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A Preliminary Preview of Compensatory Forest Plantation in Peninsular Malaysia

Tuck Chin
Stephen F Austin State University

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A PRELIMINARY REVIEW OF COMPENSATORY FOREST PLANTATION IN PENINSULAR MALAYSIA

by

TUCK Y. CHIN, B. Sc. (Forestry) (Hons)

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A PRELIMINARY REVIEW OF COMPENSATORY FOREST PLANTATION

IN PENINSULAR MALAYSIA

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TUCK Y. CHIN B. Sc. (Forestry) (Hons)

APPROVED :

J. David Lenhart

Dr. J. David Lenhart, Thesis Director

Hershel C Reeves

Dr. Hershel C. Reeves, Committee Member

Michael H Legg

Dr. Michael H. Legg, Committee Member

Janelle C. Ashley

Dr. Janelle C. Ashley,
Dean of Graduate School

ABSTRACT

Projections of supply and demand for timber appear to indicate a domestic shortage in Peninsular Malaysia by the year 2000. Timber shortage will result in loss of foreign exchange, retrenchment of timber workers, inflate prices and depress construction and housing industries.

Compensatory Forest Plantation Program (CFPP) is one of the methods taken by the Malaysian Government to avert this impending crisis.

CFPP was officially launched in 1983, in four States of Peninsular Malaysia. By 1989, forest plantations totaling 36,874 hectares were established.

A final analysis of CFPP is premature, as the program is only in its seventh year of a 15 year rotation. Results from preliminary appraisal indicate that CFPP was non - profitable from 1983 - 1989, and from 1990 onwards is financially viable. If actual data are viewed together with projected data (post 1989), CFPP is financially viable.

A number of forest management recommendations are proposed for the remaining years.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

INTRODUCTION

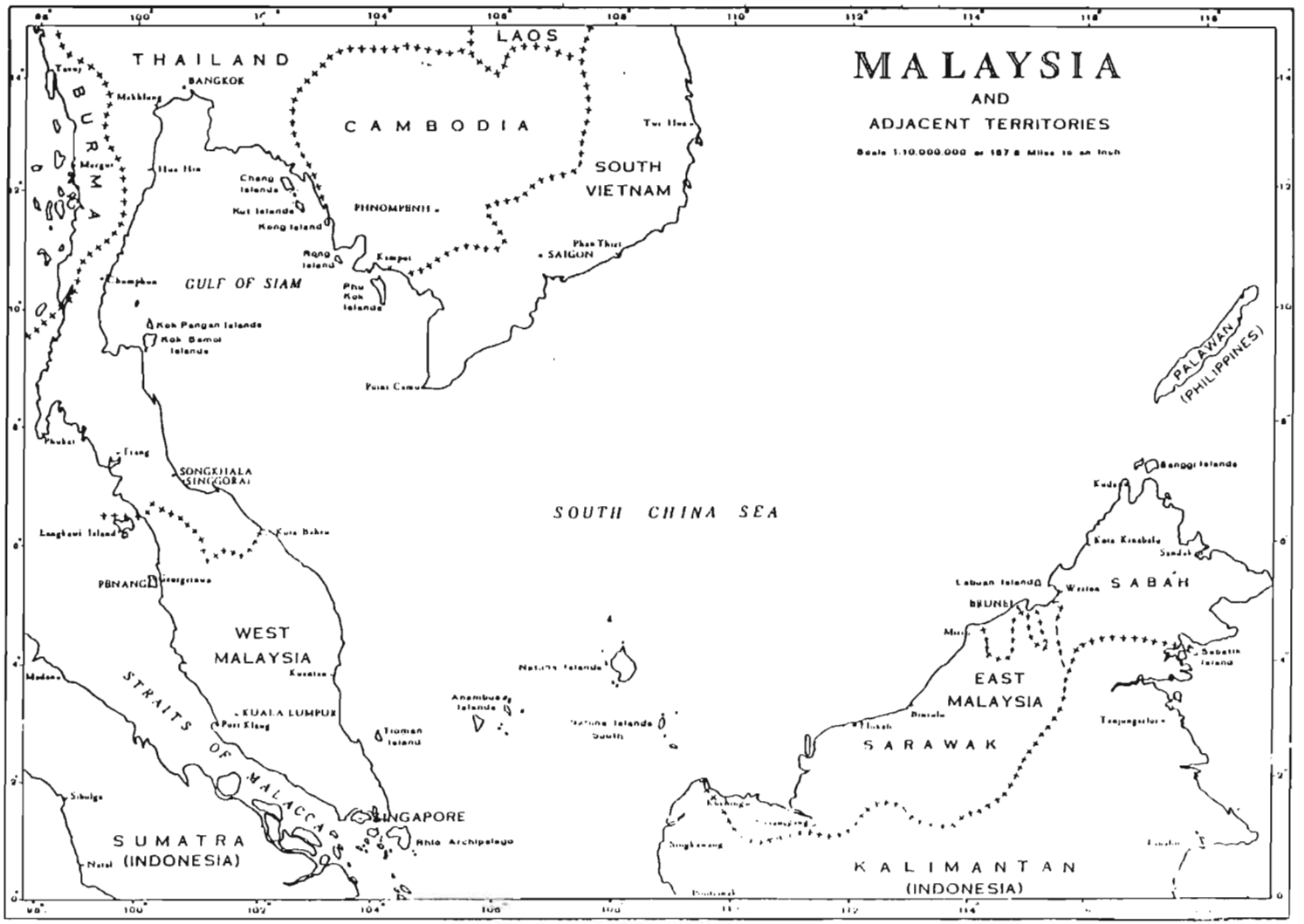
Peninsular Malaysia (Figure 1) is endowed with extensive areas of tropical rainforest, and is a species rich community (Whitemore 1975, Anon 1985). Flora is estimated to consist of about 8,000 species of flowering plants, of which 2,500 are tree species (Whitemore 1975, Anon 1989b), with 890 species capable of reaching harvestable sizes of at least 45 cm diameter at breast height (Othman 1991). Currently, over 1,300 plant species and 76 species of ferns have been identified to have potential pharmaceutical properties, and traditionally, some of these have been used as herbal medicine (Othman 1991). A total of 408 tree species has been marketed to countries around the world, under the Malaysian Grading Rules (Othman 1991). Fauna is equally diverse, with about 1,000 species of vertebrates and an estimate of 20 to 80 thousand invertebrates species (Anon 1989b).

Forest resources have contributed significantly towards the socio - economic development of Peninsular Malaysia, especially in foreign exchange earnings, government revenues and employment opportunities. These can be listed as follows

01. Total export of timber and timber products in 1990 amounted to 4.10 million cubic metres, valued at M$ 2.71 billion (US$ 1.00 billion) or 3.4% of the country's total export earnings (Anon 1991b, Anon 1991c).

02. In 1990, total forest revenue collected by the various States in Peninsular Malaysia amounted to M$ 260.00 million (US$ 96.3 million), based on a production of 12.3 million cubic metres of round logs (Anon 1991b, Anon 1991c).

Figure 1: Malaysia and adjacent territories



03. The forestry sector provides a variety of employment, such as forest administration, timber harvesting, processing and handling for both semi - skilled and skilled personnel. In 1990, this sector provided for direct employment to 72,000 people (Anon 1991c).

Apart from its monetary and job related opportunities contributions to the Malaysian economy, the forest is an integral part of the environment. The forest is useful in maintaining environmental stability, minimizing flooding and soil erosion commonly associated with tropical thunderstorms and safe guarding water supplies. Unfortunately, as in the case of many developing Third World countries, success of socio - economic development programs in Peninsular Malaysia is usually at the expense of forest resources.

Since the late 1970s, forest resources have been reduced rapidly through large scale conversion to agriculture crops (Arshad 1979, Chong 1979, Yong 1984), as well as accelerated forest harvesting to meet the growing demand for tropical hardwoods by domestic and world markets (Thang 1985). As a result in 1978, Forestry Department Peninsular Malaysia formulated a forest resource development plan based on the principles of sustained yield (Anon 1978a).

In this resource development plan, there will be a gradual reduction in harvesting within the forest. Agri - conversion of forest areas will be restricted to land suitable for agriculture and at the same time, timber exploitation is to be within the country's annual coupe or annual cut for sustainable production of timber at different levels of intensity. Management strategies emphasized the sustained yield concepts. In addition, silvicultural programs to treat the logged - over forest are to be intensified.

A current strategy complementing the forest resource development plan is the establishment of forest plantations with the Compensatory Forest Plantation Program (CFPP). Under this 15 - year program of intensive forest resource development, about 188,200 hectares of marginal and logged - over forest will be planted with fast growing and high yielding trees capable

of producing general utility timber in cutting cycles of 15 years. In comparison, natural forest has cutting cycles of 30 - 70 years, depending on the type of forest management system (Othman 1991). With the expected timber production of plantation grown logs, logging pressure on natural forest should be reduced (Evans 1982, Anon 1985).

CFPP was initiated in Peninsular Malaysia in 1982. By 1989, 36,874 hectares have been planted, another 42,000 hectares should be planted by 1993 and the balance of 109,326 hectares by 1996. The whole project is estimated to cost M$ 517.0 million (US$ 191.5 million) (Yong 1984).

OBJECTIVES

The purpose of this study is to analyze the initial performance of the Compensatory Forest Plantation Program in Peninsular Malaysia, specifically to

01. Describe the forest management situation that precipitated the CFPP.

02. Present a brief overview of the CFPP.

03. Compare the initial achievements of the CFPP relative to baseline figures, which were established at the time of its formulation.

04. If necessary, develop management procedures for the remaining 8 years of the CFPP.

LITERATURE REVIEW

Since the 1970s, a series of attempts were made to forecast the supply and demand of timber in Peninsular Malaysia (Leslie 1971, Anon 1975, Anon 1978a, Chong 1979, Freezaillah 1980, Thang 1984). Projections appeared to indicate an impending domestic shortage. Prior to 1970s, forest resources were exposed to excessive rates of commercial logging and rapid deforestation due to large scale agri - conversion to plantation agriculture and timber exports. These events coupled with inadequate forest resource development programs and a rapidly expanding domestic market for timber indicated that, if these trends continued, Peninsular Malaysia, could become a timber deficit nation.

In spite of this awareness, actions taken by the Federal Government through Forestry Department Peninsular Malaysia to redress these deficiencies were limited. This was especially so, as constitutionally, forestry is a State matter and forest resource development is the sole responsibility of the respective States. Acceptance of a National Forest Policy by State Governments in 1978 marked the beginning of a new era in forestry development. Though legally, State Governments in Peninsular Malaysia have full rights over their forest lands, National Forest Policy empower Federal Government through Forestry Department Peninsular Malaysia, with a measure of influence on issues of forest resource development. In addition, State Governments responsible for implementing forest policy, have agreed to set aside 4.71 million hectares as Permanent Forest Estate (PFE), as provided for in the National Forestry Policy (Thang 1991).

It was evident from the supply and demand situation, that Peninsular Malaysia might have a timber deficit by the year 2000 (Freezaillah 1980). This indicated to the State Governments the seriousness of a possible timber shortfall and dire need for quick concerted actions.

Present figures on the supply and demand of timber in Peninsular Malaysia from 1986 to 1990 (Darus and Chin 1990) and current projected figures to the year 2010 (Anon 1990a) supported the earlier projection. Data indicated that by the year 2000, domestic consumption would exceed domestic production of timber, resulting in an initial annual deficit of 0.95 million cubic metres (Table 1).

Yong (1984) discussed some of the implications of this deficit on Peninsular Malaysia economy, namely

01. Loss of foreign exchange earnings from timber and timber products.
02. Forced closure of some sawmills and plywood / veneer mills.
03. A significant rise in the timber prices by imports.
04. Retrenchment of approximately half of the workers currently engaged in timber industries.
05. Slowdown in building and construction industries.

Subsequently, Forestry Department Peninsular Malaysia formulated a strategy for forest resource development based on principles of sustained yield (Anon 1976) as

01. Reducing agri - conversion and establishing a Permanent Forest Estate and impose a logging quota of 75,000 hectares / year.
02. Establishing forest rehabilitation programs on logged - over forest areas by recruiting more staff and privatizing some silvicultural operations.
03. Establishing the Compensatory Forest Plantation Program (CFPP).

First two proposals were endorsed by State Governments and have been implemented. However, the CFPP departed from the traditional type of forestry planning in that a functional

Table 1. Projected annual supply and demand of timber in Peninsular Malaysia (million cubic metres)

Year	Supply	Demand	Excess(+) / Deficit(-)
1986	8.59	2.98	+5.61
1987	9.78	3.59	+6.19
1988	11.12	3.83	+7.29
1989	12.10	4.54	+7.56
1990	8.40	4.47	+3.93
1991-1993	8.20	4.39	+3.81
1994-1996	7.08	4.39	+2.69
1997-1999	6.11	4.93	+1.18
2000-2005	5.34	6.29	- 0.95
2006-2010	5.34	7.71	- 2.37

Source: Darus and Chin (1990)

Anon (1990a)

approach was adopted. Planning parameters, which were derived from critical evaluation of data from numerous sources, formed the basis for project formulation. Continuous monitoring of project implementation was crucial in ensuring plantation parameters remained valid. Any deviations had to be compensated by modifications of the project plan, to ensure that programs objectives were met. As in many investments in plantation forestry, it required large sums of money and motivation (Jesus 1990).

As forestry is constitutionally a State matter, responsibility for forest resource development and funding lies with the States. High program costs and long investment period, as compared with agriculture crops, prompted the Federal Government to provide loans to participating States. These loans were interest free and repayable in ten years, with a grace period of fifteen years.

In return, State Governments were required to ensure security of tenure, manage the plantations professionally and allow existing infrastructures and facilities in the project's vicinity to be used. In addition, State Governments also accepted Forestry Department Peninsular Malaysia as the implementing agency for CFPP. With the acceptance of the program, Forestry Department Peninsular Malaysia assumed total control for planning, implementation and coordination of CFPP.

As opposed to other forest resource development programs, which were undertaken by Departmental staff, CFPP was undertaken by the private sector, through contract work. This approach was consistent with the Government's privatizing policy (Anon 1990b).

In general, two types of contracts were awarded, one for seedling production and the other for plantation establishment. Contracts for seedling production included activities such as nursery maintenance, and the raising and tending of seedlings. Contracts for plantation establishment included site preparation, road maintenance, planting and tending of planted seedlings. Although both operations were undertaken by private sector, project planning, supervision and coordination remained with Forestry Department Peninsular Malaysia.

PHYSICAL DESCRIPTION OF PENINSULAR MALAYSIA

Location

Peninsular Malaysia, with a total land area of 13.16 million hectares, occupies a central position in South East Asia (Figure 1). It has a length of approximately 740 kilometres and a width of 320 kilometres and lies within the tropics, between latitude 1° to 7° north and 100° to 105° east. Eleven states and the Federal Territory of Kuala Lumpur comprise Peninsular Malaysia.

Topography

The country is generally hilly with a central mountain range running north to south. In the south, Peninsular Malaysia is undulating and accessible. Distinct coastal plains surround the peninsular and are more pronounced along the west coast states.

Three major river systems, drain the country namely Sungei Kelantan, Sungei Pahang and Sungei Perak (Figure 2). At their sources and in the upper reaches, rivers are generally fast flowing. At the lower reaches rivers, especially on the west coast, usually flow through swamp land, while those on the east coast are often impeded by sand bars.

Figure 2: Peninsular Malaysia

Climate

Climate of Peninsular Malaysia is typical of the humid tropics and is characterized by year round high temperatures and seasonal heavy rain, especially during north east monsoon from November to January. Mean temperatures during the day and night are 32° C and 22° C respectively. Average monthly temperature variation of 2° C occur while, diurnal temperature variations range from 8.5° C to 11° C for inland areas, and 6° C to 8° C for coastal areas. Average rainfall is about 2,540 mm per year. Humidity is always high and ranges from 70% to 90% and sky is cloudy on most days, especially during the monsoon months.

Demography

Malaysia can be considered as one of the less populated countries on the Asian continent. Based on 1990 census, average population growth was 29.8 per 1,000 population and population of the country was 17.88 million, in which Malays and other indigenous races comprises 61.7%, Chinese 29.5%, Indians 8.1% and others 0.7% (Anon 1991b). Details of population demographics from 1980 to 1990 are listed in Table 2. Bahasa Malaysia is the national language, and English is widely spoken. Islam is the official religion, but there is complete freedom of worship.

