THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

THE MASTER PLAN SURVEY REPORT ON THE IRRAWADDY BASIN INTEGRATED AGRICULTURAL DEVELOPMENT

ANNEX H

FORESTRY

MARCH 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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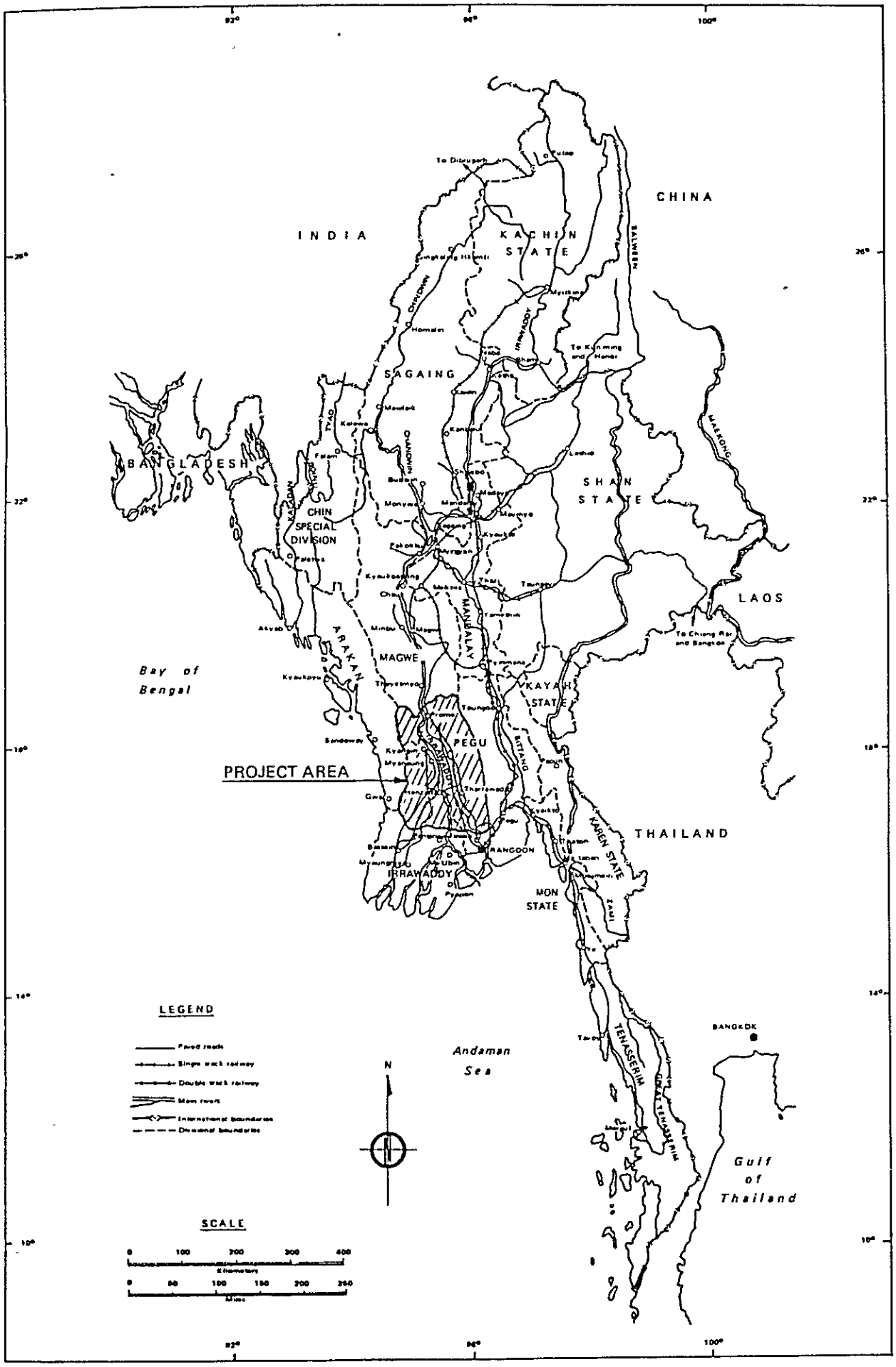
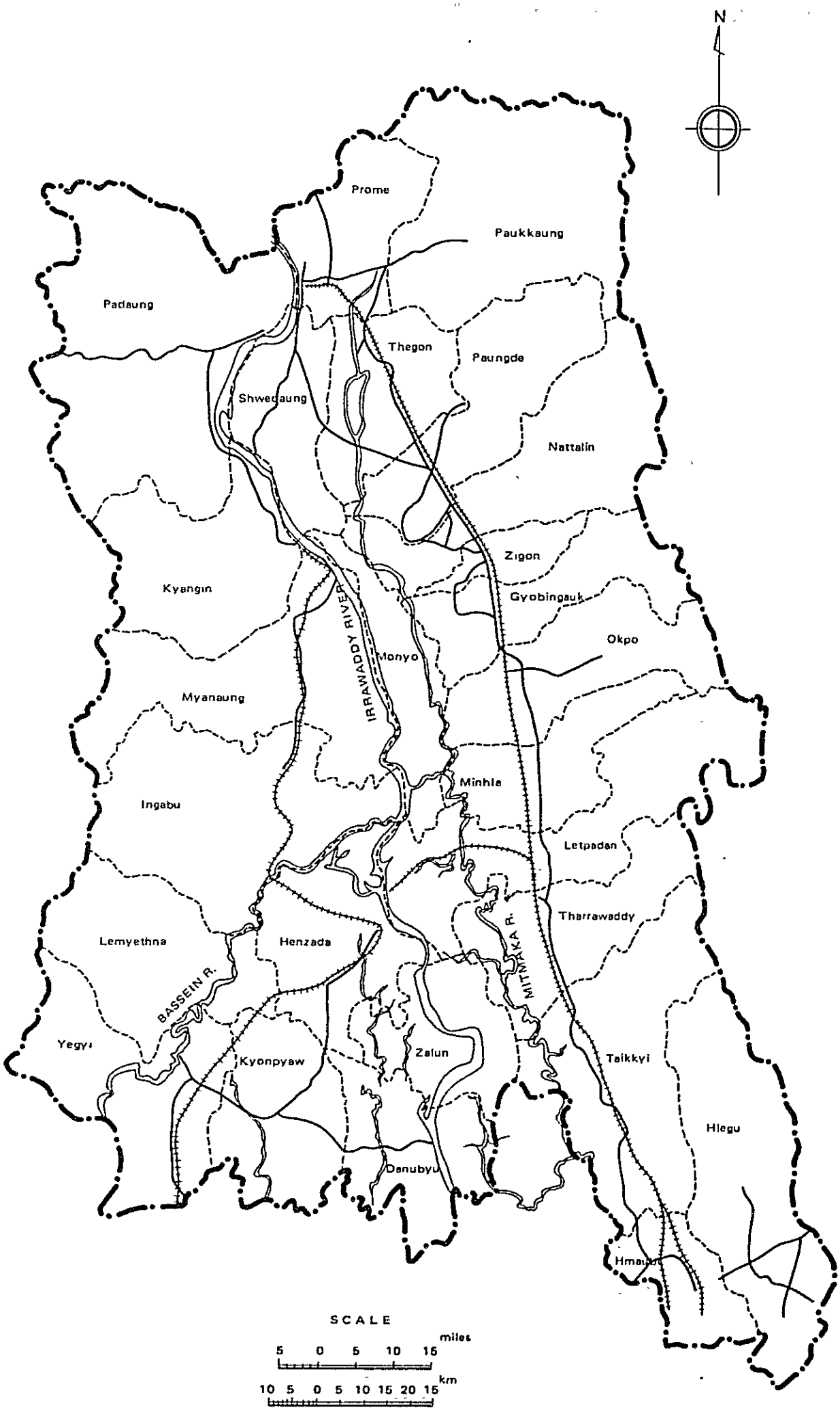

