are interested in production which needs relatively low investment and can largely be based on non-saleable plantation output.

7. NON-WOOD RESOURCES AND THEIR UTILIZATION

Bamboo

Bamboo resources

Thailand has 12 genera and about 60 species of bamboo. The main species are *Thyrsostachy siamensis*, *Banbusa blumena*, *B. polyumorpha*, *B. mana*, *B. arundiancea*, *Dendrocalamus hamiltonii*, *D. giganteus*, and *D. brandisi.* Bamboos constitute the natural undergrowth in deciduous forests. The latest survey (1998) showed that bamboo covers a total area of 800,000 hectares. On the basis of an average annual yield of 0.1 tonne/hectare green weight, Thailand's potential annual production of bamboo from natural sources is about 500,000 tonnes.

Bamboo is used extensively as a substitute for timber in construction, scaffolding, ladders, bridges, fences, and in pulp making. Numerous articles such as baskets, furniture, toys, musical instruments, sticks, beds, fans, fishing rods and traps, water containers, etc. are also made from bamboo. About 80 percent of the bamboo production in Thailand goes to non-industrial uses and about 20 percent has gone to the pulp industry but the latter use has been declining. The pulp industry's preference is to use eucalyptus if available in the market.

The importance of bamboo as a source of employment is largely unrecognized. Harvesting licenses are being issued without any resource assessment. The free removal of bamboo from forests has created shortage of bamboo which for artisans and SMEs is a more serious constraint than shortage of money. Because of inaccessibility and lack of management, the overall productivity of bamboo in Thailand is annually about 8 percent that of Japan. Since stump cleaning costs about US$0.5/clump, farmers do no cleaning of stump sites. They use edible salt to change the pH of the soil which they feel gives more bamboo shoots. No other treatment is generally done.

Bamboo plantations

To meet the demand for bamboo, farmers are also planting it on a large scale. There is an extensive niche market available among artisans in Thailand. Bamboo plantation requires one-time investment and utilization possibilities are diverse. Since the bamboo shoots are edible, the farmers use them for their own consumption whereas bamboo poles are sold in the domestic market. They are easy to transport and maintain and no insecticide is required. Farmers harvest about 20-40 percent of the culms from clumps every year. They do not require any permission for cutting in their own plantations or any transport permit.

About 10,700 hectares of plantations have been established under the extension programme of the Department of Agricultural Extension. Because of attractive yield, commercial plantations for edible shoots with *D. asper* are extending rapidly. According to an estimate, average bamboo production from 1980 to 1990 was 49.2 million culms or about 147,600 tonnes.

With the plantation of bamboo, farmers start getting income from the third year and therefore, in many villages each family has a bamboo plantation. Such a plantation can yield an average annual net revenue of US$875/hectare.

Due to its fast growth, easy propagation, soil binding property and short maturity period, bamboo is being recognized as an ideal species for afforestation, soil conservation and social forestry programmes in many parts of the world. Bamboo, as an agricultural

intercrop, can increase ground flora and the allied silvicultural and agricultural operations can significantly improve the nutrient status of the soil.

Bamboo is widely used as food and for many medicinal uses. Compared to tree crops, bamboo can produce an economic return in a relatively short period of time. Furthermore, while trees grown for timber can only be harvested once, a bamboo clump can be harvested many times over. Bamboo is a multipurpose species and its processing is labour intensive providing opportunities for diverse employment. It may also be converted to value-added products. It is thus more useful that most multipurpose woody species. Therefore, developing bamboo cultivation is of great significance not only to promote economic gains but also to improve rural livelihood and economy as well as to increase farmers' income.

Bamboo is facing competition with rubber and eucalyptus. The competitive selling prices of 6 m eucalyptus and bamboo poles are US$2.50 and US$0.62/piece, respectively. Only four bamboo culms from one clump can give the same revenue as obtained by cutting a eucalyptus tree. One bamboo clump provides several culms annually while eucalyptus needs three to four years to produce a valuable pole. Farmers harvest bamboo clumps twice a year producing on average 20 culms per clump per year. The bamboo market is very attractive. It has a high potential for domestic trade and export. In the best producing areas, local intermediaries buy bamboo for export to Taiwan POC and other markets. Bamboo is virtually a standing bank account for farmers, which requires limited management effort.

Rattan

Regulatory framework

In the past all rattan species grew in the natural forest, except *Calamus caesius* in the 14 southern provinces. Rattan was originally a non-reserved forest product and no permission was required for harvesting which led to serious overexploitation. The situation was changed through a Royal Decree in 1987 which specified rattan as a reserved forest product. To gather rattan in the forest, permission is required from the RFD and royalty is also to be paid. Thailand has banned the harvesting of rattan in natural forest and its export in raw form.

Rattan plantations

The rapid reduction of rattan in natural forests prompted Thailand and other cane producing countries to establish plantations, as an obvious strategy for sustainable development of rattan resources. Rattan gardens can also serve as a safety net for farmers. When they need cash, they can harvest some stems for sale. Selection of suitable species of rattan for plantation depends upon the targeted use:

- Large cane: *Calamus mananu, C. blumei, C. peregrinus, C. latifoluis, C. rudentum.*
- Small cane: *Calamus caesuis, C. pandanosmus, C. myrianthus,* Wai Ka Nun, Wai Sanim, *Daenomorops sabut, C. palustris, C. rudentum,* Wai Sai Kai, *C. javensis* and Wai Kao.
- Edible shoots: *Calamus viminalis, C. siamensis* and *C. tenuis*.

Rattan has been planted under different programmes in Thailand but on a small scale (Suthisrisilapa and Phuriyakrn 2002). In 1998, the total area of rattan plantations was 210 hectares mainly with five species (*Calamus longisetus, C. latifoluis, C. palustris, C. caesius* and *C. rudentum*). By 2003, 512 hectares were planted under the Royal Initiatives Programme (1997-2003) and 6,216 hectares were planted under the supervision of the RFD's Reforestation Division. Rattan plantations are found in Northern, Northeastern,

Central and Southern regions. Their objectives were to serve as food banks and to produce value-added forest products as well as to protect the reforestation area from encroachment. In state lands a total of 4,914 hectares have been planted. Private investment in rattan has not advanced because of lack of know-how, the long rotation period (about ten years), and lack of systematic promotion.

At the age of 14 years rattan has a maximum growth rate of 0.49 m/year followed by the ages of 11 years and 12 years with the growth rate at 0.46 m and 0.45 m, respectively. The appropriate age for the utilization of rattan is 12 years, depending upon the species, site conditions, etc. The rotation of the larger stem rattan is about 15 years while the small stem rattan is grown in 7-10 years.

Thailand is also producing rattan shoots for food. In fact, Thailand and Laos are competitors in the trade. The development of management for shoots of three rattan species *C. viminalis, C. siamensis* and *C. tenuis*, has been quite successful and rather sophisticated in Thailand. The shoot can be harvested as early as 1-1.5 years and full production is achieved at 6 years. The shoot production can last more than 20 years. It is estimated that an income of US$1,562/hectare can be obtained, which is a high return compared with other crops.

Utilization

The role of rattan in the rural economy is important in many areas as local people largely depend on rattan for their living. Rattan is used by the local people to produce various utensils for their own use. Cash income can also be obtained from rattan handicrafts. In many areas, local people use rattan shoots for food and also for medicine. The decline of rattan resources has significantly affected the rural economy in many areas.

More than 200 rattan furniture factories are found in Thailand but most of them are small household manufacturers. Only three factories are large and can export their products. Due to shortages of local supply, rattan is also imported from other countries such as Malaysia, Indonesia, Laos, Cambodia, Philippines, Myanmar and India and but the volume is decreasing each year. Rattan furniture is one of the important export items of Thailand with the main markets in France, Germany, UK, the US, Japan and New Zealand.

Rattan and rattan products have an export value US$0.8 to 2.2 million annually, while the value of imports has varied up to US$0.5 million (RFD 2004b). During recent years, due to decline of raw material supply, the export value from rattan has declined considerably (Sombrun 2004).

Other non-wood forest products

Non-wood forest products (NWFPs) have high economic potential and therefore, they should often be raised as crops so that people do not have to depend on wild plants. At least five million people are assumed to be critically dependent on NWFPs as they provide material needs, cash income and employment at levels which are significant to the rural and national economies. In addition, their extraction usually represents a non-exhaustive sustainable form of tropical forest utilization.

Besides bamboo and rattan, many edible and medicinal plants, seeds, mushrooms, honey, wax, lac and resin etc. belong to NWFPs. But their significance in the rural and national economies has been little appreciated. Yet they can play a key role in alleviating rural poverty, as they offer the poor the means to increase both their food production and their incomes.

Traditionally used medicinal plants in Thailand are *Rauwolfia serpentine, Gloriosa superba, Cassia augustifolis, Amomum hrevanh, Dioscorea* spp, *Derris elliptical, Hydrocarpus anthelmintica, Calophucllum inophylum* and *Stemona tuberosa.* More than 500 species of edible plants are found in Thailand. About 85 percent of major natural forest-based food products such as bamboo shoots, mushrooms and vegetable are consumed by households. There are no estimates available on the amount of food collected from natural forests. Mushrooms have been cultivated during the last 30 years and annual production is about 70,000 tonnes valued at US$27.5 million.