Economy

Malaysia's economic progress over the last three decades has been characterized by rapid economic growth with relative price stability. In the process, living standards rose significantly. This is reflected by per capita income, which rose from M$ 775.00 (US$ 287.08) in 1975 to M$ 6,202.00 (US$ 2,297.04) in 1990 (Anon 1990b). Similarly, life expectancy increased

Table 2. Population of Malaysia by year and race (million)

	Year					
	1980		1985		1990	
Races	Population	%	Population	%	Population	%
Malays and other indigenous races	8.14	58.6	9.48	60.0	11.03	61.7
Chinese	4.46	32.1	4.88	30.9	5.28	29.5
Indians	1.19	8.6	1.32	8.4	1.45	8.1
Others	0.09	0.7	0.11	0.7	0.12	0.7
Malaysia	3.88	100.0	15.79	100.0	17.88	100.0

Source: Anon (1991b)

from 61.6 years and 65.6 years for males and females respectively, in 1970 to 68.8 years and 73.7 years respectively, in 1990 (Anon 1990b). Progress has also been made on the equity front. Levels of poverty has declined, while distribution of income has improved. Nation's success has been the result of effective utilization of natural resources, economy diversification and modernization of rural agriculture sectors and adoption of a market orientated economic system (Anon 1990b).

Programs for diversifying and modernizing agriculture sectors have been pursued within the framework of a series of five yearly development plans. Primary objective is to promote rapid economic development and a more equitable distribution of income. In the process, structure of the economy was transformed from a dependency on export of rubber and tin (70% of total export earnings) in 1957 (Anon 1990b), to a world leader in the production and export of rubber, palm oil, timber, pepper, cocoa and oil, as well as a growing exporter of manufactured products (Anon 1990b). Rubber and tin declined to 9% of total exports in 1990 (Anon 1990b), whereas contribution from other sectors, particularly manufactured products, which surpassed agriculture, accounted for 58% of total export earnings in 1990 (Anon 1990b).

Malaysian economy entered 1990s with strong fundamentals such as sustained rapid growth, rising per capita income and increasing living standards. This was reflected by the Gross National Product (GNP) and Gross Domestic Product (GDP), which increased at an average of 12.8% and 12.0% respectively, from 1986 to 1989 (Anon 1991b). Balance of trade over the same period, also showed favorable balance of payments (Anon 1991b) (Tables 3 and 4). Inflation averaged within 3.4% level from 1987 to 1990 (Anon 1991b) (Table 5).

Unemployment has been a major socio - economic problem in both rural and urban areas and is fairly uniform throughout the country. Unemployment as a percentage of the work force in 1990, was estimated at 8.5% (Anon 1991b) (Table 6). In addition, economic diversifications within agriculture and industrial sectors have rendered the country less vulnerable to commodity price fluctuations and simultaneously, encouraged job creation within the diversified economy.

Table 3. Gross National and Domestic Product of Malaysia (M $ ' million)

	Year			
Malaysia	1986	1987	1988	1989
Gross National Product (GNP)	66,953	74,729	85,798	95,720
Per Capita Income (Current prices)	4,156	4,522	5,071	5,513
Gross Domestic Product (GDP)	71,729	79,711	90,806	100,850

Source: Anon (1991b)

Table 4. External trade of Malaysia (M $ ' million)

	Year			
Malaysia	1986	1987	1988	1989
Total export	28,863	36,473	42,231	58,787
Total import	26,072	30,564	41,551	58,531
Balance of trade	2,791	5,909	5,680	258

Source: Anon (1991b)

Table 5. Consumer Price Index of Malaysia (1980 = 100)

Year	Consumer Price Index
1987	126.8
1988	130.0
1989	133.7
1990	140.3

Source: Anon (1991b)

Table 6. Employment situation in Malaysia (' 000)

	Year				
Employment	1986	1987	1988	1989	1990
Total work force	6,223	6,409	6,622	6,834	7,100
Employed	5,707	5,851	6,088	6,297	6,500
Unemployed	516	558	534	537	600
% Unemployed	8.2	8.7	8.1	7.9	8.5

Source: Anon (1991c)

Process of industrialization has resulted in broadening the manufacturing production base. Major challenges in the 1990's will be to promote greater industrialization, increase research and development, assimilate and adopt new technologies. Thus, prospects for continued strong growth within the Malaysian economy will remain favorable and encouraging.

Land Use

Peninsular Malaysia is basically an agricultural country, where majority of its population are dependent on agriculture. As such, Malaysian Government has placed strategic importance on agriculture development, as progress in this sector is crucial to the country's socio - economic development. Since independence in 1957, Malaysian Government has embarked on a series of five year development plans, based on forest conversion and land settlements to improve socio - economic conditions of the people. New Economic Policy (NEP), which was adopted in 1971 and lately superseded by New Development Policy (NDP) in 1991, focused on poverty reduction and simultaneously, restructuring the economic imbalances among the people. While maintaining the overall aim of bringing about a more balanced development within Malaysia's pluralistic context, NDP aims to strike a more optimum balance between the goals of economic growth and redistribution of equity. Stress is on developing a progressive society, in which welfare of citizens includes all. However, the goals of country's wealth redistribution will not be pursued at the expense of sustainable economic growth.

In Peninsular Malaysia, a Land Capability Classification (LCC) was completed in 1970, that provided the framework upon which the existing land use policy is largely derived. LCC was complied on the basis of mineral potentiality, soil suitability and forest productivity classification and represents a single ordering of natural productive form of land use, in terms of highest value

added under present and foreseeable economic conditions. LCC can be listed as follows

Class I : Land possessing a high potential for possible mineral development.

Class II : Land possessing a high potential for possible agriculture development with a wide range of crops.

Class III : Land possessing a moderate potential for possible agriculture development with a restricted range of crops.

Class IV : Land possessing a high potential for possible productive forest development.

Class V : Land possessing little or no minerals, agriculture or productive forest potential, but suitable for possible development as protective forest, water catchment areas, game reserves, and national parks.

LCC merely provides guidelines for land use. It indicates the most appropriate areas where particular development activities can be best located. Based on the above classification, mining has priority over agriculture, agriculture over forestry and forestry over water catchment areas, games reserves and national parks. This approach to land use inhibits forestry, as it relegates forestry to a residual form of land use and thus, is allocated land that is marginal or unsuitable for agriculture development (Freezaillah 1980).

Agriculture and forestry are the major land uses in Peninsular Malaysia, as some 9.23 million hectares or 70.2% of land surface is either under agriculture or forestry (Anon 1989a). People compete for scarce land for development of agriculture and forestry. In addition, leaders are also aware of the multi - disciplinary role of forestry within water catchment areas, national parks and game reserves. Subsequently, LCC is being revised not only to reflect forestry potential, but also as a source of water, food, fuel and materials for the people. Recent Land Resource Classification (LRC) will place forestry on a more equitable footing with agriculture, especially in cases of agri - conversion of forest land.

Agriculture And Land Use

Best agriculture lands are also the best areas for growing timber, not only that they are productive, but also that they are most desirable. Where suitable agriculture sites exist within forest lands, competition for land use occurs between forestry and agriculture, particularly in the growing of plantation crops, such as rubber and oil palm. Status of land use in Peninsular Malaysia in 1990 is shown in Table 7.

Agriculture activity is mostly concentrated in the western and southern parts of the country. This pattern of agriculture development and concentration is correlated with transportation routes, port facilities and soil suitability for agriculture. Recently, large scale agriculture development shifted to the east coast states of Kelantan, Pahang and Trengganu.

Two major agriculture crops planted on a large scale in Peninsular Malaysia, are rubber and oil palm and their subsequent expansion will likely intrude into land designated for forestry.

Clearing of forest lands for agriculture development has several marked effects on forest industries and management. A substantial portion of the current timber supply is obtained from forest land being cleared for agriculture development, which is likely to continue for some years (Arshad 1979). However, agri - conversion of forest land is expected to be completed by 1995 (Anon 1989a) after which, the country will be dependent on forest reserves that are permanently designated for timber production (Anon 1989b).

Presently, forest industry is dependent primarily upon an uncertain supply of timber from the various land conversion schemes, rather than on sustained production from a forest. In addition, institutional and political factors also work in favor of these land schemes, often at the expense of forestry. Unfortunately, this easily available timber from agri - conversion, has resulted in highly selective logging associated with heavy waste of wood materials. Trees left after initial harvest are usually felled and burned.

Table 7. Type of land uses in Peninsular Malaysia (million hectares)

Types of land uses	Area
Total land area	13.16
Total developed area	6.99
Total forest area	6.17
Logged / disturbed forest	2.40
Virgin forest	1.27
Protective forest	2.50

Source: Anon (1991b)

Most of the land delineated for agriculture development comes from forestry, with stands of lowland Dipterocarps. These are forests which have been the principle source of timber products and about which, substantial knowledge pertaining to their management, silviculture and utilization has been developed. However, once the designated forest land has been converted, future timber production will be dependent on hill forest, where yields will be much lower, compared to lowland Dipterocarps forest. Access will be difficult and harvest and regeneration costs will be higher. With the acceptence of LRC, it is likely a more orderly form of agri - conversion of forest land to reflect their resource potential will be seen.

A HISTORICAL SYNOPSIS OF PAST FORESTRY PRACTICES IN PENINSULAR MALAYSIA

In forest records, which started with the British period, the genesis and development of organized forestry is seen in Peninsular Malaysia. Management of forest resources in Peninsular Malaysia began in 1901, when N. Cantley, Director of Botanical Gardens in Singapore, was directed by the colonial office in London, to set up a Forestry Department in Peninsular Malaysia (Robinson 1922). This marked the beginning of organized forestry in Peninsuular Malaysia. Mode of forest management in colonial Malaya as it was known then, was based on the British experience gained in forest management in India (Robinson 1922).

One of the Department's earliest tasks was to supervise orderly clearing of forest lands for rubber, cloves and other agricultural crops (Oliphant 1932). These were the first signs of competition between commercial needs of agriculture and forest conservation demands, and displayed the earliest signs of Malaysian land use conflict between agriculture and forestry.

Until the First World War (1914 - 1918), silviculture activities were minimal and were mainly related to production of mangrove firewood (*Rhizophora* species) (Kumar 1986). Some experimental plantings of hardwoods were carried out but were not successful, until the task was taken over by the Forest Research Institute, which was set up in 1926 (Oliphant 1934, Watson 1934). The war years delayed implementation of field trials related to natural regeneration. The post war period, witnessed the establishment of forestry schools in Oxford, Bangor, Aberdeen and Edinburgh in United Kingdom, Dehra Dun in India and a few centers in Australia and New Zealand. Subsequently, the number of trained forestry personnel posted to Malaya, increased progressively (Watson 1934, Menon 1976, Kumar 1986).

Despite an increase in the number of forestry staff, State Forestry Departments did not have a formal policy to promote timber exports (Wong 1974, Menon 1976). They concentrated on domestic markets, particularly to supply timber to government departments. This was because of high ocean freight rates to the British market, as compared to those from colonial Africa, which discouraged exports (Oliphant 1934). In other words, as long as the British market could get cheaper wood from Africa, there was no interest in importing Malayan wood. Subsequently, there was no urgency to formalize Malaya timber export policy. British forestry officers serving in Malaya were themselves ignorant of business matters and of the requirements of timber trade. Furthermore, the Malaysian economic climate was not conducive to an increased world timber demand. Lesser known species were naively dismissed as inferior quality, and demand for them had to be found locally (Oliphant 1934).

Forest management was intensive, as silvicultural treatments were carried out over small areas, whereby a fifth of the area would be devoted to heavy hardwood management on a rotation of 130 years (Wyatt - Smith and Vincent 1962).

Japanese Occupation of Malaya (1942 - 1945), brought an abrupt halt to intensive forest management policy and its related silviculture activities (Watson 1950, Menon 1976, Kumar 1986).

Following Second World War, the ` Emergency ' (1948 - 1960), was proclaimed in Peninsular Malaysia, as a result of increased communist guerrilla activities in the jungle. This situation disrupted both forest management and silviculture activities. Nevertheless, forest management was on a macroscale, which included extensive forest management followed by silviculture activities. Rotation age was 70 years, estimated rotation for light density and most medium density hardwoods, whereas heavy density hardwoods were managed on a double rotation of 140 years (Wyatt - Smith and Vincent 1962).

In 1952, an Interim Forest Policy was formulated and accepted by all States in Peninsular Malaysia. This policy called for the management of 25% of land area in Peninsular Malaysia,

representing some 40% of total forest areas. The aim was to supply timber and fuel requirements to a population of 12 million people for agriculture, domestic and industrial purposes (Anon 1959).

Independence And After

Dwindling supplies of tropical hardwoods from colonial Africa, opened the way for Peninsular Malaysia to take a lead in mobilizing its timber exports. This was witnessed by post independence (1963) timber boom in 1960's and 1970's. In other words, it was the external economic events that produced the momentum for cutting down forests, rather than through a deliberate forest policy fostered within Peninsular Malaysia. In addition, domestic pressure contributed to clearcutting of lowland forest for establishment of land development schemes, which was an important economic strategy of the government of independence.

Forest protection and regeneration was moving at a slow pace, due to budget constraints and was unable to cope with the unprecedented rate of forest openings. The Forestry Department, with its limited resources, responded by setting up a logging licensing system, to standardize grading rules on Peninsular Malaysia logs and lay ground rules to facilitate timber exports.

After independence, Peninsular Malaysia inherited a forest organizational structure that had a policy of distinguishing between protective and productive forest; a plan for promoting intensive cultivation with an aim to meet local demand. The idea of forest conservation was there, but had to be compromised, to meet agriculture demand within the newly independent country.

Early years of post - independence witnessed the Malayanization of the forest service with the executive side completed by 1960 (Kumar 1986). After nearly sixty years of British administration (since 1901), there was still no overall forest policy, which was geared to the needs

of society, no forest inventory and no land use strategy. However, there was the interim forest policy of 1952 (Anon 1959).

By 1963, forestry had became an important source of foreign exchange earnings. Each State in Peninsular Malaysia had its own forest enactment and rules, which were fairly uniform.

Since 1960's, land development schemes caused a rise in demand and prices of tropical hardwoods in world markets, and growth of local wood processing facilities had accelerated erosion of the forest base. However, growth in timber exploitation was not matched by silviculture activities carried out on logged - over areas.

One of the major strategies taken by newly independent Peninsular Malaysia was opening up land for agriculture, which placed further pressure on forestry. Under the Land Capability Classification (LCC), government policy was to give priority to mining and industry over agriculture and similarly, agriculture over forestry. Ashad (1979) reported that land development agencies such as the Federal Land Development Authority (FELDA) and the Federal Land Consolidation and Rehabilitation Authority (FELCRA) found it difficult to obtain from State Governments potential areas for agriculture development in contiguous blocks. Subsequently, attention was shifted to forest land.

The Forestry Department felt that various state forest enactment and rules were limited in scope and depth to meet present day needs of a development orientated industrial sector. In addition, earlier enactments and rules were deficient and weak in areas of forest management planning and forest renewal operations, which were vital for sustained yield. Consequently, a Uniform Forestry Act was prepared and forwarded to all States in Peninsular Malaysia. Apart from making existing forestry laws uniform, the Act also streamlined forest administration and promoted uniformity of actions and approaches in forest development strategies. This Act was later superseded by the National Forestry Act in 1984, whereby more stringent forest management regimes on resource renewal were incorporated, to reinforce sustained yield concepts.

In addition, a National Forestry Policy was outlined in 1978, for the country's acceptance. It distinguished three kinds of forest as protective, productive and amenity. These forests are to be managed so as to maximize ` social, economic and environmental benefits for the nation and its people, in accordance with principles of sound forest management ' (Anon 1979). This was not new, as portions of the policy were already operationalized in various existing state forest enactment. Other prominent features of the policy were promotion of effective indigenous Malay participation in forest and wood based industries, manpower training and encouragement of private sectors involvement in forest research and training, and enhancement of professionalism in forestry.

Coordinated implementation of forest policy between the States in Peninsular Malaysia was necessary for the National Forest Policy to be successful. Emphasis was placed on efficient exploitation of timber resources and subsequent regeneration. Recognizing this, Forestry Department Peninsular Malaysia sought the assistance of FAO / UNDP in 1972, to undertake a national forest inventory of Peninsular Malaysia through which, forest stocking would be determined, detailed forest management plans drawn up and efficient timber harvesting be undertaken.

The advantages of a declared forest policy, in a rapidly changing government bureaucracy, is a formalization of all issues that are relevant to forestry. On the other hand, forest policy should be dynamic and be responsive to the changing needs of society.

CHARACTERIZATION OF FORESTRY DEPARTMENT PENINSULAR MALAYSIA

Legal Framework

Forestry is a State matter under the Constitution. It implies that legislation and executive authority rest with the respective State Governments. As such, each state is empowered to enact laws and regulations on forestry, as well as to formulate forest policy independently. Federal Government authority only extends to provision of advice and technical assistance to training, research and maintenance of experimental and demonstration stations.