INDIA
CHINA
BANGLADESH
KACHIN STATE
SAGAING
SHAN STATE
CHIN SPECIAL DIVISION
MAGWE
MANDALAY
PEGU
KAYAH STATE
KAREN STATE
MON STATE
LAOS
THAILAND
PROJECT AREA
IRRAWADDY
RANGOON
BANGKOK
Bay of Bengal
Andaman Sea
Gulf of Thailand
LEGEND
SCALE


N
Prome
Paukkaung
Padaung
Thegon
Paungde
Shwedaung
Nattalin
Zigon
Kyangin
Gyobingauk
IRRAWADDY RIVER
Okpo
Monyo
Myanaung
Minhla
Ingabu
Letpadan
Tharrawaddy
Lemyethna
Henzada
MITMAKA R.
BASSEIN R.
Yegyi
Kyonpyaw
Zalun
Taikkyi
Hlegu
Danubyu
SCALE
miles
5 0 5 10 15
km
10 5 0 5 10 15 20 15

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ABBREVIATION, MEASURES AND GLOSSARIES

AC	Agriculture Corporation
ADB	Asian Development Bank
AE	Assistant Engineer
AGM	Assistant General Manager
AFPTC	Agricultural and Farm Produce Trade Corporation
AMD	Agricultural Mechanization Department
APS	Advance Purchase System
Ave	Average
BAG	Bachelor of Agricultural University
BKT	Basket(s)
CIF	Cost Insurance and Freight
°C	Degree Centigrade
DAGM	Deputy Assistant General Manager
DG	Director General
DGM	Deputy General Manager
Dy	Deputy
EE	Executive Engineer
EL	Elevation
EPC	Electric Power Corporation
FC	Foreign Currency
FiD	Fishery Department
FERD	Foreign Economic Relations Department
FIC	Foodstuff Industries Corporation
FOB	Free on Board
FoD	Forest Department
F/S	Feasibility Study
FY	Fiscal Year from April to March
GM	General Manager
GNP	Gross National Product
GWH	Giga Watt Hour
HP	Horsepower

HWL	High Water Level
HYV	High Yielding Variety (of paddy)
Hz	Hertz per second
IBRD	International Bank for Reconstruction and Development
ID	Irrigation Department
IDA	International Development Association
KV	Kilo Volt
KW	Kilo Watt
KWH	Kilo Watt Hour
LC	Local Currency
LDMC	Livestock Development and Marketing Corporation
LIV	Local Improved Variety
LWL	Lower Water Level
LV	Local Variety
MAF	Ministry of Agriculture and Forests
MD	Managing Director
MHD	Meteorological and Hydrological Department
MI 1	Ministry of Industry No. 1
M/P	Master Plan
MPF	Ministry of Planning and Finance
MT	Ministry of Trade
MW	Mega Watt
MWL	Mean Water Level
PD	Project Director
pH	Potential of Hydrogen
PPFC	People's Pearl and Fishery Corporation, MAF
PPM	Part(s) per Million
%	Percent
PSD	Planning and Statistics Department
SD	Survey Department, MAF
SLRD	Settlements and Land Records Department, MAF
TC	Timber Corporation, MAF
TEM	Township Extension Manager
TSP	Triple Super Phosphate

UCC	University Computer Center
UGCF	Union Government Consolidated Fund
VAHD	Veterinary and Animal Husbandry Department
VTB	Village Tract Banks
WPSD	Working People's Settlement Department

MEASURES

Length

mm	millimeter (s)
cm	centimeter (s)
m	meter (s)
km	kilometer (s)
inch	25.4 mm
ft	foot (feet) = 12 inch = 30.48 cm
mile	5,280 feet = 1.609 km

Area

sq.cm	square centimeter (s)
sq.m	square meter (s)
sq.km	square kilometer (s) = 100 ha
ac	acre (s) = 4,047 sq.m
sq.mile	square mile = 2.59 sq.km = 640 ac
ha	hectare

Capacity

ℓ	litter
cu.m	cubic meter
MCM	Million Cubic Meter
cu.ft	cubic foot (feet) = 28.32 ℓ
cu.yd	cubic yard = 0.765 cu.m
AF	Acre Foot (feet) = 1,233.48 cu.m
Qt	Quart = 1/4 gl = 1.136 ℓ (UK) = 0.946 ℓ (US)
gl	gallon = 4.543 ℓ (UK) = 3.785 ℓ (US)

Note: UK: British Measure
US: US Measure

Weight

g	gram (s)
kg	kilogram (s)
ton	metric ton
oz	ounce = 28.4 g
lb	Pound = 16 oz = 0.454 kg

Others

cm/sec	centimeter per second
m/sec	meter per second
km/sec	kilometer per second
mile /hr	mile per hour= 1.609 km/hr = 0.447 m/sec
ft/second	feet per second
cu.m/sec	cubic meter per second
cfs/cu.sec	cubic foot (feet) per second = 0.0283 cu.m/sec
gl/sec	gallon per second = 4.543 ℓ/sec = 0.0757 ℓ/min