Bee products

Honey and other bee products were mostly collected from the wild until 1980 when beekeeping expanded on a large scale in Thailand. Beekeeping is a highly useful activity for farmers. It provides easily harvestable, transportable and marketable products. It generates employment to the keepers and the traders and export earnings to the nation. Above all, it enhances pollination of crops and trees.

Lac

Lac is the resinous secretion of several species of tiny plants the most common species being *Laccifer lacca*. In Thailand, it is collected from the branches of numerous tree species of mixed and deciduous natural forests. Thailand is the second largest lac producing country after India. Lac production is done only in the North and Northeast regions. The North accounts for about 80-90 percent of total production. The average stick lac production in the last ten years has been 7,365 tonnes. Production was highest in the mid-1980s. The most productive species is Samanea, which under normal conditions can produce annually as much as 2,440 kg/hectare. *Swietenia macrophylla* yields only 250 kg/hectare.

There were more than 50,000 families involved in stick lac production in the early 1990s when there were 20 licensed lac processing plants in operation. The production volume has gone down since then.

Resin

Resin has been tapped from pine trees for centuries in Thailand. Oleoresin and gums are obtained from the two native pine species, *Pinus kesiya* and *P. merkusii.* Only *P. merkusii* is being tapped economically, yielding about 2-5 kg/tree/year while kesiya pine yields only about 1 kg/tree/year. The total area of pine forests, allowing for mixed stands, is about 216,200 hectares located mainly in the North and Northeast. The estimated potential annual production from these trees is about 12,700 tonnes. Tapping can be done all year round. In the last ten years, on average, 285 tonnes of resin were produced annually and from these, 205 tonnes of resin and 52 tonnes of turpentine were obtained. At present, the net value realized from resin and turpentine is about US$0.5/kg. The pine resin industry has the potential to create 25,000 jobs in rural areas.

Tapping dipterocarp trees is also an important source of income for many forest dwellers but the extent of the activity is not known.

Ecotourism

Tourism in Thailand is well developed and diverse, having prospered since it was promoted in the Fourth National Economic and Social Development Plan of 1977-1981. The number of foreign tourists arriving in the country has leveled at around 10 million as growth in recent years has been slow (NSO 2004). Together with domestic tourism, this represents a

huge market potential for nature-based tourism in the country. Indeed tourism in Thailand today focuses on archaeological, historical and cultural sites, protected areas and resort areas. There are sometimes overlaps between these areas.

Tourism is spreading its influence increasingly to rural areas, particularly on the coastal zone, around national parks and in the North. Its activities in interior rural areas are typical in upper watersheds where most remaining forests are found.

The tourism market has been changing toward more differentiation among types of clients and services demanded. These different type have different impacts and trade-offs regarding the environment and natural resources. Coastal zones are examples where one type of tourism can undermine the potential for other types (e.g. ecotourism). The demands of the tourism industry are not necessarily compatible with the values of local residents. In landscape management, maintenance of aesthetic values tends to have a low priority as there is no legal basis for compensation of damages incurred by activities or investments dependent on them (Thomas 2005).

The government's policy on tourism for the past few years has been gearing towards more and more sustainable tourism development with emphasis on community participation, safety and non-exploitation. One of the fastest growing sectors of the tourism industry is that of ecotourism whereby tourists visit undisturbed natural areas to experience spectacular scenery and view wildlife. The term ecotourism has been widely used to describe a form of tourism in natural areas that is based on the knowledge about and responsibility towards the ecological system of the area. At present, the number of real ecotourism visitors is still minimal. Mostly, these tourists are included in other types of tourism such as nature-based tourism, agro-tourism, cultural and historical tourism and health tourism. Most of such tourism areas are in natural parks and specific historical-cultural areas.

The national parks system in Thailand has growing importance to the ecotourism industry. With most parks easily accessible by road, there exists excellent potential to expand the number of visitors who use them. In the case of the Mekong River, the nature-based tourism potential particularly applies to Northeast Thailand, an area that the Thailand Tourism Authority (TAT) has identified as a priority for tourism development. The national parks in close proximity to the Mekong River include sites of prehistoric, archaeological and natural significance. As the Mekong region increases in its exposure and popularity, these parks are expected to experience greater numbers of visitors.

The composition of tourism attractions is being diversified. About two-thirds of all domestic tourists are engaged in varying forms of ecotourism (nature study, exploring, camping, trekking, rafting, etc), compared with slightly more than a quarter of foreign tourists (TISTR 1997). In general, Thai visitors are reputed to be more interested in sightseeing and picnicking, while foreigners appear to focus more attention on nature.

The potential of the protected areas in ecotourism has been recognized in Thailand. Ecotourism projects have been implemented since the late 1990s in several national parks and wildlife sanctuaries. These projects have also tried to involve local people (Pragtong 1999). However, both social and ecological problems tend to appear when increasing numbers of people visit protected areas; shortage of staff, for example, makes control difficult (National Park Office 2004, cited in Hares 2006). Nevertheless, tourism, together with the availability of economic assistance, has encouraged the enlargement of protected areas (Sato 2003). The presence of local people can add value to the ecotourism products through the cultural aspects of ethnic groups. In particular, the traditional cultures of ethnic groups are expected to play an increasingly important role in tourism development.

To develop such cultural or rural tourism as a complementary line of ecotourism requires that there are adequate services of accommodation and catering in place. One-day tours in villages tend to have more impacts and less income for local people than visits which involve overnight stays, trekking in the surrounding area, etc.

The problems or obstacles to developing ecotourism include the following:

A danger that the policy outlined above will not be implemented in full resulting in erosion of cultural and natural resources in protected areas and elsewhere, to the extent that biodiversity, heritage, scenic values, and eventually their tourism potential, are lost. The challenge is how to resolve conflicts between conserving Thailand's natural and cultural resources while at the same time promoting tourism based upon those resources. Heritage conservation and social impact management are also recognized as one of the key action areas of the Greater Mekong tourism development strategy (ADB 2005).

There is a tendency to focus management strategies on satisfying tourist demands rather than safeguarding the resources upon which potential is based.

- Although there are about 2,000 authorized tour operators and over 10,000 authorized guides, they are mostly geared to catering for the needs of general tourism. In particular, there is a shortage of well-informed guides who have a sound basic appreciation of nature and wilderness
- Ill-behaved tourists who deposit litter, pollute protected areas, show disrespect for local cultural values, act in an anti-social manner and resist attempts by tour operators or guides to moderate their behaviour
- Community participation in protected area management is virtually non-existent. At present local communities derive little benefit from nearby protected areas
- Mistrust and unwillingness to cooperate still exists among DNP personal, local administrative bodies, local communities and local entrepreneurs

8. FORESTRY INSTITUTIONS, POLICY AND LEGISLATION

Institutions

Royal Forest Department

In the years preceding the creation of the RFD, the forests were under the control of local chiefs. They allowed concessionaires to exploit exploitation. The RFD was therefore founded by King Rama V in 1896 to consolidate the exploitation of these forests. Three years after the RFD was established, ownership and control of all forests were transferred from the feudal chiefs to the government. During the same period, several laws, rules, and regulations on forest protection were promulgated. More forestry laws were passed from the 1910 up to the early 1960s, as new forest protection problems arose.

The administration of the Kingdom's forest resource has been regulatory in nature. This has been because a single agency, the RFD, is supposed to take responsibility over more than half of the Kingdom's land area. Because its administrative resources were limited, it had to rely on concessionaires for most of the forest management and utilization functions, such as logging, natural regeneration, tree planting, and protection. Forests which were not under concessions had to be protected by controlling their utilization and by punitive actions, which had been defined in the forestry laws, such as the Forest Act and the National Reserved Forest Act.

The RFD expanded its administrative functions over the years, as technical aspects of forestry development were assigned to it. Its organizational structure evolved in response to changes in administrative requirements and conditions, such as the ban on logging concessions and to the instruction to give priority to forest conservation. It was reorganized under the Ministry of Agriculture and Cooperatives (MOAC), and has five technical bureaus, seven administrative divisions, and 21 regional offices (Figure 2). Local forestry administration is being handled through 75 provincial forestry offices and 524 district forest offices.