In 1971, the National Forestry Council (NFC) was established by National Land Council (NLC) (Anon 1989b). Function of NFC is to facilitate adoption of coordinated and common approaches to forestry. NFC is comprised of the State's Chief Ministers and is chaired by the Deputy Prime Minister of Malaysia. NFC is a forum for Federal and State Governments to discuss and to resolve common problems and issues relating to forest policy, administration and management, while the NLC is empowered under the Constitution to formulate national policy for promoting land utilization for mining, agriculture and forestry.

Forest Legislation

As forestry is a State matter under the Constitution, each State has its own Forest Enactment and Rules. Forest legislation for orderly forest administration in Peninsular Malaysia has been adopted and implemented by States Forestry Departments since early 1930's, (Othman

1991). These early Forest Enactment and Rules were designed primarily to meet the needs of forest conservation and exploitation. As such, they were limited in scope and depth to meet long term overall development of forestry and wood based industries.

Each State has its own priorities, and forestry activities are pursued accordingly. Lack of coordination has been obvious. Recognizing these deficiencies, NFC attempted to standardize and update Forest Enactments and Rules with respect to forest administration, management planning and forest renewal activities. As a result, the National Forestry Act and the Wood Based Industries Act were formulated and passed by an Act of Parliament in October, 1984.

The National Forestry Act 1984 contained ample provisions for conservation, protection and rational utilization of forest resources. It also provided for conservation of soil, water and wildlife resources. Salient points of the National Forestry Act 1984 are attached as Appendix 1.

In addition, the Federal Government has enacted laws from time to time, pertaining to timber trade, research and development, land conservation and preservation of environmental quality. For example, the Environment Quality Act 1974 was amended to include an Environmental Impact Assessment in 1985, which prescribed certain activities that involved forest lands. These include

01. Land development schemes which cover an area of forest land into a different land use.
02. Drainage of wetlands, wildlife habitat or virgin forest which cover an area of 100 hectares or more.
03. Land based aquaculture projects accompanied by clearing of mangrove swamp forest which cover an area of 50 hectares or more.
04. Conversion of hill forest land to other land use on an area of 50 hectares or more.
05. Logging or conversion of forested land to other land use within the catchment area or reservoirs used for municipal water supply, irrigation or hydro - power

generation or areas adjacent to state and national parks and national marine parks.

06. Logging an area of 500 hectares or more.

07. Conversion of mangrove swamps for industrial, housing or agricultural use on an an area of 50 hectares or more.

08. Clearing of mangrove swamps on islands adjacent to national marine parks.

09. Other activities which may affect forest, such as coastal reclamation and hydro - power projects.

Forest Policy

Policy formulation and review concerning forestry are provided by Forestry Department Peninsular Malaysia and various State Forestry Departments. These agencies collect and compile necessary information and prepare guidelines for decision making. Actual physical implementation and control of forest sector development activities are divided between Forestry Departments, private sectors and various other government agencies, which directly participate in the activities concerned.

In the light of increased knowledge regarding forest resources potential and their socio - economic linkages, National Forestry Policy (NFP) was formulated and accepted by NFC in 1977, and endorsed by NLC in 1978 (Othman 1991). This policy is being implemented by all States in Peninsular Malaysia.

NFP emphasizes maximizing socio - economic and environmental benefits, which can be derived from effective management and utilization of forest resources. Emphases are also given to forest regeneration, rehabilitation and development and at same time research efforts are to be intensified to increase forest productivity and efficient utilization of forest resources. In other

words, NFP ensures uniformity in implementing forest management, conservation and development strategies.

Forestry education and training have also been taken into account in NFP, which emphasizes manpower development and training, in order to cope with increasing demand and challenges faced by the forestry sectors. Salient points of NFP are listed in Appendix 2. Parts of NFP were incorporated into National Forestry Act 1984 and Wood Based Industries Act 1984.

Forestry Department's Role And Functions

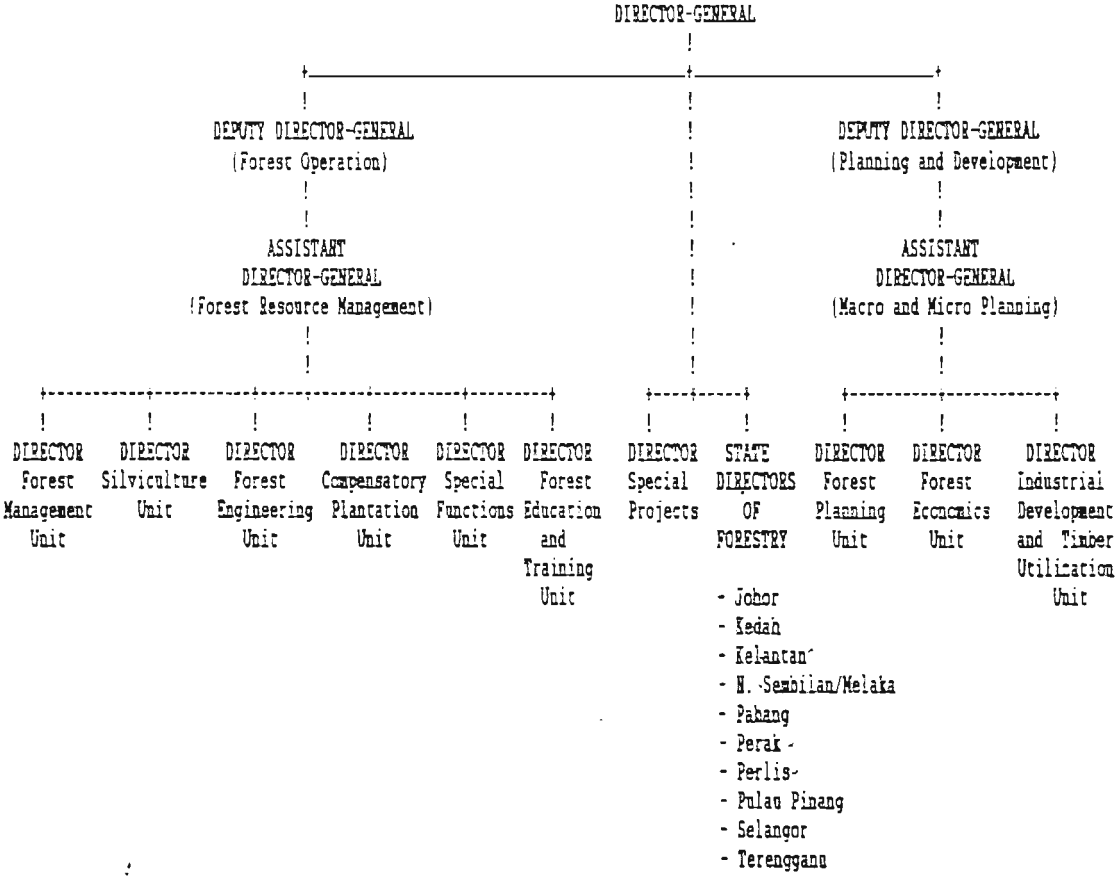
The Forestry Department is the Government agency responsible for effectively managing forest resources in Peninsular Malaysia. It comprises Federal Forestry Department under Ministry of Primary Industries and ten State Forestry Departments, each under control of the respective State Governments. Main role of the Forestry Department is to implement both National Forest Act 1984 and Wood Based Industries Act 1984, as well as to plan and coordinate forest activities in a manner that will provide maximum socio - economic returns to the country.

Functions of the Directorate and various Forestry Department divisions and State Forestry Departments are listed in Figure 3.

Organization

Forestry Department Peninsular Malaysia is under the auspices of Ministry of Primary Industries. At the federal level, Forestry Department Peninsular Malaysia, is headed by Director General of Forestry, who is assisted by two Deputy Director Generals and two Assistant Director Generals. There are ten functional units within Forestry Department Headquarters, all of

Figure 3: Organization chart of the Forestry Department Pen. Malaysia



which are headed by a Director, who is assisted by a number of senior officers. The units are

01. Forest Management
02. Silviculture
03. Forest Plantation
04. Forest Engineering
05. Special Functions
06. Forest Economics
07. Forest Planning
08. Forest Industrial Development and Timber Utilization
09. Forest Education and Training, and
10. Special Projects.

In addition, there are ten State Forestry Departments and each Department is headed by a State Director of Forestry, who is responsible for administration and regulation of forest harvesting, forest revenue collections, management and development of the forest resources, and planning and coordinating the development of wood based industries. Professional and sub - professional foresters are federal officers appointed to serve in the States. Uniformed staff includes Forest Rangers and Foresters, who are State employees. For forest management and administration, State is divided into districts, ranges and beats.

In 1990, the Forestry Department Peninsular Malaysia consisted of 144 professional foresters, 117 sub - professional foresters, 493 technical and clerical staff and 4,933 field staff (Table 8).

Major function of Forestry Department Peninsular Malaysia is to coordinate forestry development activities with State Forestry Departments. Through such approaches, objectives of Forestry Department Peninsular Malaysia are realized. These include forest development programs, forest sector management and planning, resource administration, policy formulation, orderly establishment of wood based industries and to provide for education and training.

Table 8. The Forestry Department Peninsular Malaysia, 1990

	No. of Staff		
Category	H.Q.	States	Total
Professional	53	91	144
Sub - Professional	40	77	117
Technical and Clerical	89	404	493
Others (including Field Staff)	118	4,815	4,933
Total	300	5,381	5,687

Source: Anon (1991b)

In addition, forestry administration activity is closely coordinated with other related forestry agencies such as, Forest Research Institute of Malaysia (FRIM), Agriculture University of Malaysia (UPM) for research and development inputs and Malaysian Timber Industry Board (MTIB) for timber marketing and trade inputs.

Forest Management

With the acceptance of the National Forest Act 1984, it is mandatory for every State Forestry Department to prepare and implement forest management and working plans within the Permanent Forest Estate (PFE). Working plans describe areas to be harvested, species to be removed, cutting limits, prescribed allowable cuts, and penalties for poor logging.

Traditionally, inland forests of Peninsular Malaysia have been managed under Malayan Uniform System (MUS). MUS is basically a system of converting tropical lowland multi - species and multi - storey rainforest into an even age forest, containing a greater proportion of commercial species. MUS is achieved by clear - felling release of selected natural regeneration of varying ages, aided by a systematic chemical treatment - girdling of defective and non - commercial trees. MUS felling cycle corresponds to rotation length (approximately 70 years), and the next crop depends on tending of seedling regeneration on the ground, at time of felling. This form of forest management has been successful in managing lowland Dipterocarp forest (Wyatt - Smith 1961, Wyatt - Smith and Vincent 1962, Anon 1978b).

MUS focuses mainly on seedlings and saplings at time of felling, silviculture treatments prescribed are aimed at favoring these groups, often at the expense of undesirable bigger trees, which are non - commercial. This has lead to a much heavier chemical treatment - girdling of trees, than necessary. However, MUS is unsuitable for hill forest mainly because of uneven stocking, sparse natural vegetation and inadequate natural regeneration. Subsequently, MUS of

forest management has given way to Selective Management System (SMS) (Cheah 1978, Darus and Thang 1988, Thang 1991).

SMS is designed to optimize management objectives of economics and efficient harvesting, enhance forest sustainability and minimize forest development costs (Thang 1991). With SMS, different cutting limits are applied based on particular species composition. It is a means of adapting the system, to the conditions of individual stands (Poore et al 1989).

Results of studies to date indicate that SMS, with periodic cuts every 25 - 40 years, using appropriate cutting limits and leaving adequate number of medium sized trees of marketable species for natural in - growths, will grow into commercial sizes (Thang 1991). Thang (1991) reported that average tree growth, of trees over 30 cm is 0.8 - 1.0 cm dbh / year and 2.0 - 2.5 cubic metres / hectare / year in commercial gross volume. About 75% of hill forest in Peninsular Malaysia is capable of producing every 30 years, of at least 40 - 45 net cubic metres / hectare, which is about the current average cutting level of hill forest.

The current forest resource situation favors SMS in Peninsular Malaysia (Thang 1991). Forward linkages associated with SMS operations, involve the usage of sophisticated machinery, higher employment and jobs diversification. In addition, training is intensified and the transfer of technical and organizational skills to rural population is realized.

Forest Development

In order to facilitate implementation of forest development activities, Silvicultural Cess Fund was created in 1973, in each of the States in Peninsular Malaysia. Cess is a result of a levy imposed by State Governments on log removals. This levy is to offset the cost of restoring the forest to its original status. However, with adoption of National Forest Act 1984 by State Governments of Peninsular Malaysia, the balance of Silvicultural Cess Fund was transferred to Forest Development Fund.

Under the National Forest Act 1984, a Forest Development Fund is set up to facilitate the preparation and implementation of forest management and reforestation programs. These programs are implemented by the various State Forestry Departments.

The Forest Development Fund can also be used to help finance the preparation of management, harvesting and reforestation plans by forest licensees. However, the licensee may have to reimburse the respective State Government cost of preparing and implementing such plans.

Objectives of forest development are to enhance and sustain Permanent Forest Estate (PFE) productivity in order to yield a commercial crop of prime quality logs. A post felling inventory is carried out to assess residual stocking and their distribution. Silviculture treatments are then prescribed, based on inventory analysis. Treatments usually involve chemical treatment and girdling of damaged and defective trees, and climber cutting. These operations attempt to regulate light emission on to the forest floor. Subsequently, trees of the preferred species may be able to respond vigorously. Studies carried out by various workers in different countries had provided information that both supported (Nicholson 1965, Anon 1979) and opposed (Nicholson 1958, Florence 1968) this supposition. Nevertheless, these and other findings (Dawkins 1958, Baidoe 1970) indicated that trees greater than 45 cm dbh left behind after logging will not respond to release, but the smaller sized trees may respond vigorously.

Forest rehabilitation and development operations in Peninsular Malaysia were implemented on a substantial scale when the Forestry Department treated an area of 227,110 hectares over the period 1983 - 1985, compared to 224,607 hectares harvested over the same period (Anon 1989b).

This trend of forest development has been maintained and certainly is a positive step towards achieving conservative management through intensive resource development activities. By 1986, 764,461 hectares of hill forest had been silviculturally treated (Anon 1989b). By 1990,

Peninsular Malaysia had successfully regenerated about 1 million hectares of logged - over forest within Permanent Forest Estate (PFE) (Anon 1991b).

In forested areas which are poorly stocked with natural regeneration of the preferred species, enrichment planting with preferred species is carried out. Planted seedlings are regularly tended for the first two years, during which defective trees are chemically treated and girdled, and weeding operations undertaken. These silviculture activities aim at improving the stocking for next rotation.

Another current forest development activity is establishing forest plantations. Commercial establishment of plantation forest was initiated in 1957, with planting of 799 hectares of *Tetona grandis* (teak) in northern Peninsular Malaysia (Anon 1989b). During 1960's and early 1970's, plantation efforts were directed at establishing fast growing tropical pines. About 5,558 hectares are planted mainly with *Pinus caribaea*, *Pinus merkusii* and *Araucaria* species (Othman 1991, Thang 1991).

In order to meet the expected increase in domestic demand in timber consumption by late 1990's, the Compensatory Forest Plantation program (CFPP) was launched in 1982. The objective of this program was to establish 188,200 hectares of plantations based on a 15 year rotation, of fast growing hardwood species such as *Acacia mangium*, *Albizia falcataria* and *Gmelina arborea*. By 1989, 36,874 hectares of forest plantations were established and by 1993, an additional 78,874 hectares will have been established.

CIRCUMSTANCES THAT PRECIPITATED CFPP

Agriculture and forestry are the major land uses in Peninsular Malaysia. Some 23.3% of land surface is under agriculture, while 46.9% is under forestry (Anon 1989b). As a matter of general policy since mid 1960's, priorities accorded under Land Capability Classification (LCC) are mining, agriculture and forestry. Forestry was treated as a residual form of land use and is allocated land that is marginal or unsuitable for agriculture (Freezaillah 1980). LCC reflects nationally accepted priorities, in which the system is used to indicate the most appropriate areas where a particular development should be utilized. Owing to changing land use conditions, LCC is currently being revised to reflect forestry resources' potential in provision of water, food, fuel and materials for the people. Under a new Land Resource Classification (LRC), forestry will be placed on a more equal footing with agriculture, especially in cases of agri - conversion of forest land.

Until the 1970s, forestry was considered as a stumbling block to agriculture development. This essentially was due to poor understanding and cooperation between agriculture and forestry sectors. Forest policy formulated for preservation of forest land for sustained yield, would always be in conflict with those views held by the agriculture sector, which requires more land to be opened up for agriculture development. In the absence of a national land use policy, principles of rational land use had often been overlooked. A further complication is the placement of the Forestry Department under the jurisdiction of the Ministry of Primary Industries, whereas a more logical placement would be under the Ministry of Agriculture.