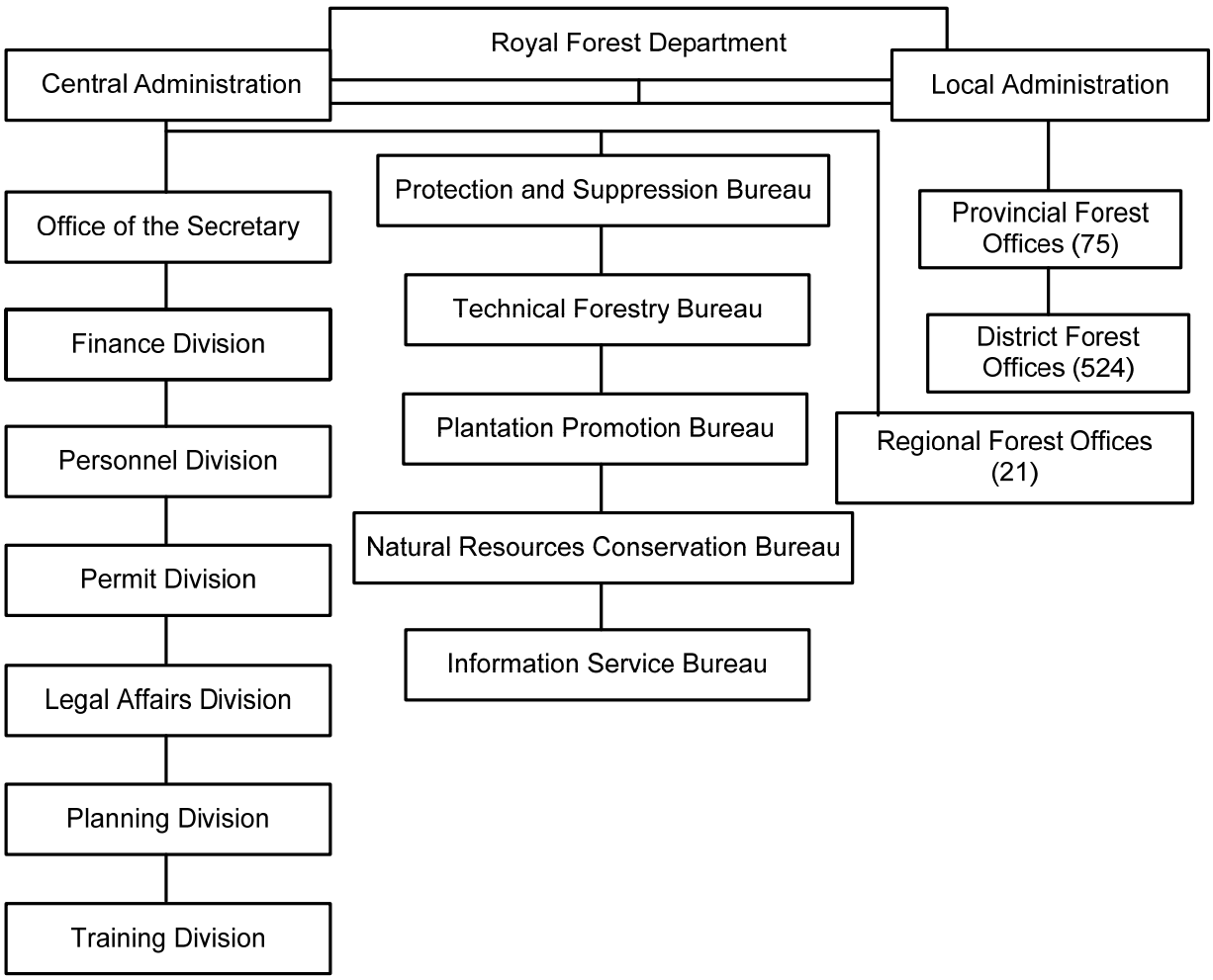


Figure 2. Organizational chart of the Royal Forest Department

Forest territories are administered by:

- A network of national parks, wildlife reserves, and other protected areas, which are directly linked to the Natural Resources Conservation Bureau. The field forestry offices address territories outside the protected areas
- The other RFD technical bureaus are not concerned with administering territories. They provide different technical services: forest protection (by the Protection and Suppression Bureau); resource inventory, silviculture, forest management, and technology development (the Technical Forest Bureau); promotion of forest plantation activities of development partners (the Plantation Promotion Bureau); and management information systems (the Information Service Bureau)

Ministry of Agriculture and Cooperatives

Formerly, a Minister and Deputy Ministers shared in overseeing the ministry and its component organizations. One of the Deputy Ministers handled forest affairs. The administrative supervision over the entire ministry is undertaken by a Permanent Secretary. In addition to the RFD, the following agencies and state enterprises of the ministry have existing or potential roles related to forestry:

Other departments and offices

- Department of Agriculture. This department provides technical assistance to farmers. It addresses forestry development, in the sense that some tree crops can be treated both as agricultural and as forestry crops
- Department of Agricultural Extension. The extension function of this office extends to the promotion of tree crops, some of which can produce wood. In the future, as the demand expands, it can lend assistance to the RFD. Duplication of extension work by several agencies will not be efficient, and may be confusing to the farmer, especially if conflicting messages are given. Forestry development will certainly benefit if the RFD's extension efforts are augmented by those of this office and of NGOs
- Cooperative Promotion Department. This office is not presently active in forestry, but it may play a future role in granting official recognition to forest communities and farmers' groups
- Land Development Department. A division of this department is responsible for land-use planning. Several categories of forestry land uses are included in this land-use related work. Conflicting results often arose in its land-use interpretation and mensuration with those by the RFD Remote Sensing Office. More collaboration between these two offices is needed
- Agricultural Land Reform Office. Large parts of state forest land are being declassified and turned over to this office for distribution to farmers. In the future, it will have to expand its collaboration with the RFD to include deforested state land that is to be leased to farmers as part of a forestry land reform programme
- Office of Agricultural Economics. This office collects statistics and conducts economic studies concerning agricultural crops. Forestry information is also included among the concerns of this office

State enterprises

- Office of the Rubber Replanting Aid Fund. This office has been instrumental in quickly expanding the areas devoted to rubber plantation to about 12 million rai. Like the FIO, this office has a potential role in channeling funds to farmers for the establishment of forest plantations. In practice, this office has already extended its operations to include non-rubber tree crops
- Marketing Organization for Farmers. This office is a possible alternative to the FIO in developing markets for forest products
- It is clear from the many possible ways of supplying needed services to farmers, that the MOAC has to carefully plan its evolution and that of its organizations, for maximum effectiveness and efficiency in resource utilization

Government's reorganization

To improve its bureaucracy, the Thai government has introduced structural and administrative reform that has resulted in the establishment of 21 ministries. It has been effective since 2 October 2002. The Ministry of Natural Resources and Environment, (MNRE), a newly established ministry, has been given responsibility for natural resources and the environment.

Regarding the aforementioned restructuring, the RFD was divided into three departments. The original RFD was attached to the MOAC. The two newly established National Park, Wildlife, and Plant Conservation Department and the Marine and Coastal Resources Department were attached to the newly set up MNRE. The RFD takes responsibility for forest areas outside protected areas. Later a Royal Decree, effective on 1 October 2003 was

issued. The RFD with its new structure (Figure 3) was transferred to be under supervision of the MNRE (Figure 4). So far, responsibility, personnel allocation and other matters are under process of mutual consideration of the two departments.

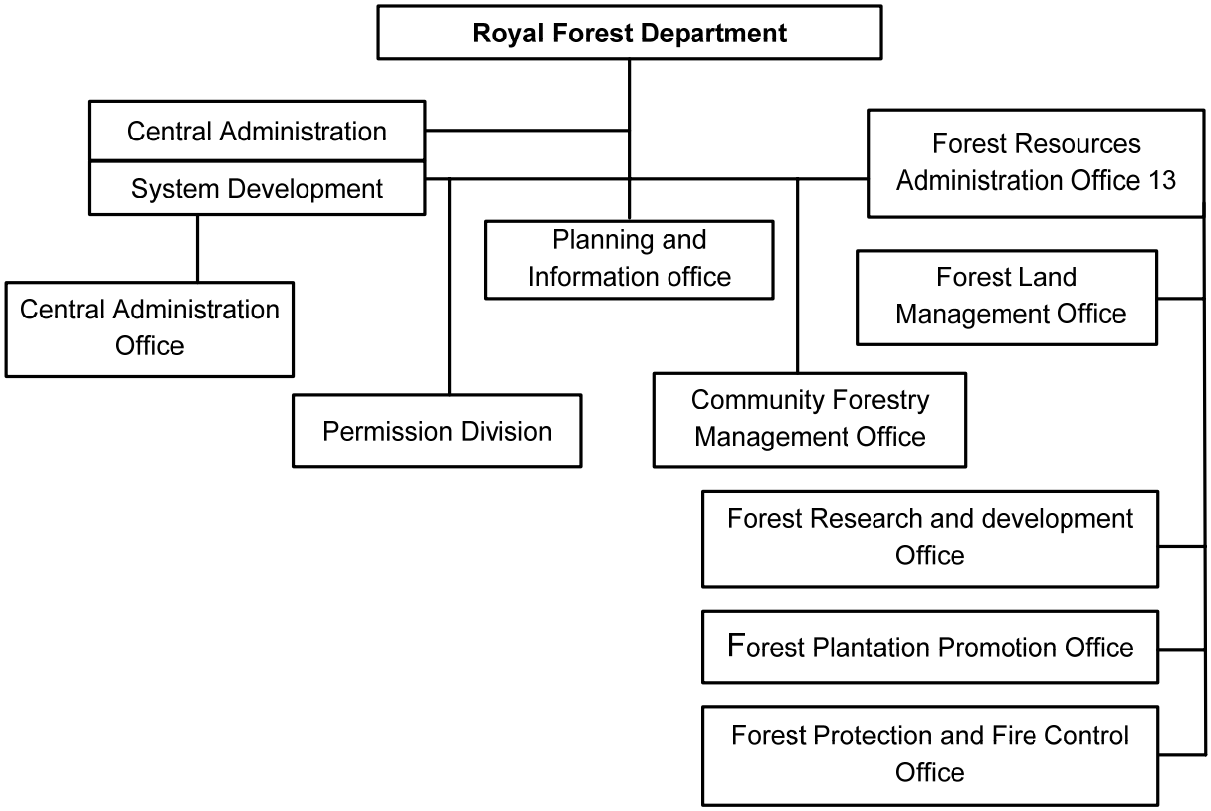


Figure 3. Government reorganization of the Royal Forest Department

Department of National Parks, Wildlife and Plant Conservation

This department administers forest resources, wildlife and plants in protected areas in parallel with the rehabilitation of degraded forests. Tasks include conservation, promotion, strategy application and public awareness building.

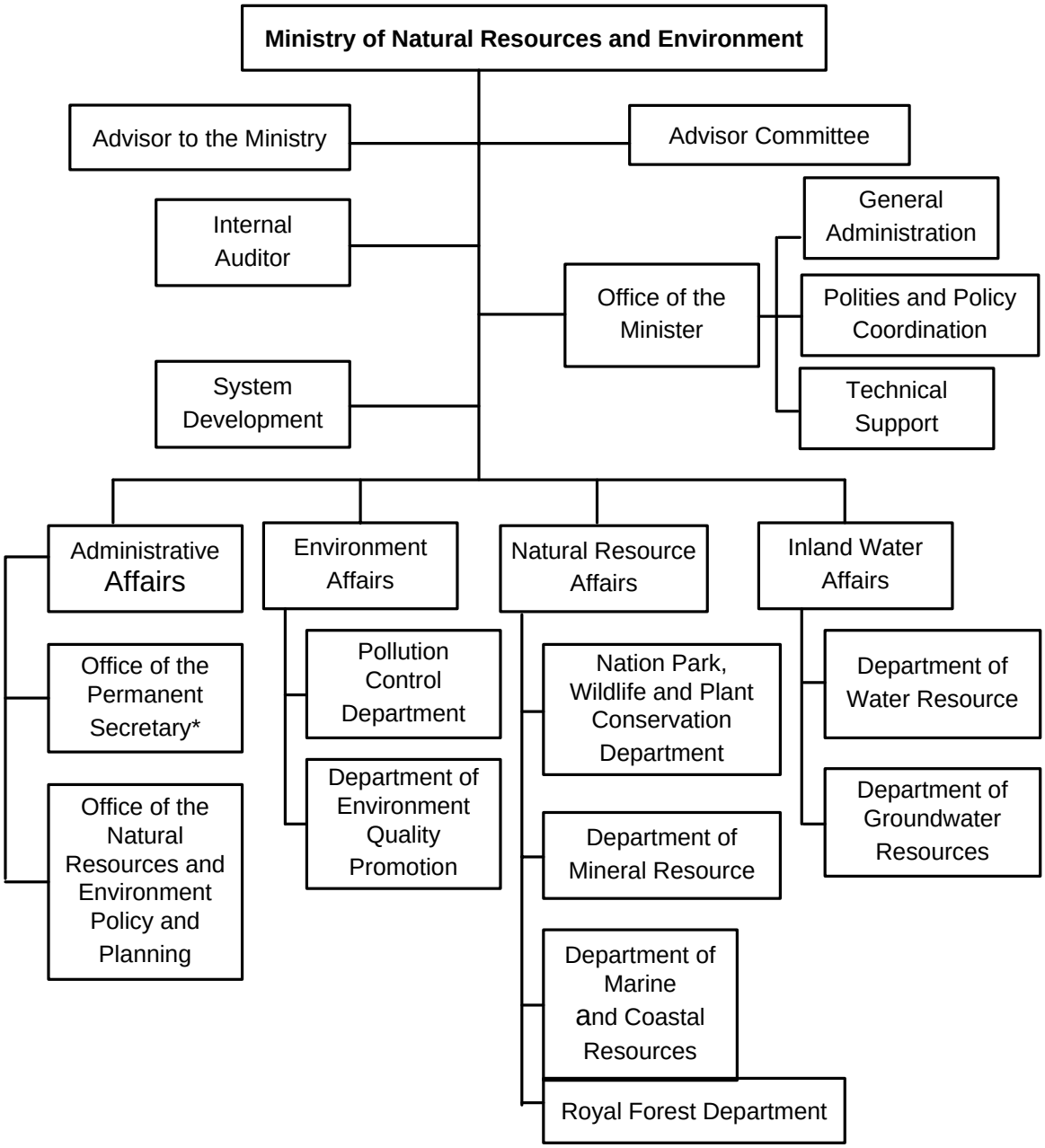
Resource protection and community participation: These sustain the ecological systems, the environment and biological diversity required to maintain productive watersheds, wildlife, nutrition sources, public recreational and tourism sites. Details are listed below:

1. Conserve, protect, oversee and preserve forests, wildlife, and plants to be productive and balance ecological systems with sustainable and maximum benefit from natural resource utilization.
2. Rehabilitate and solve problem of degraded natural resources and environment. This includes control of fires and other catastrophes, which destroy the forest ecology.
3. Control, supervise, oversee and prevent forest encroachment and deterioration. Enforce the law against committing wrongful acts under the law relating to National Forest Reserves, National Parks, Wildlife Conservation and Protection and other related law.
4. Study, conduct research and develop the conservation, administrative management and rehabilitation of forest resources, wildlife, plants and biological diversity.

5. Develop and set measures and standards for the conservation, administrative management and use of forest resources and wildlife.
6. Provide services on forestry information and transfer of forest technology.
7. Perform other functions as required by law to be the authority and duty of the Office of the Permanent Secretary of Natural Resources and Environment or as designated by the Ministry or the Cabinet

Ministry of Natural Resources and Environment

At present, the Ministry has one Minister with one Permanent Secretary and four Deputy Permanent Secretaries. The Minister oversees the ministry and its component organizations. Administrative supervision over the entire ministry is undertaken by a Permanent Secretary and four Deputy Permanent Secretaries who have responsibilities for Environment Affairs, Natural Resources Affairs, Inland Water Affairs, and Administrative Affairs.



Remark: State Enterprises include:

- Zoological Park Organization
- Water Management Organization
- Botanical Garden Organization
- Forest Industry Organization
- Thai Plywood CO., LTD

*The Office of PNRE (Provincial Natural Resources and Environment) is attached to the Office of Permanent Secretary.

- Forestry Division
  - protection
  - permission
- Environment Division
- Natural Water Division
  - ground water
  - water resource
- General Administration section

Figure 4. Government organization of the Ministry of Natural Resources and Environment

State enterprises

Forest Industry Organization. The FIO is an autonomous state corporation, which was set up to harvest teak forest and to process wood into usable forms. Subsequently, the FIO became widely involved in reforestation, in accordance with the government policy to reforest logged-over areas. In its reforestation programme, the FIO applies the forest village system, which employs landless villagers as workers and allows them to interplant agricultural crops between the rows of newly established tree. The FIO forest village system covers 53 forest areas (24 in the north, 16 in the northeast, and 13 in the central and southern regions).

The FIO will have to evolve into an organization responsible for providing support to forest-based communities and villagers in forest management. Depending on the decision of the government, the expanded functions of the FIO may include supplying quality planting materials, piloting new processes for raising source plants for NWFPs, channeling funds for tree planting, and developing markets and providing market guarantees for forest products.

Thai Plywood Company Limited. This state enterprise was established to make more efficient use of forest resources by producing plywood and other wood products of a standard quality. This company is already partly owned by the private sector; eventually, it will have to become a fully private enterprise according to the government's privatization policy.

Other ministries and agencies

In addition to the MNRE, the following ministries and agencies have existing and potential roles related to forestry:

Ministry of Interior. The day-to-day operations of the provincial and district forest offices of the RFD previously were supervised by the Office of Governor of the different provinces, which are under the Ministry of Interior's Local Administration Department. The Forest Police Unit of the Police Department assists the RFD in forest protection. Other offices under the Ministry of Interior that have to do with forestry include the Department of Town and Country Planning and Bangkok Metropolitan Administration for promoting and developing urban forestry; the Office of Accelerated Rural Development and the Community Development Department for providing support services to forest-based rural development; and the Department of Lands for registering lands and installing policies and measures to discourage land speculation.

Ministry of Industry and Ministry of Commerce. These two ministries are responsible for promoting forest-based industries and products. Forest-based industries are under the responsibility of the Department of Industrial Promotion. Forest-based products are under the responsibility of the Department of Internal Trade, Department of Foreign Trade, Department of Commercial Registration, and Department of Business Economics.