During 1960's and 1970's, a national program of land development was initiated during First, Second and Third Malaysia Plans. Forestry, therefore had to give way to agriculture land

development. During the First Malaysia Plan (1966 - 1970), roughly 123,000 hectares of new land were opened by the Federal Land Development Authority (FELDA), the Federal Land Consolidation and Rehabilitation Authority (FELCRA) and to a lesser extent by related state agencies. Under the Second (1971 - 1975) and Third (1976 - 1980) Malaysia Plans, 866,058 hectares of land were put under agriculture (Arshad 1979). Arshad (1979) also reported that land development agencies, especially FELDA and FELCRA found it difficult to obtain contiguous areas from State Governments for agriculture development. Hence, they had to look to forestry to fulfill the land development objectives.

Effects of such openings had often been at the expense of rich lowland forest. While many hectares of forest land were cleared, it was true that they were not put into immediate use. In addition, these areas allocated for agriculture also included lowland forests that were already silviculturally treated. As a result, the Forestry Department Peninsular Malaysia was cautious with regard to embarking on extensive silviculture treatment of logged - over forest, given the uncertainty surrounding the future of forest reserves. Even the original Permanent Forest Estate (PFE) was gradually being reduced. Originally, PFE encompassed 5.5 million hectares in 1973 (Kumar 1986), but was reduced to 5.2 million hectares by 1977 (Kumar 1986). By 1990, total area of PFE is only 4.71 million hectares (Anon 1990c).

After more than 64 years of research in forest management, a reliable silviculture technology in tropical rainforest is evolving. Main reason is perhaps the slow process by which effectiveness or reliability of certain silvicultural systems can be ascertained. Silviculture systems for forest rehabilitation have modified over time but rarely keep pace with changing conditions, such as excision of lowland Dipterocarp forest for agriculture. Hence, the lack of changes in forest management itself, may have retarded forestry development viz - a - viz against demand from the agriculture sector. Subsequently, most lowland forests are being converted to agriculture schemes and PFE is slowly being pushed to more hilly terrain.

Previously, forest management was largely confined to preparation of working plans, repleted with prescriptions for annual coupe or annual cut and sustained yield. Working plans were often ineffective, owing to economic and political lobbying to open more forest land for agriculture. Moreover, there was no reliable forest inventory to record the fast changing landscape. Only in 1972, when the Food and Agriculture Organization of the United Nations (FAO) was called in, was the first national forest inventory for Peninsular Malaysia completed (Anon 1976). This inventory was updated by the second national forest inventory in 1981-1982, which was undertaken entirely by the Forestry Department Peninsular Malaysia. Stand and stock tables were produced by species groups, diameter classes and quality classes, together with stocking maps at scales of 1: 250,000 and 1: 750,000.

The National Forest Inventory of 1972 showed that areas logged far exceeded the allowable cut, while forest regeneration and rehabilitation to enhance and sustain potential productivity of rainforest remained small (Kumar 1986). As a result, there was a build up of about 0.5 million hectares of previously logged forest requiring silviculture treatments (Rashid 1984). Since 1978, areas which were silviculturally treated, kept pace with forest logging operation (Anon 1991a). Subsequent increase in silviculture development work in the 1980's implied that back - logged areas were being treated. Darus and Thang (1988) confirmed that the rate of silviculture treatment was estimated to be 116,600 hectares as compared to the annual logging rate of 71,200 hectares (Anon 1989b). This is certainly encouraging and a positive step in the direction of more effective conservation and rehabilitation of forest resources in Peninsular Malaysia.

Initially, Forestry Department Peninsular Malaysia suffered from lack of trained personnel, which resulted in the slow pace of forest resources replacement activities. The Public Services Department's policy of recruitment impinged on forest management, because priority was seldom given to forestry. Coupled with this, was the lack of infrastructural facilities, vehicles and dwelling units in strategic locations to implement forest reforestation programs. Requests for additional staff were seldom granted and resulted in seriously limiting both physical and financial

achievements of Forestry Department Peninsular Malaysia. However, due to recent reorganization of the department together with substantial increases in the operating budget, most of these deficiencies have been eliminated. Forestry is now operating in a more professional manner.

With the passing of the National Forest Act 1984, there was a gradual reduction in agri - conversion limited only to lands which are suitable for agriculture. In addition, intensive forest rehabilitation seems to be the order of the day. Coupled with this, Government encourages utilization of lesser known timber species, rather than being dependent upon a number of well known commercial species. Lesser known species are promoted on an end use classification system, where trees are categorized on the basis of a particular end use, rather than marketed as a single species.

Smaller diameter logs of popular species are likewise promoted, especially those coming out of forest areas to be converted to land development. Royalties are reduced to encourage use of these smaller size logs. In 1972, Peninsular Malaysia banned exports of logs of ten commercial species and later (1979) increased the number to sixteen commercial species. By 1985, a total ban of log exports from Peninsular Malaysia was imposed, in order to encourage production of more value added on timber products (Othman 1991), and also to delay the eminent shortages of logs coming from natural forest.

These are the conditions leading to the launching of CFPP. However, it is now appropriate to have a cursory look at the status of forest resources prior to launching of CFPP.

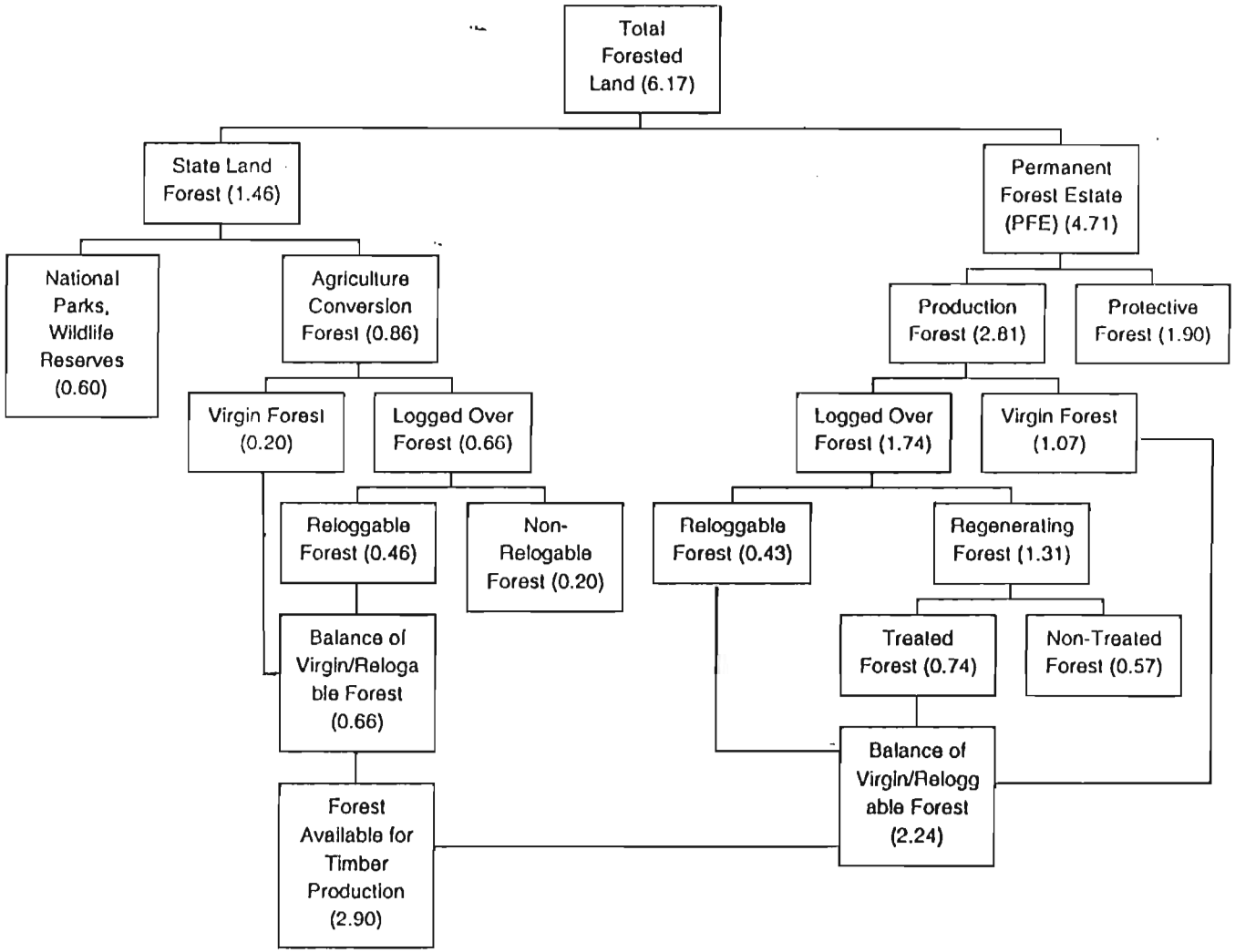
Forest Resources Status

Peninsular Malaysia has a physical land area of 13.16 million hectares, of which 6.17 million hectares is estimated to be forested. During the last decade, about 81,000 hectares of State Land Forest were converted into agriculture annually and this trend is expected to be

maintained for the next two decades (Arshad 1979). It is estimated that by 1996, all available State Land Forest will be converted to agriculture and logging will only be within PFE. Currently, PFE totals 4.71 million hectares that have been legally constituted as forest reserves both by National Forestry Council and respective State Governments.

Various categories of forest land and their estimated areas are detailed in Figure 4. PFE consists of 4.71 million hectares, of which 40% is protective forest (protective hill forest and wildlife reserves), while the balance of 1.46 million hectares is suitable for agriculture conversion. About 23% of agriculture conversion forest is still virgin while 77% or 0.66 million hectares are classified as logged - over forest. Seventy percent of this logged - over forest is merchantable and such areas are expected to be fully exploitable by 1996. Only 2.81 million hectares of PFE are considered to be productive. Of this area, roughly 1.74 million hectares have been selectively logged, but much still contains merchantable trees, because until very recently, timber harvesting has been highly selective. Thus, total area available for timber production is estimated to be 2.90 million hectares. It is against this shrinking base of timber production areas that CFPP was formulated.

Figure 4: Forest resources of Peninsular Malaysia (million hectares)



OVERVIEW OF CFPP

In view of projected shortage of timber for domestic consumption in Peninsular Malaysia by the late 1990's, the NFC in 1981, recognized the need to develop and expand the country's forest resources. A preliminary goal was to implement a program of fast growing plantations that would supplement the timber supply from natural forests. In other words, timber from these plantations would compensate for the expected shortfall in timber supply from natural forest, hence the term `compensatory forest plantation '.

Objectives

Primary objectives are

01. To maintain self sufficiency in timber supply in Peninsular Malaysia.
02. To alleviate hardships of lower income groups by producing general utility timber at affordable prices.
03. To create new employment to compensate for loss of jobs in forestry sector, because of reduced timber production from natural forest.
04. To increase productivity of forest land by converting marginal and poor forest into compensatory plantations.
05. To reduce excessive drainage on foreign exchange by decreasing import of timber and timber products.

Project Description

About 188,200 hectares of forest plantations would be established in Peninsular Malaysia within 15 years, starting from 1981 to 1995 (Yong 1984, Johari 1987). Forest plantations are expected to produce sawlogs for general utility use on a 15 year rotation, with a cost of about M$ 517 million (US$ 191.5 million) (Yong 1984, Johari 1987).

CFPP is projected to generate about 0.2 million cubic metres of sawlogs per year from thinning operation from 1991 - 1995 (Anon 1989a). This is expected to increase to 2.0 million cubic metres per year from final harvest during 2000 - 2005 (Anon 1989a), as more hectares are brought into production under CFPP. Projected timber production is expected to be equivalent to anticipated shortfall in domestic timber supply, thereby implying a strategy towards self sufficiency.

Project Financing

Under the Constitution, forest management is the prerogative of the States. However, recognizing long term nature of plantation forestry, the Federal Government agreed in 1982, to advance loans (Federal Loan) to States willing to participate in CFPP. A sum of M$ 20 million (US$ 7.5 million) was pledged to Johor, Negeri Sembilan, Pahang and Selangor, during Fourth Malaysia Plan (1981 - 1985), to finance the establishment of 7,022 hectares of forest plantations (Table 9). Loans were interest free, repayable in 25 years with a grace period of 15 years. This was the first time in the history of forest resource development where the Federal Government

Table 9. Planting targets of CFPP (1983 - 1985) - Federal Program

State	Hectares				Loan Amount (M$' million)
	1983	1984	1985	Total	
Johor	1,400	1,410	-	2,810	8.006
N. Sembilan	330	340	-	670	2.007
Pahang	-	446	2,446	2,892	7.997
Selangor	320	330	-	650	1.990
Total	2,050	2,526	2,446	7,022	20.000

Source: Johari (1987)

agreed to bear the entire project cost, since forestry is a State operation. In taking the loans, State Governments agreed

01. To ensure security of tenure of the plantations established, at least until they are harvested.

02. To manage plantations professionally, until they are mature for harvesting or pending harvesting, no trees are to be felled.

03. To allow existing infrastructure and facilities to be used for project implementation.

04. To make available some manpower required for project implementation.

05. To accept Forestry Department Headquarters as the implementation agency.

With the loan acceptence, the Federal Government had assumed total control of project planning, implementation and coordination. For this purpose a Forest Plantation Unit was set up at Federal level.

During 1984, the Government of Malaysia obtained a loan from Asian Development Bank (ADB), Loan No. 709 - MAL of M$ 56.0 (US$ 24.5) million to finance 50% of the cost of establishing 40,000 hectares of forest plantation in four participating states during 1985 -1988 (Phase I of the program). Loan is repayable within 20 years with a grace period of 4 years, charged at an interest rate of 10.25% per annum and a commitment fee of 0.75% per annum on the unborrowed portion of the loan. The Government of Malaysia financed the other half of the loan. These monies are reloaned to State Governments on the same terms, as that of previous CFPP loan. Planting targets under the ADB program are listed in Table 10.

Under ADB program, scope and size of the project increase considerably. While emphasis is still on plantation establishment, infrastructure and supporting components such as construction (housing and roads), equipment (heavy and light), training (locally and overseas), research and consultancy services are also included.

Table 10. Planting targets of CFPP (1985 - 1988) - ADB Program

State	Hectares					Loan Amount (M$"million)
	1985	1986	1987	1988	Total	
Johor	2,300	4,037	5,007	4,656	16,000	44.606
N. Sembilan	402	387	1,211	-	2,000	6.569
Pahang	2,900	4,600	8,500	-	16,000	45.328
Selangor	400	1,406	3,549	645	6,000	16.197
Total	6,002	10,430	18,267	5,301	40,000	112.700

Source: Johari (1987)

Choice Of Species For Planting

In order to fulfill the objectives of CFPP, all species must be

01. Fast growing and able to attain sawlog size in 15 years.

02. Able to produce timber suitable at least for general utility purposes.

03. Amenable to planting under plantation conditions in Peninsular Malaysia.

04. Able to produce seed in abundance, under local conditions.

Based on the above criteria, species currently chosen for plantation establishment were *Acacia mangium, Albizia falcataria* and *Gmelina arborea.*

Implementation Of Activities And Operations

Although procedures for implementing CFPP are similar to that of rubber and oil palm cultivation, they do differ in the methods of site preparation and establishment. In CFPP, top soil is minimally disturbed during site preparation. There is no delimbing or windrowing of trees, and planting rows are not terraced. Large planting holes are not required and no cover crops are established (Johari and Chin 1986). However, the time frame for establishing forest plantations is considerably shorter than that of agriculture crops. Established agriculture contractors have to modify their methods to suit the requirements of forestry plantation development. Moreover, operation scale is not as large as those offered by the more established land development agencies. As a result of these differences, capable and established contractors were initially, reluctant to bid for work within forestry sectors. A number of contracts were awarded to less than capable contractors and caused delay to the project.

In general, the contract system adopted for CFPP works well. It has enabled Forestry Department Peninsular Malaysia to implement its most ambitious and largest reforestation

program, without the burden of recruiting a large number of staff to undertake field operations. Administrative, financial and social problems associated with increased staff are eliminated. However, the contract system is not without its share of problems. During early years of CFPP (1985 - 1986), Malaysian economy was in recession, and lowest bidders, who were usually those with minimum qualifications were awarded most jobs, although there were more qualified contractors in the bidding lists. These contractors often possessed little capital and were dependent upon progress payments to pursue each step of the field operations. If payments were delayed, due to poor quality of work or non - compliance of contracts or delayed payments, contract implementation was affected accordingly.

Over the years, general capabilities of the contractors improved, and it was possible to enlarge the scope of the CFPP contracts. In 1985, three types of contracts for plantation establishment, seedling production and post planting treatments were awarded. In 1986, seedling production was combined with plantation establishment. Since 1987, procedures were further streamlined, whereby three operations were combined into a single contract. This allowed contractors to schedule their operations in an efficient manner rather than be dependent upon the progress of other contractors to complete their contracts. In the early years, when three separate contracts were awarded, site preparation might be on schedule, but availability of planting materials might depend upon progress of the seedling contractors. Hence, any delay on the part of seedling contractors would disrupt the sequence of plantation establishment. Conversely, seedling production might be on scheduled, but site preparation was delayed. This would result in over - mature seedlings, which would be unsuitable for planting. By combining three operations into one contract, a contractor would be able to schedule seedling production relative to progress of site preparation and establishment.

Seed Supply

Initially, *A. mangium* and some *Al. falcataria* seeds were purchased from Australia, Philippines and Sabah, East Malaysia at prices ranging from M$ 700 - M$ 3,000 (US$ 259.26 - $ 1,111.11) per kilogram, depending on quality. Since 1987, improved seed stands have been established within existing forest plantation. Seed stands of *G. arborea* in Kuala Kangsar, Perak can supply all the seed of that species, required for planting. However, it is the objective of this program to establish forest plantations with species from selected clones. Subsequently, steps have been taken to establish clonal gardens for production of both clonal seed and vegetative cuttings as planting materials. Self sufficiency in seed supply has meant not only cost savings, but also better assurance of quality.

Seedling Production

A. mangium, Al. falcataria and *G. arborea* seeds are first germinated in sowing beds, under shade. Germinated seedlings are then transplanted into polythene bags after 2 weeks. These tubed seedlings will be ready for field planting in about 3 months, when they reach a height of 20 - 30 cm.

Site Preparation

For conversion of forest land to forest plantations, felling followed by broadcast burning is preferred over windrowing (by bulldozers) and then burning (Mead and Speechley 1989). The latter practice leads to uneven growth and lower overall plantation productivity. An additional,

management difficulty is that burning can occur only in the dry season, which in Peninsular Malaysia can be quite short.

Advantages of a good broadcast burn is that, not only are nutrients in the biomass released to the soil, but the burn also improves access, kills off competitive coppices and unwanted seeds. This reduces weeding operations later. Loss of nutrients during broadcast burning and erosion or nutrient runoff after broadcast burning, can occur on some sites.

The alternative is to hand cut and burn, which requires 20 - 26 man days / hectare. The site is not usually as clean as after the semi - mechanical method, so more weeding may be required. Preference usually depends on terrain, relative costs, availability of labor and machinery. Normally, hand cut operation is preferred in areas where slopes exceed 30% and in areas associated with fragile soils (Sakhibun and Kudin 1980, Yong 1984, Johari and Chin 1987). Establishment practices and seed source have been reported as influencing growth rates (Mead and Speechley 1989, Miller and Hepburn 1989).

Planting And Spacing

Usual practice on recently burned sites is to use a poling or a staking system, which may be associated with hand spraying operations to mark out the planting spots individually. Normal planting density is 3.7 x 3.0 metres (900 stems / hectare).

Apart from the need for site occupancy, choice of initial spacing is governed by purpose of the plantation and degree of malformation of plantation species. With pulpwood, malformation is of less importance, although straightness can reduce harvesting costs. With sawlog production, sufficient numbers of trees need to be planted to enable selection of well formed trees. This will vary with site (and indeed with microsites where windrowing and burning have been used) and with genotype.

Fertilizing

Preliminary results of fertilizing do not show any significant advantage during early stages of plantation development (Johari 1987). Trials are being conducted to delay fertilizing until trees are about 8 years old and using mixed fertilizers instead of just phosphatic fertilizers.

Weeding

Canopy closure in *A. mangium* and *Al. falcataria* plantation generally occurs within 18 months (Liew 1984, Yong 1984, Johari and Chin 1986, Johari 1987). It is advantageous to free young trees from weeds, especially during early months of growth. During first 3 months after planting, the area is still relative free from weeds, circle weeding and slashing between rows at age 4, 6 and 12 months is sufficient. A general weeding or slashing is carried out in the second, fourth and eighth year, together with thinning operations. However, methods and frequency of weeding vary with sites and associated weed problems. In steeper areas, especially those with poor burns, growth of weeds is usually more prolific and more frequent weeding may be needed. Use of chemicals for weeding is being studied and may be adopted in the future, as manual cost of weeding operation escalates.

Pruning

Three compensatory plantation species are proned to heavy early branching. On sites where trees develop multiple stems from their bases, selection of single stems may be needed before they are 1.5 metres tall. Selection of single stems is usually carried out about 4 months after planting. Pruning (up to 50% height) is carried out during first year to eliminate all

undesirable competing leaders and any abnormal branches. A second pruning up to 6 metres is carried out at age 2, together with weeding operation.

Thinning

Trials to determine stem removals and frequency of thinning for various plantation species are underway, and results will be known in the near future. Meanwhile, from preliminary results, it is proposed that a first thinning be carried out at age 2, with 33% stem removals. This non - commercial thinning will remove suppressed, malformed and unhealthy trees. Subsequent commercial thinnings are planned between ages 4 to 5, with 33% stem removals and between ages 8 to 9, with 50% stem removals. Final thinning at ages between 8 to 9 will leave behind a residual crop of 200 stems / hectare. A management schedule is listed in Table 11.

Protection

Protection is an integral part of forest management. A forest plantation is an accumulating asset that must be protected against disease, pest and fire. Since CFPP inception, there has been no major out - break of disease or pest (Johari and Chin 1986, Johari 1987, Anon 1989a). However, during the nursery stages, minor diseases and pest problems have occurred, but they have been adequately controlled. In the field, prophylactic measures against termites are routinely taken to prevent attack. Minor incidence of root rot, die - back and heart rot have been reported by Liew (1984), Lee et al (1988) and Mead and Speechley (1989), and these have been routinely monitored and treated. As an added preventive measure against heart rot and die - back infection, pruning scars are dressed with wound healing compounds during pruning.

Table 11. CFPP silviculture prescriptions

Period	Prescription
After planting	Treatment 1
4 months	1. Weeding
	2. Singling
6 months	3. Weeding
	Treatment 2
1 year	1. Weeding
	2. Pruning (50% height)
	Treatment 3
2 year	1. Weeding
	2. Thinning (33% removals)
	3. Pruning (6m height)
	Treatment 4
4 year	1. Weeding
	2. Thinning (33% removals)
	Treatment 5
8 year	1. Weeding
	2. Thinning (50% removals)
	3. Fertilizing

The need for a large fire control system in forest plantations in Peninsular Malaysia is debatable, since the climate is wet throughout the year, except in the extreme northwest which is outside the areas designated for forest plantations. Forest fires are rare and affected areas are usually less than five hectares each (Koh 1982). However, basic precautionary measures are observed. Fire towers are manned and fire patrols are sent out to patrol the plantations during periods of high fire danger. Basic fire fighting equipment such as water tankers, knapsack sprayers, chain saws, rakes, spades and other tools are maintained.

Status

In general, overall implementation of CFPP has been successful despite some initial problems associated with disbursement of Federal Loan of M$ 20 million (US$ 7.4 million) to the four participating States of Johor, Negeri Sembilan, Pahang and Selangor. These were resolved through loans arranged between Federal Government and ADB (Loan No. 709 -MAL). During Phase I (1985 - 1988), 35,924 hectares (90%) of forest plantation were established, incurring a cost of M$ 46.3 million (US$ 10.5 million) (41%) and a total of US$ 14 million of the unused portion of the loan was refunded to ADB.

In addition, 24,030 hectares of forest plantation were silviculturally treated. Civil construction, purchases of equipment, in - service training for plantation personnel and research were also undertaken, as required under the terms of ADB Loan.

With completion of Phase I, Federal Government is obtaining another sectorial loan of US$ 29.5 million from ADB, to finance another 42,000 hectares of forest plantation. ADB portion will finance 43% of total cost of US$ 69 million, with the balance of US$ 39.5 million coming from Federal Government. In addition, the number of participating States will increase from four to seven, to include Kelantan, Perak and Trengganu.

BASELINE FIGURES USED IN THE FORMULATION OF CFPP

Consistent with the aim to maintain self sufficiency in timber supply in Peninsular Malaysia, a total of 188,200 hectares of CFP is to be established within a time span of 15 years from Fourth Malaysia Plan period. Average annual plantings were to be increased progressively from about 5,300 hectares during Fourth Malaysia Plan (1980 - 1985) to 12,100 hectares during Fifth Malaysia Plan (1986 - 1990) and to about 20,200 hectares during Sixth Malaysian Plan (1991 - 1995). This project is expected to yield sufficient timber to compensate for the shortfall of timber production from natural forest. Baseline figures used in the formulation of CFPP are shown in Table 12.

In Table 13 is a summary of growth performances of CFPP species planted in Sabah and in Peninsular Malaysia. *G. arborea* plantations in Kuala Kangsar were estimated to have a mean annual increment (MAI) of 28 cubic metres / hectare / year at age 11 (Freezaillah and Sandrasegeran 1966). *Al. falcataria* plots in Sungei Buluh, Selangor had a MAI of 28.4 cubic metres / hectare / year at age 10 (Mitchell 1963). However, in Sabah (East Malaysia) MAI of 30 cubic metres / hectare / year and 55 cubic metres / hectare / year for *G. arborea* and *Al. falcataria* respectively, were observed (Anon 1984a). MAI for *A. mangium* in Peninsular Malaysia has not been estimated, but it should be comparable to, or better than *G. arborea*, because of its comparatively faster growth rates. MAI for *A.mangium* has been reported to reach 30 cubic metres / hectare (Anon 1984a) and at Sibuga Forest Reserve, Sabah. In northern Sabah, MAI of 43.9 cubic metres / hectare at age 10 for *A. mangium* was reported by Tham (1980). *Pinus caribaea* plantations in Peninsular Malaysia, grew relatively slow with a rate of 17.5 cubic metres / hectare / year for pulpwood rotation of 12 years (Smart 1972).

Table 12. Baseline planting targets of CFPP (1981 - 1995) (hectares)

Plan	Period	Planting target	Ave. planting / year
Fourth Malaysia Plan	1981-1985	26,500	5,300
Fifth Malaysia Plan	1986-1990	60,500	12,100
Sixth Malaysia Plan	1991-1995	101,200	20,200
Total	--	188,200	12,500

Source: Yong (1984)

Table 13: Growth rates of selected plantation species.

Species	MAI (cu. m. / ha / yr.)	Age (years)	Source
Peninsular Malaysia			
Gmelina arborea	28.0	11	Freezaillah & Sandrasegran (1966)
Albizia falcataria	28.4	10	Mitchell (1963)
Pinus caribaea	17.5	12	Smart (1972)
Sabah			
Gmelina arborea	30.0	--	Anon (1984a)
Albizia falcataria	55.0	--	Anon (1984a)
Acacia mangium	30.0	--	Anon (1984a)
Acacia mangium	43.9	10	Tham (1980)

Based on these data, MAI for all three species used in the formulation of CFPP was conservatively estimated at 17.5 cubic metres / hectare / year for a rotation of 15 years. With improved knowledge on forest plantation management and intensified tree breeding programs, expected yield will undoubtedly be much higher in the future. Hence, conservative yield levels applied in the baseline calculations should be attainable.

Guided by these data, baseline figures for the yield of CFPP were estimated to be 262 cubic metres / hectare / year, of which 52 cubic metres / hectare is the thinning yield at 8 years and 210 cubic metres / hectare yield at the end of the rotation (Yong 1984).

ACCOMPLISHMENTS OF CFPP BETWEEN 1983 - 1989

Progress Of Project

The CFPP was first implemented in the States of Johor, Negeri Sembilan and Selangor in 1983 and followed by Pahang in 1984. By 1984, a total of 950 hectares of forest plantation had been established, costing M$ 2.347 million (US$ 0.869). This accomplishment represented only 14% of Federal Project's overall target of 7,022 hectares. Main reason for this slow progress was lack of capital. This resulted in lowering planting targets to match actual allocations for each State for that particular year. Due to this shortage of development funds the Federal Government resorted to external borrowing to finance CFPP in Peninsular Malaysia. Physical and financial accomplishments of CFPP are listed in Table 14.

With ADB Loan (No. 709 - MAL), the program's scope and size were considerably enlarged. While emphasis of the ADB project (Phase I) was still on establishment of forest plantations, infrastructure components such as purchasing of equipment, construction of dwellings and roads, training of project personnel, research and consultancy services were also emphasized.

ADB Loan (No. 709 - MAL) was signed on March 13, 1985. Subsequently, 6,002 hectares of marginal and poor forest were tendered out to be converted to forest plantation and 4,390 hectares of forest plantation were established the same year. This represented 73% of the target, with the balance to be completed the following year. Normally, it takes 11/2 - 2 years to complete a plantation establishment contract satisfactorily. Thus an area tendered out or bidded

Table 14. Accomplishments of CFPP (1983 - 1985), Federal Program.

State	Hectares Planted			Expenditure (M$' million)
	1983	1984	Total	
.Johor	295	250	545	1.116
N.Sembilan	178	15	193	0.417
Pahang	--	--	--	0.401*
Selangor	--	212	212	0.413
Total	473	477	950	2.347

Note: * infrastructure and equipment

Source: Johari (1987)

at the beginning of the year, will normally be completed the following year. However, in exceptional cases, when weather is favorable (to undertake field operations) matched with efficient contractors, plantation establishment can be completed within the same calendar year.

Similarly in 1986, 10,430 hectares were tendered out and 4,100 hectares of forest plantation were established. In order to facilitate implementation of CFPP, supporting equipment such as vehicles and infrastructures were both purchased and constructed.

In 1987 and 1988, 18,267 hectares of marginal forest and 5,301 hectares of poor forest were tendered out to be developed as forest plantation and 5,771 and 15,246 hectares were established, respectively. Similarly, 6,417 hectares of forest plantation were established in 1989. Logistics (equipment and vehicles) and infrastructures (dwellings and roads) were both purchased and constructed respectively, for the purpose of supervision and maintenance of new and existing forest plantations.

Under ADB Loan No.709 - MAL, Phase I of the project was to be completed by 1988. However, due to variances of weather and capabilities of contractors, the program was subsequently delayed and loan closing was extended to early 1989. Phase I of CFPP was finally completed in 1989 with 35,924 hectares (90%) of the forest plantation established, costing M$ 46.3 million (US$ 10.5) or 41% of initial allocation. Owing to a lack of use, a total of US$ 14.0 million was refunded to ADB. In addition, 24,030 hectares of forest plantation were given silvicultural treatments. One hundred kilometres of roads and 29 dwellings (offices in strategic locations, stores and fire towers) were constructed to facilitate supervision and maintenance of the plantations in addition to purchases of vehicles and equipment. A summary of the physical and financial accomplishments is listed in Table 15.

With completion of Phase I of CFPP, Federal Government is in the process of obtaining another sectorial loan of US$ 29.5 million from ADB for the duration 1989 - 1993. The loan will finance 43% of total cost of US$ 69.0 million, for establishing 42,000 hectares of forest plantation. Remaining portion of the money of US$ 39.5 million is to be borne by the Federal Government.

Table 15. Accomplishments of CFPP (1985 - 1989), ADB Program

State	Hectares						Expenditure (M$' million)
	1985	1986	1987	1988	1989	Total	
Johor	1,350	1,550	2,008	6,470	3,388	14,772	16.840
N. Sembilan	354	212	381	215	321	1,483	3.066
Pahang	2,175	1,222	2,760	5,451	1,509	13,117	18.112
Selangor	511	1,100	622	3,110	1,199	7,063	8.292
Total	4,390	4,100	5,771	15,246	6,417	35,924	46.310

Source: Anon (1989a)

In addition, three more State Governments in Kelantan, Perak and Trengganu have agreed to participate in Phase II of CFPP.

Location

CFPP will eventually involve most of the States in Peninsular Malaysia. During Phase I, only four States participated, where infrastructure and expertise for plantation establishment were readily available, due to earlier pilot pine plantation project.

During Phase II of CFPP, three more State Governments of Kelantan, Perak and Trengganu will be participating. Locations of potential forest plantations are detailed in Figure 5.

Generally, the locations are largely rolling to hilly country and are climatically suitable for planting. In addition, the forest plantation sites are easily accessible both by roads and telecommunications and both skilled and unskilled labor are easily available from nearby townships and rural settlements.