Ministry of Education. Schools play an important role not only including forestry in their different curricula, but also by providing extension services through their outreach programmes. A number of universities offer curricular programmes and courses in forestry and forestry-related disciplines. Foremost of these is the Faculty of Forestry of Kasetsart University.

National Economic and Social Development Board (NESDB). This prepares the National Economic and Social Development Plan on a five-year cycle, formulates policies to implement the plan, and assesses the Kingdom's development programmes and projects to

ensure consistency with the plan. The forestry master planning process will have to be coordinated with the planning work of this agency.

Apart from the NESDB, there is National Economic and Social Advisory Council (NESAC) established with regard to Article 89 of the Constitution of the Kingdom of Thailand. NESAC is composed of 99 members and divided into two sections.

1. Economic Sector with 50 members
    - Agriculture sub-sector with 16 members
    - Industry sub-sector with 16 members
    - Service sub-sector with 16 members
2. Social Sector with 49 members
    - Social sub-sector with 49 members
    - Nature-based sub-sector with 49 members
    - Knowledge sub-sector with 49 members

Non-government and secular organization and schools

There are many types of organization within the NGO community whose activities have a bearing on the concerns of the forestry sector. Some NGOs concern themselves with environmental matters, some with local development, and others with both. Of special concern to future development of the forestry sector are the NGOs, secular organizations, and schools which can operate at the grassroots level to support forest-based rural development.

Private forest-based industry organizations

Organizations concerned with the forest-based industry are typically associations of industry operators including those for furniture-making, sawmilling, panel manufacturing, pulp and paper manufacturing, and rubber wood product manufacturing. These associations keep a registry of their members, as well as statistics on product types, capacity, and actual production; conduct periodic assessment of the state and problems of their industry; and lobby for incentives and other support from the government.

National Forest Policy

Before 1985 forest policy was expressed primarily though subsequent pieces of legislation (Table 29). In the first phase forests were brought under state ownership and management. The legal status of the permanent forest estate was established either as protected areas or forest reserves. In the latter phase, concessions were given to private operators and the state-owned FIO which were subsequently cancelled when the logging ban was instituted.

As part of the policy implementation the institutional structure was built up and adjusted, and various government programmes were implemented. The evolution of the related legislation on land and promotion of agriculture also had impact on forest policy implementation (Table 29).

A Nation Forest Policy was drawn up and adopted by the cabinet in 1985 in an attempt to consolidate sectoral policy in the country and to place forestry within the context of overall national development (Box 5). The process of preparing the policy was thorough and detailed, with extensive public hearings and input. Reforestation and afforestation were seen as important strategies to supply future wood demand in the country. The private sector was to become involved in tree planting and, in addition to meeting domestic demand, export supply was also foreseen. The Policy identified the need for partnerships

between the public and (commercial) private sectors. Short-, medium- and long-term plans were mandated for development of forest lands and the forest industry. Forest laws and regulations were to be thoroughly reviewed and revised and the RFD was directed to encourage local community participation and to cooperate closely with the private sector. The Policy urged all components of government and society to collaborate with the RFD in defining and maintaining a forest resource base which can support the needs of society (Pragtong and Thomas 1990). However, the Policy was silent about the root causes of deforestation and poverty reduction in forest areas and it did not explicitly involve rural people.

Table 29. Key milestones of the Thai Forest Policy

Year	Policy measure
Mid-19th century	- Commercial forestry with exploitation of teak started and expanded with road networks under the partnerships of princely states and British foresters in Burma
1874	- Proclamation of the monarchy's legal ownership of all land
	- Royal order was issued to collect tax on export of timber
Early 1890s	- Legislation enacted to require government approval of any contracts between foreigners and northern lords prohibiting overlapping concessions
1896	
1897	- Establishment of the Royal Forest Department and termination of northern lords' control over forest resources
Late 1890s	- Royal Order was issued to regulate cutting of teak forests
1901	- Enactment of the Forest Protection Act, the Teak Tree Protection Act, a law prohibiting the unauthorized marketing of timber, a law outlawing teak extraction unless duties and royalties were paid
1913	
1932	- Land law for individual private ownership, which distinguished factual occupancy (without legal protection), and ownership (protected). This led to confusion and conflicts
1938	
1941	- The Forest Conservation Act was passed during the time of King Rama VI
	- Constitution.
	- Promulgation of the Act for the Protection and Reservation of Forests
	- Enactment of the Forest Act. Forest land was defined as "land which has not been acquired by any person under the land law. Farming on such land (Pah Sa-nguan) was legal only under authorization by the RFD. This created incentives for entrepreneurs and landless farmers to migrate into previously forested areas and establish claims
1945	
1954	- RFD is placed in the Ministry of Agriculture and Cooperatives
	- The Forest Act provided the most comprehensive coverage of forest law. It has been amended several times, but remains the basis of forest law. It regulates forestry-related activities on all land that is not under private ownership and prohibits the felling of certain species of trees whether they are on private or public lands
1960	
1961	
1962	- The end of the colonial teak era with termination of concessions to foreigners which were not renewed. Logging continued under the concession systems for national entrepreneurs
1964	
	- Enactment of the Land Code: anyone occupying forest land was eligible to receive a claim certificate (Nor Sor 1) which could then be upgraded to temporary occupation (Nor Sor 2), a certificate of utilization (Nor Sor 3) or a title deed (Nor Sor 4 or Chanode)
Late 1960s	
1974	
1975	- Enactment of Wildlife Reservation and Protection Act
	- Government Decree to establish that at least one half of land cover was permanently retained as public forest land
	- Enactment of the National Lands Act
1983	- Promulgation of the National Parks Act and establishment of the first National Park (Khao Yai)
1985	- Enactment of the National Forest Reserve Act which established gazettement of forest reserves with the intention of showing deforestation. A target was established to set aside 50 of the country's protected land areas as forest (already defined in the 1961 Government Decree)
1989	- Promotion of export-oriented cash agriculture which led to conversion of degraded concession areas into farm lands.
	- Declaration of amnesty for occupants of forest reserves

	- Enactment of the Agricultural Land Consolidation Act. - Approval of Plan for the Forest Village Program managed by the RFD - Enactment of the Agricultural Reform Act - Launching of the National Forest Land Allotment Project which allowed leasing of up to 2.4 ha for three years without tenurial provisions - Enactment of the Land Development Act - Adoption of National Forest Policy which reduced the forested area target to 40% (15% protected forest, 25% economic forest) - The RFD was authorized to classify about 20% of the public forest land (Pah Sa-nguan) as non-forested area - Resolution on Watershed and Land - The Five-year Resettlement Program (Khor Jor Kor) allowed commercial reforesting of degraded forest - Logging ban in natural forests
1991	- Eviction of occupants in Khor Jor Kor areas started but led to a moratorium
1992	- 7th National Economic and Social Development Plan changed the forest area target of 40% (25% protected forest, 15% economic forest) - Land reform.
1993	- Completion of the Forest Master Plan with a focus on development and community forestry
1994	- Amendment of the Wildlife Reservation and Protection Act
1997	- National Enhancement and Conservation of Environmental Quality Act - First draft of Community Forestry Bill - Tambon Administration Organization Act - The New Constitution was adopted with provisions for communal rights in the conservation and use of natural resources
2002	- The First Policy and Perspective Plan for Enhancement and Conservation of National Environmental Quality (1997-2016) included guidelines for institutions for the management of community forests, water, biodiversity and protection of watersheds, and the participation of people and communities. The forest cover target was set as 50% (30% conservation and 20% economic forest).
2005	- Separation of the DNP from the RFD. - Establishment of the Ministry of Natural Resources and Environment. - Adoption of the 9th NEDP with earlier forest cover targets for production forest (reforestation) - The draft Community Forestry Bill still discussed in Parliament in a joint Committee.

Sources: Sittichai et al. 2006; Rasmussen et al. 2000; Lynch and Tabott 1995.

The Forest Policy was not successful in addressing the root causes of deforestation (which are largely outside the sector), the growing imbalance in the demand and supply of industrial wood and woodfuels, illegal operation in forest harvesting, and the livelihoods of people who were living in and around forest areas, often without proper permit or tenure rights. As a result, the process of degradation has continued. In the late 1980s this led to so serious consequences that a logging ban in natural forest as a drastic measure was introduced. The focus of the policy shifted thereafter towards an emphasis on conservation which still continues as reflected in the forest area targets for production and conservation. The usefulness of such a target can, however, be questioned, particularly as it has not been achieved after more than 40 years of application (Box 5).

With the shift of the emphasis in the forest policy towards conservation, the production aspects have been set aside. Pragtong and Thomas (1990) raised three key issues in this respect which still remain to be clarified: (1) to what extent should economic forest emphasize natural forest management or intensive tree plantations:; (2) to what extent should public forest lands be privatized; (3) what scale of management units should be emphasized in private sector collaboration.