Stumpage Income

Directly quantifiable benefits are considered as sole incremental benefits from the program. Benefits were increased production of smallwood from second and third thinnings at years 4 and 8 respectively, and sawlogs from final harvest at year 16. Based on actual stumpage income, first thinning at age 2 is precommercial, with an average yield of 8.75 cubic metres / hectare. Second thinning at age 4, is commercial yielding 21.5 cubic metres / hectare and fetching a price of M$ 1.10 / cubic metre (US$ 0.41 / cubic metre). Table 16 shows actual stumpage volumes and income from thinnings, at age 4.

Figure 5: Compensatory Forest Plantations in Peninsular Malaysia

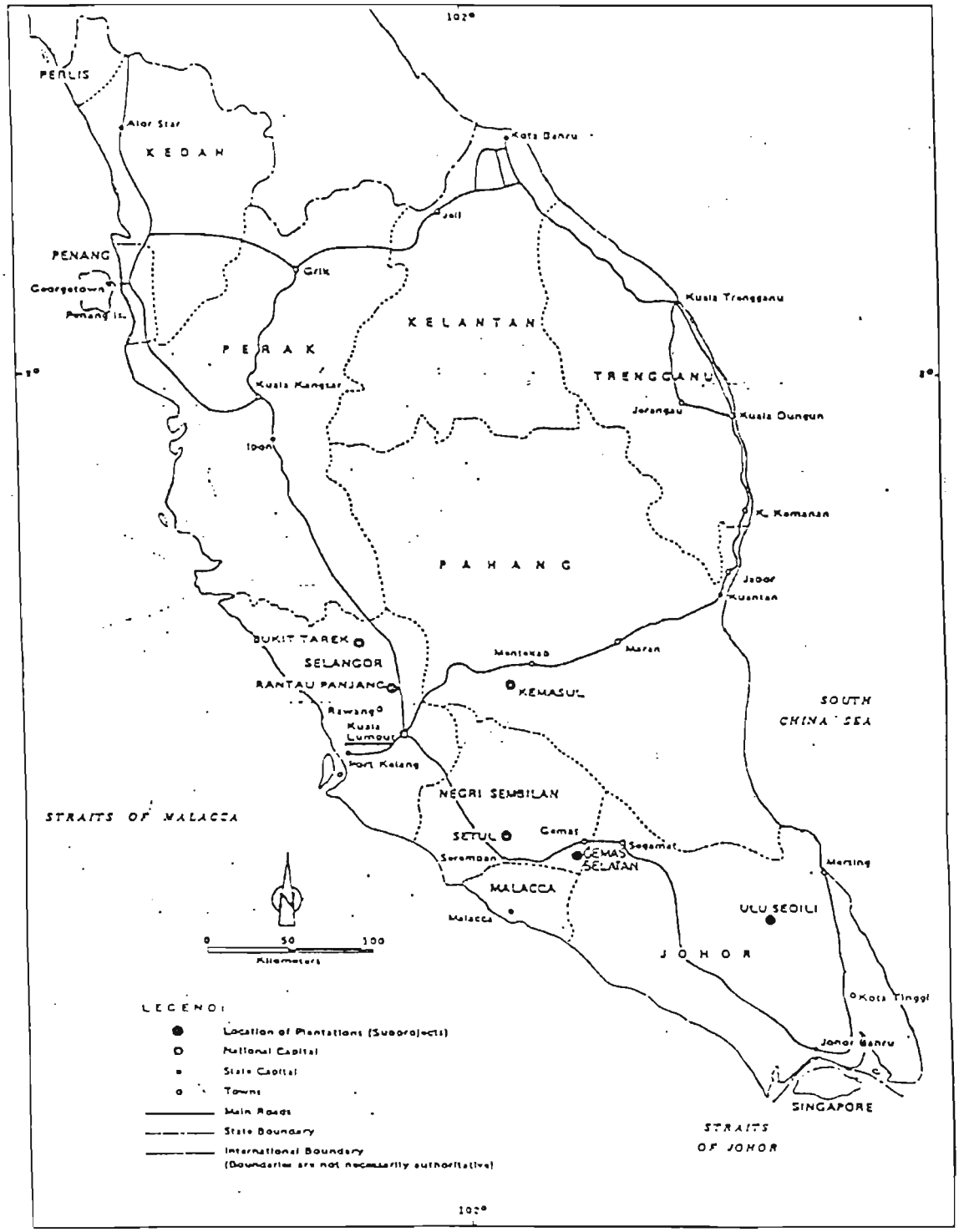


Table 16. CFPP stumpage income (1983 - 1989) (M$ ')

Year	Area (ha)	Thining year 4 Volume (cu.m./ha)	Thining year 4 Income (M$ ')	Total stumpage Volume (cu.m./ha)	Total stumpage Income (M$ ')
1983	473				
1984	477				
1985	4,390				
1986	4,100	10,170	11,187	10,170	11,187
1987	5,771	10,256	11,282	10,256	11,282
1988	15,256	94,385	103,824	94,385	103,824
1989	6,417	88,150	96,965	88,150	96,965

Stumpage Cost

Stumpage cost for the program has been based on the average of the actual bidding prices of successful contractors. Cost items include plantation establishment, fertilizers and agrochemicals, plantation management and silviculture treatment, construction and civil works, vehicles and equipment, consultancy services, training, research and development, maintenance of equipment and machinery from 1982 - 1989. Actual cost of CFPP is presented in Table 17.

Plantation Survival, Disease And Insects

The three CFPP species, *A. mangium, G. arborea* and *Al. falcataria* are easy to grow and adaptable to a wide range of conditions. Their success as plantation species (with a survival rate more than 90% even after the sixth year of planting) is primarily due to vigorous growth and a tolerance to a wide range of soil conditions (Mead and Miller 1991). The three CFPP species have the ability to compete and grow reasonably well, where competition is severe, especially as on Imperata grassland (Udarbe and Hepburn 1987). There are relatively free from pest and diseases (Johari and Chin 1986, Johari 1987, Anon 1989a). All three species have good wood properties (Logan and Balodis 1982, Chew and Jaafar 1986, Tomimura et al 1987 and 1988, Chew and Ong 1988, Wong et al 1988) and are potentially acceptable for a wide range of end uses.

Table 17. CFPP stumpage cost (1982-1989) (M$ ' 000)

Activity	1982*	1983	1984	1985	1986	1987	1988	1989
1. Administrative cost								
* HQ	279,059	277,154	255,887	290,637	573,930	450,711	463,274	258,915
*State	88,014	176,029	264,043	352,058	440,072	440,072	440,072	330,054
2. Development cost								
* Pl. establishment**		803,605	1,073,631	3,715,886	5,756,620	9,626,263	12,593,917	6,326,663
* Fert. & Ag. chem.		150,676	201,306	807,971	305,547	1,658,748	346,646	13,626
* Construction & civil works				43,920	481,566	275,132	41,568	
* Vehicles & Equip.				142,393	488,648	862,809	248,757	362,852
* Consult. serv.							304,119	
* Training					17,614	121,365	160,573	134,953
* R & D								11,319
* Maintanence (equip.& machinery)		50,225	67,102	18,142	31,000	95,411	93,059	191,967
Total	367,073	1,457,689	1,861,969	5,327,087	7,657,351	13,736,945	14,925,549	7,671,917

Note : * Expenses incur at planning stage prior to the CFPP
** In the early years, forest management costs are included in forest plantation establishment costs

PROJECTED CFPP MENSURATIONAL AND ECONOMIC VALUES

To assist in an analysis of expected future performance of the CFPP plantation, projected mensurational and economic values and parameters were established.

Growth Performance And Harvest Volume

Results from present growth plots of *A. mangium* (from ages 4 to 7), within existing forest plantations in Peninsular Malaysia, indicate an average MAI of 20.15 cubic metres / hectare (Table 18). Table 18 also indicates that growth of *A. mangium* is fast and rapid at early ages. MAI ranging from 30.0 - 55.0 cubic metres / hectare have been reported for similar forest plantations in Sabah (Tham 1980, Anon 1984a Liew 1984). MAI of between 28.0 - 28.4 cubic metres / hectare have been reported for the same species in Peninsular Malaysia (Freezaillah and Sandrasegeran 1966, Mitchell 1983). Based on these results and data from existing growth plots, MAI of CFPP conservatively can be estimated to be at least 20.15 cubic metres / hectare, for a rotation of 15 years. Estimated MAI is similar to the figures projected independently by ADB, of 20.0 cubic metres / hectare (Anon 1989a).

However, with improved knowledge on forest plantation management and continuous tree improvement programs, expected yields may be higher. Hence, the conservative yield applied here of 20.15 cubic metres / hectare should easily be attainable throughout the life of the forest plantations, under average conditions.

Table 18. Average growth performances of *Acacia mangium* within CFPP

State	Average MAI (cu. m. / ha) @ ages				Overall Ave. MAI (cu. m. / ha)
	4	5	6	7	
Johor	16.11	25.23	25.34	32.65	24.83
N. Sembilan	12.10	15.00	20.90	--	16.00
Pahang	15.72	19.14	23.97	27.40	21.56
Selangor	13.92	17.70	23.01	--	18.21
Average	14.46	19.27	23.31	30.03	20.15

Based on present growth rate of 20.15 cubic metres / hectare / year, net production will be 80% of gross incremental production, with a 20% reduction due to harvest loss (Anon 1989a). Hence, final harvest is projected to be 170 cubic metres / hectare (Anon 1989a).

Sales

As CFPP has yet to reach maturity, timber sales are associated exclusively with thinning operations. Thinnings at age 2 are precommercial, yielding an average of 8.75 cubic metres / hectare. Second and third thinnings at ages 4 and 8 are commercial, yielding an average of 21.5 and 59.5 cubic metres / hectare, respectively.

Earlier studies have reported that timber from CFPP possess attributes suitable for conversion into products such as plywood, panels and decking for houses and boats, general carpentry, moldings and boxes (Logan and Balodis 1982, Chew and Jaafar 1986, Tomimura et al 1987 and 1988, Chew and Ong 1988, Wong et al 1988). In other words, the timber from CFPP has the potential to be general utility timber and at the same time, have the benefits of a wide market spectrum within Peninsular Malaysia.

Stumpage Income

Smallwood from thinnings at age 4 have been sold for M$ 1.10 / cubic metre (US$ 0.41 / cubic metre) and thinnings at age 8 have been sold for M$ 23.00 / cubic metre (US$ 8.52 / cubic metre) (Sani 1992). An average price of the final harvests can best be approximated from price trends of similar general utility timber with similar physical and chemical properties. Technical properties of CFPP species are similar to Light Red Meranti (LRM) as reported by Lee et al (1979), Lee and Lopez (1980), Anon (1983), Johari (1987) and Anon (1989a). Thus, financial stumpage price of final harvest can be derived, from current prices of LRM, adjusting for quality

differential, transport costs, harvesting costs and Government taxes. Stumpage price for final harvest is taken as M$126.00 / cubic metre (US$ 46.67 / cubic metre). A summary of its derivation is shown in Table 19 while Table 20 and Table 21 show stumpage income of CFPP, on a per hectare basis and on income expected at the end of rotation, respectively.

Stumpage Cost

From 1990 onwards, stumpage costs will be derived proportionately, based on actual costs and adjustment for cost increases over time, in accordance with national parameters for programs of this nature. Physical contingencies of up to 5% of base cost from 1990 onwards, are added to account for uncertainties in the operation, equipment and protection of forest plantations. In programs associated with ADB, a contingency of 5% is normally incorporated into cost estimate projections (Anon 1989a). Cost items include administration, plantation establishment, forest plantation management, fertilizer and agrochemicals. Other costs include construction and civil works, vehicles and equipment, consultancy services, training, research / development and general maintenance.

Initially, most administrative costs are associated with supervision of contract work system to ensure compliance of contract conditions. Once forest plantations are established, administrative tasks will take on both supervisory and protective roles. Future administrative costs are estimated to increase by 2% per annum. For purposes of this preliminary review, only plantations established by 1989 will be used in the appraisal, thus no new plantation establishment will be considered. In accordance with present management regime for CFPP, an application of fertilizers is expected at age 8. A dosage of 120 g Christmas Island Rock Phophate (CIRP) and 60 g Triple superphosphate (TSP) will be applied. Cost of fertilizers and application is estimated at M$ 40.00 / hectare (US$ 14.81 / hectare). From 1990 onwards, cost estimates are

Table 19. Determination of stumpage value of final harvest (M$ ')

Item	Product price of final harvest (M$ ')			
	A. mangium / G. arborea		*Al. falcataria*	
1. Mixed LRM (ex-mill)		$365.00		$365.00
2.Adjusted for quality differences		$256.00		$124.00
		(30%)		(66%)
3. Less: Cost of transportation:	$23.00		$17.00	
Cost of extraction:	$52.00		$45.00	
Government taxes (14%)	$35.00		$18.00	
		$110.00		$80.00
Stumpage value		$146.00		$44.00
Average stumpage value		$135.80		

Note: To be more conservative in the calculation, the stumpage value was taken as $126 / cubic metre, the same value appraised by ADB for the program (Anon 1989a). It was further assumed that the value would remain constant in real terms throughout the program

Table 20. Thinning stumpage from CFPP (Age 2 - 15)

Age	Trees / hectare		Stumpage / hectare		
	Pre Thinning	Post Thinning	Volume (cu. m. / ha)	Unit Price (M$ ')	Income (M$ ' / ha)
2	900	300	8.75	--	--
4	600	400	21.50	1.10	23.65
8	400	200	59.50	23.00	1,368.50
16*	200	0	170.00	126.00	21,420.00

Note: * projected

Table 21. CFPP stumpage income (1990 - 2004) (M$ ')

Year	Thining (year) 4 Volume (cu.m./ha)	Thining (year) 4 Income (M$ ')	Thining (year) 8 Volume (cu.m./ha)	Thining (year) 8 Income (M$ ')	Final harvest (year) 16 Volume (cu.m./ha)	Final harvest (year) 16 Income (M$ ')	Total stumpage Volume (cu.m./ha)	Total stumpage Income (M$ ')
1990	124,077	136,485	28,144	647,312			152,221	783,797
1991	327,789	360,568	28,382	652,756			356,171	1,013,324
1992	137,966	151,763	261,205	6,007,715			399,171	6,159,478
1993			243,950	5,610,850			243,950	5,610,850
1994			343,375	7,897,625			343,375	7,897,625
1995			907,137	20,864,151			907,137	20,864,151
1996			381,812	8,781,676			381,812	8,781,676
1997							0	0
1998					80,410	10,131,660	80,410	10,131,660
1999					81,090	10,217,340	81,090	10,217,340
2000					746,300	94,033,800	746,300	94,033,800
2001					697,000	87,822,000	697,000	87,822,000
2002					981,070	123,614,820	981,070	123,614,820
2003					2,591,820	326,569,320	2,591,820	326,569,320
2004					1,090,890	37,452,140	1,090,890	137,452,140

used and in accordance with management regime as tabulated in Table 11. Status of forest management activities relative to the plantation establishment and their cost estimates are listed in Tables 22 and 23.

From 1990 onwards, no additional buildings or road bridges are planned. Existing facilities can accommodate the needs of forest plantations till maturity. Economic life span for buildings and bridges is 20 years. Forest plantations will have a road density of 4 metres / hectare for main access roads and 9 metres / hectare for branch roads. This was achieved by upgrading the existing logging tracks. Road upgrading is usually carried out in conjunction with land preparation and plantation establishment operations. Hence, its cost has been incorporated into earlier plantation establishment expenses.

Vehicles and equipment usage is less intensive as forest plantations have already been established. Hence, they will be used mainly for supervisory and protective roles. It is assumed for every 5,000 hectares, 4 landrovers (@M$ 80,000.00 each), 2 five ton lorries (@M$ 100,000.00 each) and 2 trailers (@M$ 25,000.00 each) are required. Total cost / hectare from 1990 onwards, is estimated to be M$ 114.00 / hectare (US$ 42.22 / hectare). Economic life of vehicles and equipment is estimated to be 8 years.

In compliance with the requirements of Phase I of ADB Loan, consultancy services were engaged in 1987 and completed within the same year. Most training expenses are incurred during the initial critical years of the forest plantation, where staff of Federal and State Forestry Departments are sent for training both locally and overseas. With experience gained from the above training as well as from ` hands on ' experience with CFPP, it is expected that training expenses will gradually be reduced over the years at 15% per annum, as more local training will be emphasized. However, a minimum of M$ 20,000.00 / year (US$ 7,407.41 / year) is required to conduct local training satisfactorily.

Table 22. Forest management status of CFPP.

Year of planting	Treatment No. 1 (<1 year)	2 (1 year)	3 (2 year)	4 (4 year)	5 (8 year)
1983	1	1	1	1	0
1984	1	1	1	1	0
1985	1	1	1	1	0
1986	1	1	1	1	0
1987	1	1	1	0	0
1988	1	1	1	0	0
1989	1	1	0	0	0

Note : 1 = Given

0 = Not given

Table 23. Post 1989 plantation treatment requirements (years)

Year of estab.	Ha	Post 1989 plantation treatment requirements (years)						
		8	9	10	11	12	13	14
1983	473	T5						
1984	477		T5					
1985	4,370			T5				
1986	4,100				T5			
1987	5,771	T4				T5		
1988	15,246		T4				T5	
1989	6,417	T3		T4				T5
Total (M$ ' 000)		3,155	2,910	2,147	902	1,270	3,354	1,412

Note : Estimated cost of Treatment No. 3 (T3) = $ 310.00 / hectare (US$ 114.81 / hectare)

Treatment No. 4 (T4) = $ 184.00 / hectare (US$ 68.15 / hectare)

Treatment No. 5 (T5) = $ 220.00 / hectare (US$ 89.07 / hectare)

In compliance with the conditions of ADB loan, a sum of money has to be set aside for research and development. Presently, research in forest plantations are undertaken by the Forest Research Institute of Malaysia (FRIM) and the Agriculture University of Malaysia (UPM), as part of their on - going programs. Most of the expenses incurred under this itemization are mainly for purchases of equipment to supplement the above organizations. Present rate of expenditure is expected to be maintained throughout the rotation.

From 1990 onwards, estimates of cost are used. This item is mostly associated with maintenance of plantation roads, where the main and branch roads are graded every alternate year. It is because of the vast expanse of the plantation, only a portion of it will be graded at any one time. Normally, contract will take two years to complete. As a result, for each hectare of forest plantation established, an estimate of about M$ 3.00 / hectare (US$ 1.11 / hectare) is allocated for upkeeping road systems and related equipment. Computer print out of the actual (1983 - 1989) and projected (1990 - 2004) cash flows of CFPP is enclosed as Table 24.

Table 24. Actual and projected cash flows of CFPP (1982-2004) (M$'000)

Items	Total	-1	1	2	3	4	5	6
I. Expected Revenue								
1. 1983 Program	10,790					11		
2. 1984 Program	10,381						11	
3. 1985 Program	100,146							104
4. 1986 Program	93,530							
5. 1987 Program	131,647							
6. 1988 Program	347,754							
7. 1989 Program	146,386							
Total	841,174	0	0	0	0	11	11	104
II. Expected Costs								
2.1 Administration (FD)	7,407	279	277	256	291	574	451	463
2.2 Administration (State)	8,259	88	176	264	352	440	440	440
2.3 Plantation establishment	39,998		804	1,074	3,716	5,757	9,625	12,594
2.4 Fertilizer and Agro'.	4,962		151	201	808	306	1,659	347
2.5 Forest management cost	15,150							
2.6 Construction and C/Access	843					44	422	275
2.7 Vehicles and equipments	6,417				142	459	863	259
2.8 Consultancy services	304							304
2.9 Training	1,152					18	121	161
2.10 Research and Development	176							
2.11 General maintenance	1,323		50	67	18	31	95	93
2.12 Contingency (5%)	1,645							
Total	87,640	367	1,458	1,862	5,327	7,659	13,737	14,925
III. Surplus/Deficit								
1. Revenue	841,174	0	0	0	0	11	11	104
2. Cost	87,640	367	1,458	1,862	5,327	7,659	13,737	14,925
3. Surplus/Deficit	753,534	(367)	(1,458)	(1,862)	(5,327)	(7,648)	(13,725)	(14,822)

Post planting (years) 7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	647								10,132						
		553								10,217					
			5,008								94,034				
57				5,511								87,822			
	136				7,896								123,615		
		361				20,864								326,569	
			152				8,782								137,452
57	783	1,014	6,160	5,511	7,896	20,864	8,782	0	10,132	10,217	94,034	87,822	123,615	326,569	137,452
259	264	269	274	279	285	291	297	303	309	315	321	327	334	341	348
330	337	344	351	358	365	372	379	387	395	403	411	419	427	436	445
6,327															
14	19	19	176	164	231	610	257								
	3,155	2,910	2,147	902	1,270	2,354	1,412								
42															
363					54	54	500	467	658	1,738	722			54	54
125	115	98	83	71	60	51	43	37	31	26	22	20	20	20	20
11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
192		111		111		111		111		111		111		111	
	195	188	152	95	114	243	145	66	70	130	75	44	40	49	44
7,673	4,096	3,950	3,154	1,991	2,390	5,097	3,044	1,382	1,474	2,734	1,572	932	832	1,022	922
57	783	1,014	6,160	5,511	7,896	20,864	8,782	0	10,132	10,217	94,034	87,822	123,615	326,569	137,452
7,673	4,096	3,950	3,154	1,991	2,390	5,097	3,044	1,382	1,474	2,734	1,572	932	832	1,022	922
(7,575)	(3,313)	(2,936)	2,966	3,520	5,506	15,767	5,738	(1,382)	8,658	7,483	92,462	86,890	122,783	325,547	136,530

FINANCIAL ANALYSIS OF CFPP (1990 - 2004)

A complete schedule of each transaction project to occur between 1990 (year 8) and 2004 (year 22) was presented earlier in Table 24. Each cash flow was identified by its year of occurence, description, type and amount.

Table 25 presents a yearly summary of the projected cash flows discounted to the beginning of 1990. Financial analysis of CFPP involved discounting the projected incomes and costs at various rates of interest to 1990, the beginning of the forecast period. The Net Present Value (NPV) is the value of future cash flows in CFPP at the beginning of the period 1990 - 2004. Varying interest rates reflect changes in risk. In addition, Benefit / Cost (B / C) ratio was calculated at various rates of interest, Table 25. B / C ratio was calculated by dividing discounted income by discounted costs. A positive B / C ratio indicates a return on investment in which benefits are greater than liabilities. Normally, in cases where project was partially or wholly funded by loans, as in the case with CFPP, B / C ratio would be provided, to indicate the benefits of the project over its costs.

Interest rates ranged from 2% - 20% (at 2% intervals) to determine the sensitivity of NPV and B / C ratio to changes in interest rates. In this case, discounted rate was inversely proportional to size of NPV (Table 25). It was seen that a 20% discounted rate had a dramatic effect by reducing the NPV from M$ 622.2 million (US$ 230.4 million) to M$ 78.2 million (US$ 29.0 million). All NPVs were positive which indicated the profitability of CFPP at each of the possible interest rates. Total benefits expected from CFPP, still exceed the expected costs.

Table 25. Projected cash flows of CFPP from 1900 - 2004 discounted to 1990 at various interest rates (M$ ' 000)

Discount rate (%)	Income	Cost	Net value	B / C
2	$652,976	$30,761	$622,215	21.23
4	$512,475	$27,534	$484,941	18.61
6	$402,341	$24,825	$377,516	16.21
8	$319,228	$22,532	$296,696	14.17
10	$255,120	$20,547	$234,573	12.42
12	$206,715	$18,888	$187,827	10.94
14	$166,333	$17,428	$148,905	9.54
16	$135,726	$16,212	$119,514	8.37
18	$111,522	$15,050	$96,472	7.41
20	$92,269	$14,065	$78,204	6.56

In an attempt to review the financial status of CFPP from 1983 - 2004, actual cash flows (incomes and costs) were compounded at discounted rates ranging from 2% to 20% (at 2% intervals), until the end of 1989, Table 26. Compounded net values were negative and ranged from M$ 56.0 million (US$ 20.7 million) to M$ 90.2 (US$ 33.4 million) and similarly, B / C ratios were also negative. Values in Table 26 were then combined with values in Table 25 into Table 27. At interest rates of 2% - 18%, financial values were positive, while B / C ratio exceeded 1. However, at 20% discount rate the NPV was negative and the B / C ratio is less than 1, which implied that the cost of the investment exceeded the returns from the project.

Although prior to 1989, CFPP was not profitable, considerable savings were accrued as US$ 14.0 million or 57% of the loan amount was refunded back to ADB. Post 1989 and combination of actual and projected forestry values supported the financial viability of CFPP. However, these evaluations were based on direct costs and benefits. In other words, forestry was assessed for its wood benefits.

There were wide ranging indirect costs and benefits associated with forest plantations established on marginal and poorly stocked natural forest. If these values, such as amenity, recreation, water retention, wildlife habitats were inputed with monetary values and incorporated into project feasibility, then perhaps, a different set of results would occur as to whether forest plantation was a profitable form of land use as opposed to continued use of marginal and poorly stocked forest. However, due to conceptual difficulties and practical problems of inputing values for these intangible costs and benefits, especially in a Third World country like Malaysia, these were not included in conventional economic evaluation. Nevertheless, it must be borne in mind that as the country becomes more developed, it might necessitate changes in policy options concerning forest land use.

A major justification of CFPP was to maintain the forest sector at its present level of activities, thereby ensuring security of jobs currently available in this sector. This was being

Table 26. Actual cash flows of CFPP from 1983 - 1989 compounded to 1989 at various interest rates (M$ ' 000)

Compound rate (%)	Income	Cost	Net value
2	$231	$56,306	- $56,037
4	$236	$59,795	- $59,559
6	$245	$63,481	- $63,236
8	$255	$67,382	- $67,127
10	$264	$72,291	- $72,027
12	$271	$75,863	- $75,592
14	$281	$80,472	- $80,191
16	$290	$85,345	- $85,055
18	$298	$90,494	- $90,196
20	$308	$95,938	- $95,630

Table 27. Combined compounded and discounted CFPP values at 1990 at various interest rates (M$ ' 000)

Interest rate (%)	Income	Cost	Financial value	B / C
2	$653,207	$87,067	$566,140	7.50
4	$512,711	$87,329	$425,382	5.87
6	$402,568	$88,306	$314,280	4.56
8	$319,483	$89,914	$229,569	3.55
10	$255,384	$92,838	$162,546	2.75
12	$206,986	$94,751	$112,235	2.18
14	$166,614	$97,900	$68,714	1.70
16	$136,016	$101,557	$33,459	1.33
18	$111,820	$105,544	$6,276	1.06
20	$92,577	$110,033	- $17,426	0.84

realized as wood generated from thinnings was being used for wood chips, particleboard and some saw timber production. Wood production will increase, as forest plantations mature. With continuous tree breeding and silviculture treatments of the plantation, it will no doubt increase both timber quality and yield, for saw timber production. Thus, CFPP should sustain, if not increase, the employment within forestry sector.

Greatest contribution of CFPP perhaps is, its ability to stabilize timber prices at affordable levels, especially to the lower income groups. Projected net costs of timber produced from this program were calculated by dividing the cost of CFPP by projected yield (170 cubic metres / hectare) at various interest rates (2% - 20%), ranged from M$ 13.89 / cubic metre (US$ 5.14 / cubic metre) to M$ 17.55 / cubic metre (US$ 6.5 / cubic metre), respectively. Timber produced at these prices should provide enormous leeway to both Federal and State Governments to regulate timber prices at levels affordable to the lower income groups, thereby fulfilling one of the objectives of CFPP.

The basic objective of CFPP was to compensate for the shortfall of timber coming out from natural forest. However, it would not compete with local timber export market, but rather curtail the necessity of importing timber for domestic consumption, thereby saving sizable foreign exchange.

Hence, from the above analyses it is evident that CFPP was physically feasible, financially viable and socio - economically desirable.

CONCLUSION AND RECOMMENDATIONS

A complete appraisal of CFPP is presently premature, since the program is still a long way from completion. However, CFPP in Peninsular Malaysia is now in its seventh year of a rotation of 15 years. Some factors, especially growth performances, physical and financial accomplishments, stumpage income, plantation establishment and development costs are now available. Based on these figures, a preliminary review of CFPP can now be undertaken. Findings indicate that

01. CFPP is physically feasible but non - commercial in the early years (1983 - 1989). Since 1990, CFPP has been commercially viable. In presenting an overall view of CFPP under Phase I, actual data (pre 1990) were combined with projected forestry values (post 1990) and results indicate that CFPP is financially viable.

02. Growth performances indicate that the general utility timber produced will make up for any shortfall that may arise towards the turn of 21st century and will be useful in the nation's economic development.

03. It is socio - economically desirable that as wood produced from CFPP will be at affordable prices to the lower income groups.

04. Wood from CFPP will eliminate the need for timber importation, thereby saving the nation's scarce foreign exchange.

05. Availability of funds derived from the international monetary and technical servicing agency such as ADB has greatly assisted in achieving the country's national aspirations through development of this valuable resource.

At the present moment, CFPP has achieved what it has set out to do compared to baseline figures and its projected values show encouraging results. In the author's opinion, future efforts should be consolidating the development of the existing forest plantations. This should ensure that the forest plantations will grow to maturity and realize maximum value. Recommendations for forest plantation development are

01. Research and development efforts need to be intensified to ensure CFPP continue to be free from diseases, pests and insects. A joint committee between Forest Research Institute of Malaysia (FRIM), Agriculture University of Malaysia (UPM) and Forestry Department Peninsular Malaysia shoud be set up, not only to ensure that there is no duplication in the research and development programs, but also that the efforts should be pragmatic and tailored to the needs of the forest plantations and the people it serves.

02. Silviculture techniques in pruning, thinning and fertilizing need further refinement so that the desired form and growth be attained at the earliest period possible.

03. Tree improvement programs should be intensified so as to ensure production of quality trees. In addition, vegetative propagation of CFPP species should be undertaken on an operational scale to improve genetic stock and bring about subsequent cost savings in their maintenance.

04. Earlier studies have supported the general utility nature of CFPP species. However, the timber has yet to be marketed vigorously. Now that CFPP is at its half way mark and as the plantations mature progressive commercial thinnings are being removed from the plantation. Steps should now be taken to develop local markets so that the timber will be readily acceptable.

05. Private sectors should be encouraged to participate since CFPP has proven to be viable both physically and commercially. This participation will not only reduce Government's capital investment, but also have private sectors

contributing to the nation's efforts in ensuring sufficient timber in the future. Finally, the task of providing general utility timber to the nation, will require combined efforts of both Government and private sectors.

LITERATURE CITED

Anon, 1959. Some aspects of the forest policy in the Federation of Malaya. Mal. For. Res. Phamp. No. 25.

Anon, 1975. Forest sector development in Peninsular Malaysia. A revision of data inputs and their analysis. FAO/UNDP Working Paper No. 34.

Anon, 1976. Forest management policy and strategies for Peninsular Malaysia. Forestry Department Peninsular Malaysia, unpublished report.

Anon, 1978a. Forestry Department Peninsular Malaysia Annual Report 1978.

Anon, 1978b. Forest resources of Peninsular Malaysia. Mal. For. 41: 82-98.

Anon, 1979. Forest resource base, policy and legislation of Peninsular Malaysia. Mal. For. 42: 328-347.

Anon, 1983. Mangium and other fast growing Acacias for the humid tropics. Report of an ad hoc panel of the advisory committee on technical innovations. National Research Council, Washington, D.C.

Anon, 1984a. Seeds for forestry and environmental conservation. Sabah Softwoods Sdn. Bhd., unpublished report.

Anon, 1984b. Memorandum of understanding on the proposed compensatory forest sector project. Economic Planning Unit, Prime Minister Department, Malaysia, unpublished report.

Anon, 1985. Tropical forestry action plan. FAO Publication. 154p.

Anon, 1989a. A second compensatory forest sector project. Forestry Department Peninsular Malaysia, unpublished report.

Anon, 1989b. Forestry in Malaysia. Ministry of Primary Industries Malaysia Publication. 67p.

Anon, 1990a. Forestry Department Peninsular Malaysia, unpublished data.

Anon, 1990b. Bank Negara Malaysia Annual Report 1990.

Anon, 1990c. The Malaysian rainforest: A living heritage. Forestry Department Peninsular Malaysia, unpublished report.

Anon, 1991a. Maklumat-maklumat sumber hutan diSemenanjung Malaysia pada 31 Disember, 1990. Forestry Department Peninsular Malaysia, unpublished report.

Anon, 1991b. Perangkaan Perhutanan Semenanjung Malaysia. Forestry Department Peninsular Malaysia Publication. 69p.

Anon, 1991c. Statistics on commodities (forestry). Ministry of Primary Industries Malaysia Publication. 147-177p.

Arshad, A. 1979. A national agricultural policy and its implications on forest development in the country. Mal. For. 42: 348-353

Baidoe, J.F. 1970. The selection system as practiced in Ghana. Comm For. Rev. 49: 159-165.

Cheah, L.C. 1978. Forest regeneration and development options in Peninsular Malaysia today. Mal. For. 41: 171-175.