Box 5. Key Measures of the 1985 National Forest Policy

To achieve a long-term and coordinated national forest administration and development and for better understanding between state and private sectors, it is hereby declared as a national forestry policy that:

1) Long-term guidelines for forest management and development shall be established to maximize national social and economic benefits and national security, with sufficient measures provided for environmental protection. Emphasis shall be placed on harmonized utilization of forest resources and other natural resources.
2) Role and responsibility sharing among various government agencies and the private sector in forest management and development shall be promoted.
3) National forest administration shall be reorganized in line with the changing quality and quantity of forest resources and environment.
4) Forty percent of the country area shall be kept under forests. The forest area shall be divided as follows:
   - 4.1 Protected forest: 15 percent of the country area shall be kept as protection forests for nature conservation recreation and environmental quality protection.
   - 4.2 Production forest: 25 percent of the country area shall be designated as production forest to produce timber and other forest products.
5) Public and private sectors together shall develop and manage the forest area to achieve the objective of providing perpetual direct and indirect benefits to the country. Science and technology to increase the efficiency of agricultural production shall be enhanced to reduce the risk of agricultural production and to reduce the risk of the forest being destroyed to increase agricultural land.
6) The State shall establish a forest development plan as part of the natural resources development plan in the National Social and Economic Development plan to harmonize a mutual utilization action between forest resources and other natural resources.
7) Efficiency in timber production shall be increased through appropriate forest management techniques using both selection and clear cutting systems. In the clear cutting system, the cleared area shall be replanted immediately.
8) To conserve and protect the natural environment, the State shall accelerate the city planning process and designate specific area for forest residential, rural and agricultural areas in each province to prevent forest land encroachment.
9) The National Forest Policy Committee shall be established under the Forest Act for policy formulation, supervision and management of national forest resources.
10) The State shall undertake extension programmes to create public awareness, instill positive attitude, and proper skills on wise-use, as opposite to the negative effects of forest destruction and wasteful use of forest resources.
11) The State shall promote reforestation by the public and private sectors for domestic industrial consumption. Export of wood and wood products shall be encouraged. Community forestry such as reforestation on public land by the private sector, tree planting on marginal agricultural land and establishment of forest woodlots for household consumption shall also be promoted.
12) The State shall encourage integrated wood using and pulp and paper industries to realize the whole-tree utilization concept.
13) Amendment of forest acts shall be made to support efficient forest resource conservation and utilization.
14) Forest research shall be carried out in collaboration with universities and educational institutions concerned.
15) Wood energy as a substitute for fossil fuel shall be promoted through energy plantations.

16) Any land with the slope of 35 percent or more on an average shall be designated as forest land. No title deed, or land use certificate under the Land Acts shall be issued for the land of this category.
17) Explicit guidelines shall be established to deal with various forest degradation problems e.g. shifting agriculture, forest fires, forest clearing by the hill tribe minorities, etc. Measures on enforcement of law and penalty codes shall be specified and respective due processes shall be established. Measures shall also be devised to penalize corrupt government official and influential persons.
18) Incentive systems shall be established to promote reforestation by the private sector.
19) Human resource and rural settlement planning must be in conformity with national natural resource management and conservation plans.

The sixth NESDP specified 15 percent of the forests to be managed for conservation purposes and the remaining 25 percent to be managed for production. This was reversed by the seventh NESDP (1992-1996), which reacted to rapid forest degradation and the deterioration of the environment; forest areas for conservation were increased to 25 percent and 15 percent were allocated for timber production.

Box 6. Forest Cover Percentage as a Policy Goal

The forest cover percentage as the key sectoral goal was introduced in Thailand by a foreign forestry specialist more than 50 years ago. The country's forest policy has been formulated within the framework of achieving a target percentage of land area to be covered by forests. The original target was 50 percent and it has since then been revised (mostly downwards) time differentiating the areas reserved for production and protection forest.

In this way, the forest policy goal was reduced to one single indicator and setting of the targeted values for economic and protection forest was a reflection of value judgment. It was not based on scientific knowledge on how much forest would be needed in Thailand for maintenance of the environmental services of the country's forest, or on assessment of what should the forest's socio-economic contribution to the nation's development be. The forest cover percentage is a simple indicator which lends itself to straightforward monitoring if necessary information is available (as has been the case in Thailand). But, it has shortcomings: (a) it makes implicit assumption on the relationship of forest cover and the contribution of forests to environmental conservation and socio-economic development, and (b) the division between protection and economic forest is too simplified a vision on practical forest management.

The implicit assumption of the past policy is that biodiversity conservation is being addressed by setting aside a network of different categories of protected areas. As a result, little attention is being paid to addressing biodiversity conservation in other land categories, including other forests, TOF and other resources. However, as deforestation and forest degradation continue to erode the biodiversity base of the country, it is becoming increasing clear that the protected area system alone will not be sufficient to ensure that biodiversity is adequately conserved. Analyses in many countries have indicated that, while a well-designed network of protected areas provides the essential backbone of conservation needs, attention should also be paid to a conservation agenda outside the protected areas (Kanowski et al. 1999). The introduction of biodiversity conservation as an element of rehabilitation activities in production forests is one way of doing this.

Legislation

In the past, Thai people could exploit forest resources such as free-logging, clearing, and trading etc. There were no laws or regulation for controlling issues by the government. Logging for trading began in King Rama IV's reign in 1842 by English entrepreneurs. Logging and collection of non-wood products for household use could still carry on freely.

In 1834, the first written law was issued – the Royal Proclamation on Teak and other Timber Species S.E. 1236 (1874) – but it focused on duty collection and there were no criminal penalty provisions. The first law that provided criminal penalty provisions was the Forest Act, Teak Logs which Bear Defaced Hammer Marks (1896), and every law pertaining to forest resources and the environment enacted consequently had penalty provisions.

In 1896, in King Rama V's reign, the RFD was set up to handle forest resources. The Wildlife Conservation and Protection Act was enacted in 1960. In 2003, the Wildlife Conservation and Protection Act, 1990 abolished the Wildlife Conservation and Protection Act, 1960.

In 1961, the National Park Act was enacted to conserve natural resources and to maintain their natural status as well as to prevent destruction and transformation. In 1989, it was amended, in accordance with the logging concession ban issued in 1989.

In 1964, the National Forest Reserve Act, 1964 was enacted to protect forest resources. In the National Economic and Social Development Plan (volume 1), the Thai Government scheduled to reserve forest area by approximately 50 percent of the country area (250,000 km^2 or 156 million rai). Measures for protection and reservation or to establish the reserve forest area took too long and opened opportunities for deforestation. Later it was amended with some new provisions.

In 1992, the Forest Plantation Act 1992 was enacted to provide incentives to the private sector to run tree-plantation businesses.

In 2002, two new departments, the National Park, Wildlife and Plant Conservation Department and Marine and Coastal Resources Department were established. Some RFD officers, properties and functions were transferred to the new departments. The National Park, Wildlife and Plant Conservation Department's functions were to conserve, preserve, rehabilitate promote, and manage forest resources and to manage for sustainable usage.

In 2002, the Chain Saw Act was enacted with appropriate guidelines for chain saw control, an important deforestation instrument.

9. FORESTRY RESEARCH EDUCATION, TRAINING AND EXTENSION

Research

MNRE forest research units

Forest research in Thailand started ten years before the RFD was founded in order to develop knowledge on the extent of teak resources For the early decades research emphasized the management of natural forests. Four regional silvicultural research stations were established in 1952 and others were added subsequently. The Teak Improvement Centre in Lampang and the Pine Improvement Centre in Chiang Mai were established with Danish support. Four lac research stations were also established. Some collaborative research projects were carried out with the support of the Republic of Korea and Japan (REX project). All this has represented a major public sector investment in forest development.

Since the RFD Research Division was divided into two when the DNP was established, this created overlapping. There is no central body for forestry research which has resulted in some overlap and lack of coordination. Among the 19 current DNP research projects about five would probably better fall under the RFD which, on the other hand, has eight ongoing projects related to forest biodiversity.

Universities and other bodies

The Faculty of Forestry at Kasetsart University (KUFF) conducts research in important areas covering forest management, silviculture, forest biology, wood products, watersheds, and forest engineering. The Faculty is actively engaged in inter-disciplinary research and educational activities on critical issues of sustainable forest management and utilization. The research programme is carried out by individual faculty members through the Forest Research Centre (FRC), which is basically a National Centre for Research and Development in all the fields of forestry. The FRC has 67 staff members with 58 percent holding PhD degrees.

Areas of current and future research in the FRC include (a) community-based ecotourism, (b) forest fire policy analysis, (c) remote sensing and GIS applications in resource planning, (d) protected area system analysis and planning, (e) mechanical properties of rubberwood, (f) agroforestry, (g) highland reforestation, (h) biodiversity of forest insects, (i) watershed modeling, and (j) mangrove ecology and coastal zone management. KUFF has two research stations one in Chiang Mai and the other in the South.

Research funding is mainly through the Kasetsart University Research and Development Institute (KURDI). Funds for forestry research have been quite limited; at present forestry represents only 2 percent of the KU research budget.

Besides KUFF and the RFD, research on different aspects of forestry is also conducted by other state and private sector institutions. Chiang Mai University and the Farming Systems Research Institute of the Department of Agriculture conduct research on upland and highland farming systems. Khon Kaen University and the Chulalongkorn University Social Research Institute conduct research on community forest. Research on environmental conservation and medicinal plants has been carried out by Mahidol University. The FIO has carried out research on commercial teak growing, fast-growing trees, nursery techniques, utilization of teak thinnings and agroforestry. Studies are also being done by the private sector, particularly on forest plantation development which the Thai Cement Company

Limited, Phoenix Pulp and Paper Company Limited and the Kitti Plantation Company Limited are undertaking.

Various NGOs are also carrying out valuable research on site-specific issues. Some have also done policy analysis to define their agendas. These have served as valuable inputs for the policy process as there is limited other research on policy issues.

Education

There are several universities in the country that offer Bachelor's and Master's degree courses related to forest and natural resources but with different emphasis on technical subjects. These include Kasetsart University, which offers courses on forestry, agriculture and fisheries, Chiang Mai Agriculture University, known for courses on farming systems and natural resource management, and Khon Kaen University for courses on rural development and regional planning. Similarly, Mae Jo University offers courses on land use and ecotourism, and Chulalongkorn University on community development (in which community forestry is a part of the course curriculum).

Kasetsart University has the only fully fledged forestry faculty in the entire country. It offers BA, MA, and PhD programmes in forestry and related subjects. The four-year BA programme presently includes three specific subjects. These are forestry, wood sciences and technology, and pulp and paper technology. The forestry course covers: forest resource management forest engineering, social forestry and forest biological sciences.

The MA programmes, which started in 1967, include four specialized subjects: forestry, parks and recreation, forest resource administration and tropical forestry. The forestry programme has five major areas of specialization, including forest management, forest biology, forest products, watershed management and silviculture. The MA programme on forest resource administration also includes a special weekend programme, designed to accommodate people who cannot attend regular weekday classes.

The PhD programme in forest, which started in 1992, focuses on five subjects: silviculture, forest management, watershed and environment management, forest ecology and tropical forestry (international programme).

There seems to be no problem for forestry graduates in finding jobs as they become easily employed by various departments of MORE and NGOs and the private sector. The majority of the forestry professionals in the MNRE are reported to have studied in Kasetsart University.

Training

Prior to splitting into two departments, the RFD had a training division, with several training centres in different parts of the country. The most important ones included the training centres located at the central office and those in Phrae Province, Khao yai, Cha am, Chiang Rai and Tak Provinces. However, following the MNRE's decision to restructure the RFD, the training division was removed, placing all the respective human and financial resources and facilities under the DNP. According to the DNP's training plan for 2005-2006, the activities (meetings, workshops and seminars) cover such topics as orientation training for newly recruited staff, training of trainers, management and services, conflict management and negotiation, insect inventory/survey techniques, forest fire control, environmental impact assessment after forest destruction, forest law and enforcement, forest criminal case investigation, tools and techniques for financial analysis, youth camp trainers, GIS, database management, appropriate morals (King's birthday), research, development strategy for the DNP, and refresher courses for senior government officials,

etc. Overall, in total, some 150 activities are planned and carried out each year involving over 3,000 trainees.

The main constraint facing further training is that all the resources have been assigned exclusively for the training of the DNP staff. This overlooks the training needs of the staff working in the RFD and other departments. The RFD staff (more than 4,000) responsible for the management of national forest reserves, promotion of community forestry and private reforestation, are completely deprived of further training possibilities.

Extension

There is no specific extension division or unit in the RFD or DNP. However, some RFD field projects have provisions for extension activities, although with a focus on nurseries, seedling production and planting on private lands. Some RFD staff feel that Office of Community Forest Management is also responsible for extension services. Some staff refer to the public relations unit within the MNRE, and see this to be equivalent to an extension unit. There is no clear understanding in the RFD of what forest extension entails.

10. PROBABLE SCENARIO OF THAILAND'S FORESTRY

Forest area and forest cover

In 1961, Thailand was rich in forest resources which covered 171,017,812.80 rai (273,628.50 km^2) or 53.33 percent of the country's area. Later on, forest cover was reduced by slash-and-burn shifting cultivation, land resettlement, dam and road construction, land reform for agriculture etc. and declined to 99,156,250 rai or 30.92 percent of the whole Kingdom's area, while the existing 1,221 National Forest Reserves covered 143,925,400 rai (230,280.64 km^2) or 44.89 percent of the country's area.

The RFD Action Plan (2009-2011) targeted the amount of National Forest Reserves for protection and maintenance as 67.7 million rai, the DNP Four-Year Action Plan (2009-2011) specified the Protected Area to be maintained at 73 million rai.

With regard to the 1985 National Forest Policy, forty percent of the country area or 128 million rai shall be kept under forest; 25 percent of the country area for protected forest and 15 percent of the country area for production forest. Presently, the total area of protected forest and production forest is 140.7 million rai but so far forest cover within the forest area of 140.7 million rai is less than 128 million rai.

In order to achieve the targeted forest cover of 128 million rai, the RFD, DNP, DMC, FIO and TPC will play important roles in taking action to set up the annual plan and budget with support from the Office of National Economic and Social Development Board, Bureau of Budget and the strong commitment from the government to help approve and allocate the budget for reforestation/rehabilitation and maintenance as well as protection. This activity should be done for ten years continuously. By 2020, Thailand's forest cover will reach the targeted area of 128 million rai.

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12. ANNEXES

Annex 1. Forest area 1961-2006

B.E.	North		North-East		East		Central		South		Whole Kingdom		Year
	Sq.km.	%	Sq.km.	%	Sq.km.	%	Sq.km.	%	Sq.km.	%	Sq.km.	%	
2504	116,275.00	68.54	70,904.00	41.99	21,163.00	57.98	35,661.00	52.91	29,626.00	41.89	273,629.00	53.33	1961
2516	113,393.00	66.96	50,671.00	30.01	15,036.00	41.19	23,970.00	35.56	18,435.00	26.07	221,707.00	43.21	1973
2519	102,327.00	60.32	41,494.00	24.57	12,631.00	34.60	21,826.00	32.38	20,139.00	28.48	198,417.00	38.67	1976
2521	94,937.00	55.96	31,221.00	18.49	11,037.00	30.24	20,426.00	30.31	17,603.00	24.89	175,224.00	34.15	1978
2525	87,756.00	51.73	25,886.00	15.33	8,000.00	21.92	18,516.00	27.47	16,442.00	23.25	156,600.00	30.52	1982
2528	84,126.00	49.59	25,580.00	15.15	7,990.00	21.89	17,685.00	26.24	15,485.00	21.90	150,866.00	39.40	1985
2531	80,420.00	47.39	23,693.00	14.03	17,244.00	25.59	17,244.00	25.59	14,630.00	20.69	143,803.00	28.03	1988
2532	80,222.00	47.29	23,586.00	13.97	17,223.00	25.55	17,223.00	25.55	14,600.00	20.65	143,417.00	27.95	1989
2534	77,143.00	45.47	21,799.00	12.91	16,616.00	24.65	16,616.00	24.65	13,449.00	19.02	136,698.00	26.64	1991
2536	75,231.00	44.35	21,473.00	12.72	16,408.00	24.34	16,408.00	24.34	12,808.00	18.11	133,554.00	26.03	1993
2538	73,886.00	43.55	21,265.00	12.59	16,288.00	24.17	16,288.00	24.17	12,455.00	17.61	131,485.00	25.62	1995
2541	73,057.00	43.06	20,984.00	12.43	16,049.00	23.81	16,049.00	23.81	12,125.00	17.15	129,722.00	25.28	1998
2543	96,270.28	56.75	26,526.94	15.71	8,438.28	23.12	21,461.85	31.84	17,413.43	24.62	170,110.78	33.15	2000
2547	92,068.42	54.27	28,095.69	16.64	8,240.33	22.57	21,243.24	31.52	17,943.29	25.37	167,590.98	32.66	2004
2548	89,380.99	47.31	25,334.60	15.00	7,935.82	21.74	20,678.58	30.68	17,671.31	24.99	161,001.30	31.38	2005
2549	88,368.11	52.09	24,549.88	14.54	7,883.62	21.60	20,555.07	30.50	17,295.91	24.46	158,652.59	30.92	2006
	169,644.29		168,854.40		36,502.50		67,398.70		70,715.19		513,115.02		Total

Source 1/ RFD 2007
2/ Royal Thai Survey Department
3/ Management and Restore Forest Conservation Office, National Park, Wildlife and Plant Conservation Department

Note : 1. Forest area acquired from LANDSAT 5 (TM), interpretation imageries at the scale of 1:50,000
2. Existing forest area in this table means forest of all types such as evergreen, pine, mangrove, mixed deciduous, dry dipterocarp, scrub, swamp, mangrove and beach forest etc., either in the national forest reserves, national parks, wildlife sanctuaries, forest working plan with an area of 5 hectares (3.125 rai) or more with trees taller than 5 metres or more and with canopy more than 10% of the ground area.