Chew, L.T. and A. Jaafar. 1986. Particleboards from Acacia mangium. Paper presented at the 9th Malaysian forestry conference, Sarawak, Malaysia.

Chew, L.T. and C.L. Ong. 1988. Urea - formaldehyde particleboard from Yemane (Gmelina arborea). Jour. of For. Sc. 1: 26-34.

Chong, P.W. 1979. The growing domestic demand for timber and its influence on forest management. Mal. For. 42: 376-389.

Darus, H.A.and T.Y. Chin. 1990. Country report: Malaysia. Improve productivity of man made forest through applications of technological advances in tree breeding and propagation. Paper presented at the Asia-Pacific regional workshop on tree breeding and propagation, Bangkok, Thailand.

Darus, M.H.M. and H.C. Thang. 1988. Reforestation policy of Peninsular Malaysia. Paper presented at the 2nd MIER commodities and policy group meeting, Kuala Lumpur, Malaysia.

Dawkins, H.C. 1958. The management of natural tropical high forest with special reference to Uganda. Imp. For. Inst. Paper No. 34.

Evans, J. 1982. Plantation forestry in the topics. Clarendon Press, Oxford. 472p.

Florence, R.G. 1968. The role of blackbutt in east coast forest. Aust. For. 32: 118-127.

Freezaillah, C.Y. 1980. Forest resource development in Peninsular Malaysia. Paper presented at the International forestry seminar, Serdang, Malaysia.

Freezaillah, C.Y. and K. Sandrasegeran. 1966. Growth and yield of Yemane (Gmelina arborea Roxb.). Mal. For. 29: 140-153.

Johari, B. 1987. Compensatory Plantation Program in Peninsular Malaysia. Paper presented at the seminar on the future role of forest plantations in the national economy and incentives required to encourage investments in forest plantation development, Sabah, Malaysia.

Johari, B. and T.Y. Chin. 1986. A review of plantation experiences in Peninsular Malaysia. Paper presented at the 9th Malaysian forestry conference, Sarawak, Malaysia.

Jesus, R.M. 1990. The need for reforestation. Paper presented at the Workshop on large scale reforestation, Oregon, USA.

Koh, H.L. 1982. Fire occurences and fire protection practices in the existing pine plantations in Peninsular Malaysia. Paper presented at the 8th Malaysia forestry conference, Penang, Malaysia.

Kumar, R. 1986. The forest resources of Malaysia: Their economics and development. Oxford Uni. Press, Singapore. 286p.

Lee, S.S., S.Y. Teng , M.T. Lim and A.K. Razali. 1988. Discoloration and heart rot of Acacia mangium Willd.- some preliminary results. Jour. of Trop. For. Sc. 1: 170-177.

Lee, Y.H., E.A.C. Rahman and Y.P. Chu. 1979. The strength properties of some Malaysian timbers. Mal. For. Serv. Trade Lft. No. 34.

Lee, Y.H. and D.T. Lopez. 1980. The machine preperties of some Malaysian timbers. Mal. For. Serv. Trade Lft. No. 35.

Leslie, A.J. 1971. The demand side of the Malaysian forestry sector. Forestry Department Peninsular Malaysia, unpublished report.

Liew, T.C. 1984. Present state of knowledge and research priorities of forest plantations in Sabah. Paper presented at the seminar on the development of forest plantation in Malaysia, Sabah, Malaysia.

Logan, A.F. and V. Balodis. 1982. Pulping and paper making characteristics of plantation grown Acacia mangium from Sabah. Mal. For. 45: 217-236.

Mead, D.J. and R.R. Miller. 1991. The establishment and tending of Acacia mangium. Groome Poyry Ltd, Sumatra, Indonesia, unpublished report.

Mead, D.J. and H.T. Speechley. 1989. Growing A. mangium for high quality sawlogs in Peninsular Malaysia. Paper presented at the regional symposium on recent developments in tree plantations of humid / subhumid tropics of Asia, Serdang, Malaysia.

Menon, K.P.V. 1976. History and development of forest and forest industries. For. Res. Inst. Misc. Rep. 1976.

Miller, R.R. and A.J. Hepburn. 1989. A review of the growth of Acacia mangium at the Bengkoka afforestation and settlement project, north Sabah. Paper presented at the regional symposium on recent developments in tree plantations of humid / subhumid tropics of Asia, Serdang, Malaysia.

Mitchell, B.A. 1963. Possibilities for forest plantations. Mal.For. 26: 259-286.

Nicholson, D.I. 1958. An analysis of logging damage in in tropical rain forest, North Borneo. Mal. For. 21: 235-245.

Nicholson, D.I. 1965. A review of natural regeneration in the Dipterocarp forest of Sabah. Mal. For. 28: 4-26.

Oliphant, J.N. 1932. The constitution of reserved forests in the Malay Peninsular. Empire For. Jour. Vol. 11: 239-242.

Oliphant, J.N. 1934. Some economic aspects of timber production in Malaya. Empire For. Jour. Vol. 13: 42-62.

Othman, A.M. 1991. Malaysia's potential supply of timber in the future. Paper presented at the symposium on international trade in forest products around the Pacific rim, Seoul, Korea.

Poore, D., P. Burges, J. Palmer, S. Rietbergen and T. Synnot. 1989. No timber without trees. Earthscan Publication Ltd., London. 252p.

Rashid, A.M.A. 1984. Forestry development in Peninsular Malaysia by the year 2000 and beyond. Paper presented at the proceedings of the State Forest Directors conference, Penang, Malaysia.

Robinson, R.L. 1922. Forestry in the empire. Empire For. Jour. Vol. 1 (1): 11-34.

Sakhinbun, M.H. and K.H. Kudin. 1980. Plantation techniques of Hevea brasilensis in Malaysia. Paper presented at the International forestry seminar, Serdang, Malaysia.

Sani, A.S. 1992. Personal communication.

Smart, J.B. 1972. Analyses of cost and economics of proposed pine pulpwood plantation in West Malaysia. FAO / FO: SF /MAL / 67 / 512. Working Paper 21.

Tham, C.K. 1980. Acacia mangium Willd. as a plantation species for Imperata cylindreca (L) Beauv. grassland in Sabah. FAO / UNDP / Mal / 78 / 009.

Thang, H.C. 1984. Timber supply and demand in Peninsular Malaysia. Forestry Department Peninsular Malaysia, unpublished report.

Thang, H.C. 1985. Can the existing wood resources meet future requirements. Forestry Department Peninsular Malaysia, unpublished report.

Thang, H.C. 1991. Forest management practices in Malaysia. Paper presented at the ASEAN seminar on land use decisions and policies, Penang, Malaysia.

Tomimura, Y., K.C. Khoo and I. Suzuki. 1987. Manufacture of medium density fibreboard from Malaysia A. mangium. Mokuzui Gakkaishi 33: 335-338.

Tomimura, Y., K.C. Khoo, C.L. Ong and T.W. Lee. 1988. Medium density fibreboard from Albizia falcataria. Jour. of For. Sc. 1: 26-34.

Udarbe, M.P. and A.J. Hepburn. 1987. Development of Acacia mangium as a plantation species in Sabah. Paper presented at the International workshop on Australian Acacias in developing countries, Queensland, Australia.

Watson, J.G. 1934. Forest research in Malaya. Empire For. Jour. Vol. 13: 223-231.

Watson, J.G. 1950. Some materials for a forest history of Malaya. Mal. For. Vol. 13: 63-72.

Whitemore, T.C. 1975. Tropical rainforest of the Far East. Clarendon Press, Oxford. 398p.

Wong, T.M. 1974. A marketing strategy for Malaysian timber. Mal. For. 37: 244-262.

Wong, W.C., K.S. Ho and C.N. Wong. 1988. Acacia mangium from Sabah for plywood and decorative panel manufacture: initial trials. Jour. of For. Sc. 1: 42-50.

Wyatt-Smith, J. 1961. A review of Malayan silviculture today. Mal. For. 24: 5-18.

Wyatt-Smith, J.and A.J. Vincent. 1962. Progressive development in the management of tropical lowland evergreen rainforest and mangrove forest in Malaya. Mal. For. 25: 199-223.

Yong, C.T. 1984. Compensatory Plantation Project - A long term strategy to maintain timber self-sufficiency in Peninsular Malaysia. Paper presented at the seminar on the development of forest plantation in Malaysia, Sabah, Malaysia.

GLOSSARY

Annual coupe	: An area of forest that will be harvested each year and this is determined by dividing the productive forest areas by the rotation age.
Clonal seed orchard	: An area where genetically selected trees are grown for the production of high quality seeds, which will be used to improve the stocking in the forest plantation.
Cutting cycles	: A forestry rotation
Dipterocarp forest	: A forest comprising predominantly of the high density and low density Shorea species, with varying proportions of the Parashorea species, Dipterocarpus species and Dryobalanops species. These forest also contain timber species of the families Leguminosae, Burseraceae, Meliaceae, Anacardiaceae, Apocynaceae, Sapotaceae and many others.
Enrichment planting	: Planting of trees in forest areas which are poor of natural regeneration.
Forest exploitation	: The extraction of logs from the forest.
Forest management	: The science of managing a forest in accordance with sound forestry principles and practices.
Forest reserve	: A forest established by the State Government under the provisions of the State Forest Enactment.
Game reserve	: Land set aside under the provision of the Game Enactment for the purpose of games conservation.
Malayan Uniform System	: A silviculture system in which the felling cycle corresponds to the length of its rotation (approximately precribes the removal of the mature crop in one single felling of all trees down to 45 cm DBH) for all species. The next crop depends upon tending the seedling regeneration on the ground, at the time of felling.
National Forestry Council	: A council comprising of the Chief Ministers of the States of Malaysia that coordinates policy on forestry matters. It is chaired by the Deputy Prime Minister of Malaysia.

National Forestry Policy	: A policy approved for implementation by the National Forestry Council. The policy ensures uniformity in the implementation of all forest management, conservation and development strategies towards achievin common objectives.
National Parks	: Land set aside under special legislation for recreational and educational purposes.
Permanent Forest Estate	: Areas of forest reserves, strategically located throughout the country, in accordance with the concept of rational land use such as Protective, Productive and Amenity Forest.
Pinus caribaea	: A tropical pine species found in Central America that has been widely used in forest plantation establishment in the tropics.
Poison girdling	: An operation of girdling and poisoning with chemicals of unwanted weed and injured trees to favor the growth of the more desirable and commercial species.
Productive forest	: A forest that has been set aside for productive functions, especially in the production of major forest produce such as logs.
Reforestation	: Establishment of trees by natural or artificial means.
Rotation	: The time period between planting and harvesting of trees.
Selective Management System	: After a pre-felling inventory, an appropriate silvicultural system is selected with cuting limits for different groups of species. It is a method of adapting the system used, to the conditions of the individual stand.
Silviculture operations	: The art and science of cutting trees.
Tropical Forest Action Plan	: An action plan sponsored by FAO, dedicated to more effective coordination, cooperation and collaboration between donor agencies and developing countries to improve the availabilty and use of human and financial resources for the conservation and sustainable development of the tropical forest resources.

APPENDIX

Appendix 1: Salient points of the National Forestry Act 1984

The salient points of the National Forestry Act, 1984 which have been accepted for implementation by all the States Forestry Departments in Peninsular Malaysia in terms of forest management, conservation and development are as follows

01. The Director of the State Forestry Department shall

   A. prepare and implement state forest management plans which shall prescribe the allowable cut either in terms of volume or area, in accordance with the principle of sustained yield,

   B. prepare and implement reforestation plans,

   C. review from time to time the state forest management plans and reforestation plans prepared under paragraphs (a) and (b) respectively, and

   D. prepare and implement programs relating to amenity forest.

02. When any land in the Permanent Forest Estate is excised for economic use higher than that for which it is being utilized, the State Authority shall constitute an approximately equal area of land as the Permanent Forest Estate.

03. Unless otherwise exempted by the State Authority, before any license is issued, the Director of the State Forestry Department shall require the applicant to do any or all of the following

   A. to demarcate on the ground the area or part there of covered by the license, the situation and extent of which shall be determined by the Director in

accordance with the provisions of the license, within which operatios will be carried out by the applicant on becoming a licensee; and

B. to prepare a forest management plan or forest harvesting plan, and a reforestation plan in the manner to be specified by the Director.

04. Where a licensee, without reasonable excuse, fails to carry into effect a reforestation plan to the satisfaction of the Director, the Director may in addition to revoking the license, require the licensee to pay forthwith to the State Authority a sum equivalent to the amount that would be incurred by the State Authority if it were to undertake or to engage any person to carry into effect the plan.

05. The State Authority shall establish a Forest Development Fund which is funded through the following means

A. any sums that are annually appropriated by the State Legislative Assembly for the purposes of the Fund,

B. any forest development cess collected in respect of any forest produce removed from any forested area,

C. any loans or grants given to the State Authority by the Federal Government for the purposes of the Fund,

D. any money paid to the State Authority for carrying out into effect a reforestation plan when the forest licensee failed to implement it successfully, and

E. all moneys collected under any previous forest law by the State Authority for the purpose of financing research on forestry, silviculture works, forest surveys, inventory and other related operations connected with forest development in the state, which remains unexpended.

06. The Fund shall be used for the following purposes

A. the preparation of the state forest management plans,

B. the preparation and implementation of reforestation plans,

C. the reviewing of the state forest management plans and reforestation plans,

D. the preparation and implementation of programs relating to amenity forests, and

E. any expenses incurred by the State Authority in carrying into effect a reforestation plan when a licensee fails to implement it.

Appendix 2: Salient points of the National Forestry Policy

The salient points of the National Forestry Policy are as follows

01. To dedicate as Permanent Forest Estate sufficient areas of land strategically located throughout the country in accordance with the concept of rational land use in order to ensure

A. sound climatic and physical conditions of the country, the safe guarding of water supplies, soil fertility and environmental quality and the minimization of damage by floods and erosion to rivers and agriculture lands, such as forest land being known as Protective Forest,

B. the supply in perpetuity at reasonable rates of all forms of forest produce which can be economically produced within the country and are required for agriculture, domestic and industrial purposes, such as forest land being known as Productive Forest, and

C. the conservation of adequate forest areas for recreation, education, research and the protection of the country's unique flora and fauna, such forest land being known as Amenity Forest.

02. To manage the Permanent Forest Estate with the objective of maximizing social, economic and environmental benefits for the nation and its people in accordance with the principles of sound forest management.

03. To pursue a sound program of forest development through regeneration and rehabilitation operations in accordance with approved silvicultural practices in order to achieve maximum productivity within the Permanent Forest Estate.

04. To ensure through and efficient utilization of forest resources on land not included in the Permanent Forest Estate, prior to the alienation of such land, by means of proper coordinated planning by land development agencies in order to obtain maximum

benefits for the people through complete harvesting and processing of such resources, adhering strictly to the optimum need of local processing industries.

05. To promote efficient harvesting and utilization of all forms of forest produce and to stimulate the development of appropriate forest based industries with determined capacities commensurate with the resource flow in order to achieve maximum resource utilization, create employment opportunities and earn foreign exchange.

06. To ensure the sound development of trade and commerce in and to promote the exportation of forest products.

07. To undertake and support an intensive research program in forest development aimed at achieving maximum yield from the Permanent Forest Estate, maximum direct and indirect benefits from harvesting and utilization and, above all maximum financial returns on investment in forest development activities.

08. To undertake and support a comprehensive program of forestry training at all levels in the public sector in order to ensure an adequate supply of trained manpower to meet the requirements of forestry and forest based industries.

09. To encourage private sector's involvement in forestry research and training at all levels with a view to accelerate industrial development and enhance the quality of professionalism in forestry and forest industrial practices.

10. To foster, by education and publicity, a better understanding among the community of the multiple values of forest to them and their descendants.

VITA

After matriculating at A. C. S., Ipoh, Perak, Malaysia, Tuck Y. Chin entered the Australian National University, Canberra, A.C.T., Australia, and graduated with a Bachelor of Science (Forestry) (Honours) in 1974. Since graduation, he has served with Forestry Department Peninsular Malaysia in various capacities, throughout the country.

He has served in four States in Peninsular Malaysia and has held positions of State Silviculturist (Perak), Forest Management Officer (Forestry Department Headquarters), Deputy State Director of Forestry (Trengganu) and Regional Plantation Manager (Johor). Prior to his departure to United States of America, he has held the post of Deputy Director of Forest Plantation, Forestry Department Headquarters, Kuala Lumpur. In January, 1992, he entered Stephen F. Austin State University. He is married to Lilian Too and they have a daughter, Elaine Chin.

Permanent Address: 37, Jalan SS 25 / 33,
Taman Mayang, Petaling Jaya,
47301 Selangor, Malaysia.

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