Annex 2. Number and area of National Forest Reserves

Region	2003		2004		2005		2006		2007	
	Unit	**Sq.km.**	**Unit**	**Sq.km.**	**Unit**	**Sq.km.**	**Unit**	**Sq.km.**	**Unit**	**Sq.km.**
North	257	111,964.78	257	111,964.78	257	111,964.78	257	111,964.78	257	99,997.52
North-east	353	55,333.40	353	55,333.40	353	55,333.40	353	55,333.40	353	55,333.40
Central and East	143	34,889.06	143	34,889.06	143	34,889.06	143	34,889.06	143	46,766.58
South	468	28,183.15	468	28,183.15	468	28,183.15	468	28,183.15	468	28,183.15
Total	**1,221**	**230,370.39**	**1,221**	**230,370.39**	**1,221**	**230,370.39**	**1,221**	**230,370.39**	**1,221**	**230,280.64**

Source: RFD 2007

Note: 1. Total area of the national forest reserves is compiled from maps and their corresponding area published in the government gazette which occasionally overlap each other and some areas have already been revoked from the reserved category for other use.
2. In the North, including Nakhon Sawan, Kamphaeng Phet and Uthai Thani.

Annex 3. Annual reforestation by objectives

Unit: sq.km.

Item	From beginning to 2001	2002	2003	2004	2005	2006	2007	Total
Afforestation by Government Budget	6,769.47	55.92	39.36	56.00	132.00	94.24	92.84	7,239.83
Reforestation Campaign in Commemoration of The Royal Golden Jubilee	3,846.89	168.31	23.86	49.90	262.81	97.18	106.78	4,555.73
By Forest Industry Organization (FIO)	336.59	0.00	0.00	0.00	25.86	47.75	29.76	439.96
By Thai Plywood Co., Ltd.	39.07	5.72	1.22	2.80	3.88	1.96	2.78	57.43
Reforestation by Concessionaire Budget	184.98	4.50	4.68	5.66	14.00	10.13	34.84	258.79
	226.50	24.00	48.69	29.06	54.00	65.12	27.36	474.73
Total	**11,403.50**	**258.45**	**117.81**	**143.42**	**492.55**	**316.38**	**294.36**	**13,026.47**

Annex 4. Treefarm Plantation Promotion Programme and present remaining planted area 1994-2002

Year Planted / Area Planted	Area Planted with 5-year Payment		Remaining Planted Area	
	Farmers	Rai	Farmers	Rai
1994	28,365	392,547.49	23,419	311,316.27
1995	26,774	326,154.00	20,870	226,088.25
1996	8,812	116475.75	6,549	73,399.00
1997	7,565	103,918.25	6,202	80,835.75
1998	1,964	28,074.25	1,827	23,855.75
1999	1,900	27,346.75	1,880	24,672.75
2000	3,097	40,037.00	3,010	39,051.50
2002	1,649	21,504.75	1,649	21,504.75
Total	**80,126**	**1,056,058.24**	**65,406**	**800,724.02**

Annex 5. RFD Four-Year Action Plan B.E. 2052-2554 (2009-2011)

Vision Being Principal Agency in the Administration and Forest Management for Maximum Benefits of the Nation.

Mission with regard to laws

1. Forest Protection
2. Forest Land Management
3. Forest Rehabilitation
4. Promotion of Economically Viable Tree Planting
5. Promotion of Participatory Forest, Resource Management in the Form of Community Forestry, Unbar Forestry Areas forestry
6. Develop Permission and Services
7. Research and Develop Appropriate Technologic in the Forest Resources Management and Utilization Including Standard and Certificate Specification.

Target

Forest Resources Have Been Administrated and Managed Efficiently

Key Performance Indicators

1. Number of National Forest Reserve Area has been protected and maintained at 67.7 million rai
2. Number of Forest Rehabilitation have been operated at 1,373,390 rai
3. Number of Farmers have been inspected for certifying usufructuary rights at 150,000 farmers

Remark : This RFD Four-Year Action Plan contains only 3 years (2009, 2010, 2011) because it was adjusted from the original Four-Year Action Plan (2008-2011)

Annex 6. His Majesty the King's Guidelines for Watershed Conservation

His Majesty the King Bhumiphol Adulyadej has suggested many guidelines for forest rehabilitation both for upland and lowland. Some of his suggestions in general are:

1. First of all forestry officials have to plant trees in human heart then they will plant trees on the ground and will tender those trees by themselves.
2. Villagers should be trained as forest guards because both villagers and forestry officials are sharing the same benefit.

His Majesty's specific guidelines to watershed conservation and rehabilitation are:

1. To perpetually maintain upper part of watershed. It is important to protect the existing forest and reforest the upper hills that were deteriorated. Trees planted should be forested tree and fuel-wood tree. Villagers can cut fuel-wood tree but should plant it back periodically. Forested tree will increase air humidity that is one factor to support precipitation process. It also support stability of surface soil in case of heavy rainfall. If upper watershed can maintain a good forested condition the local resident in the area will have plenty of water for their consume.
2. Planting forested tree should be carried on along with hill-tribe development projects that are under sector's responsibilities of forestry, irrigation, and agriculture. Multi-purposes and fast growing tree species should be planted on denuded land and waterways to hold soil moisture. Small check dams should be constructed along waterways to retard flow and sediment.
3. Do not reforest on area that have villagers occupied. Forest tree planted should be selected from local species to create a diversified forest. Tree seedlings should be strong enough to survive after planting.
4. Reforestation that will benefit to villagers should apply "3 types of planting for 4 types of benefits" that is 1) planting tree for home-use 2) planting edible tree and 3) planting economic tree. These 3 types of planting will also yield the fourth benefit, that is "soil and water conservation. If villagers realized these benefits they will not against the reforestation program and will also help to maintain reforested areas.
5. To rehabilitate deteriorated forest, suitable sites can be selected and leave alone the sites then forest can recover by itself. Especially in dry dipterocarp forest trees can grow back from stumps or in other deteriorated forest trees can grow from seeds or from young natural seedlings. The important of reforestation by this method is to "non-disturbing" the area. Let the trees grow naturally.

3.3.7 Main Guidelines for Watershed Rehabilitation

1. Planting Forest Tree

There are 2 categories of forest tree planting to rehabilitate upper watershed. Seedlings of native species are the first priority to be planted.

1. Planting on denuded area.
On denuded area such as abandoned shifting cultivation it needs dense spacing of tree planting. Spacing of at least 4 by 4 meters or 16 square meters per tree are required.
2. Planting on moderately deteriorated area.
This categories there are still some mature forest trees on the areas that can rehabilitate themselves. To speed up rehabilitation planting tree by 8 by 8 meters or 64 square meters per tree are required.

2. Planting Vetiver Grass for Soil and Water Conservation

His Majesty the King Bhumiphol Adulyadej has realized the important of soil and water conservation. His philosophy is " Have to store water in soil and have to fix soil in situ". So he recommended methods for soil and water conservation, i.e., to plant vetiver grass on the area to fix soil coupled with to construct check dam in series along the streams to retard streamflow and sediment.

His Majesty's statement on benefit of vetiver grass was "Vetiver grass is the grass that has deep root system vertically penetrated into the soil. Planting vetiver grass along the contour line on hillside slope and along water way and small creeks will help to protect surface soil erosion and hold moisture within soil. Roots of vetiver grass can also hold nitrogen and other chemical and pollution substances preventing them to reach streams. Planting vetiver grass around reservoir can also help protect surface soil eroded into reservoir bed".

3. Check Dam Construction

Check dam or moisture holding dam is one of His Majesty the King's watershed management technology. His recommendations is to construct series of check dam along the small creeks on upper watershed or on steep slope to retard water flow and also can prevent sediment transported down to lower watershed.

Implementation of check dam

Check dam has various benefits, i.e., to retard sediment and built up soil moisture, to rehabilitate watershed ecosystem, to promote economics of upper watershed communities, and to be a water resources of the communities. Presently there are 3 types of check dam constructed on upper part of watershed all over country.

1. Integrated check dam

This is a temporary check dam built up from local materials such as bamboo, rock, soil, sand mixed with cement, etc., along the first order streams. The main purposes are to check velocity of water flow, retard sediment, and finally to store soil moisture on upper watershed.

2. Semi-permanent check dam

This check dam is constructed on second or third order streams of not more than 5 meters width. Construction materials are more permanent than temporary check dam, i.e., brick and cement, steel-concrete, compressed concrete. The semi-permanent check dam has an ability to trap sediment, retard velocity of stream flow like integrated check dam but also act as a small reservoir to be a water storage for community.

3. Permanent check dam

This check dam is more or less similar to semi-permanent check dam but constructed with more permanent construction materials to favor last longer service time and give more benefit to community in term of micro irrigation system