Glossaries

lakh	100,000
crore	10,000,000
viss	1.633 kg
Pyi	2,127 kg
basket	20.9 kg (paddy)
basket	34.0 kg (rice)
bag	75.6 kg (rice)
Chaung	River or Stream
Kyat	Unit of Local Currency (about 30 Japanese Yen)
In	Lake or Swamp area
Yoma	Mountain range
1 US$	6.44 kyats

SUMMARY

(1) The forest in the Area, particularly the reserved forest, is kept in favourable conditions due to the selection felling of teak.

(2) The means of forestry production are now in stage of co-existing, namely conventional elephant/floating system as well as logging machine/truck system. The former will give place to the latter in near future.

(3) The overcutting in the unclassed forest for fuel wood supply is now causing devastation of the forest in the Area. Effective countermeasures must be urgently established.

(4) The devastation of the unclassed forest may propagate to the reserved forest unless the fuel wood supply is assured. The plantation program of the short maturing species initiated by the Forest Department must be expedited.

(5) Despite the big investment is required to implement the item (4), the progress is not satisfactory due to low price of the fuel wood.

(6) To overcome such situation, the Forest Department expects proper foreign financial aids.

(7) Also, equipment for logging, extraction and processing is substantially required to increase forest products and to modernize the forest industry.

An essence of this Annex is compactly presented in Appendix H-1, and an outline of this Annex is described in Appendix H-2.

I. GENERAL DESCRIPTION

Burma has a forest area of approximately 38.85 million hectares (150,000 sq.miles) equivalent to 57% of its land area, 678,000 sq.km (262,000 sq.miles). Burma is favoured by vast forest areas and abundant forest resources. The forestry sector, however, accounts for only 2.5% of the gross domestic product in 1974/75 as shown in Table H-1. The forestry production shifts that both of teak and hardwood were more than 724,000 cu.m (400,000 tons) in 1939/40 of the prewar and teak production in 1972/73 was 543,000 cu.m (300,000 tons) and hardwood, 1,828,000 cu.m (1,010,000 tons) and the former has not yet reached the level before the war (See Table H-2).

However, the teak stands for a virtual importance in her foreign trade bringing in Kyat 232 million out of entire export earning of Kyat 913 million or accounting for 25.4%, next to the rice. The depression in timber production may be due to precarious local condition and insufficient extraction measures despite the fact that the situation took a favourable turn after 1976/77.

TABLE H-1 GROSS DOMESTIC PRODUCT BY SECTOR

(Unit: Million Kyat)
(1969/70 Constant Price)

Sector	1972/73	1973/74	1974/75		1975/76 2/
				(%)	
Agriculture	2,765	3,023	2,963	(26.6)	3,179
Fishery 1/	715	803	764	(6.9)	835
Forestry	272	236	274	(2.5)	262
Mining	139	120	121	(1.1)	140
Industry	1,081	1,054	1,094	(9.9)	1,232
Eelctric Power	72	89	86	(0.8)	113
Construction	204	187	195	(1.8)	205
Transportation	587	555	573	(5.2)	588
Communication	35	38	41	(0.4)	41
Trade	2,637	2,663	2,769	(25.0)	2,921
Finance	204	184	216	(1.9)	129
Government Services	1,031	1,038	1,146	(10.3)	1,280
Other Services	795	822	842	(7.6)	865
Total	10,537	10,812	11,084	(100.0)	11,790

Remarks: 1/ Inclusive of Animal Husbandry
2/ Provisional

Source : Preliminary Survey Report on South East Asia Forestry Cooperation
- May 1977 JICA -

TABLE H-2 TREND OF TIMBER PRODUCTION

(Unit: Thousand Ton)

Year	Teak	Hard Wood
1939/40	447	478
61/62	250	916
69/70	301	912
70/71	302	928
71/72	291	1,038
72/73	307	1,007
73/74	95	373
74/75	251	497

Source: General Situation of Burma Feb. 1977
Ministry of International Trade and Industry

II. CURRENT FOREST CONDITION IN THE AREA

II.1. Forest Resources

Most of the forest in the Survey Area extends along the Pegu Yoma, the east of the Area and also is in the Arakan Yoma, the west, with the total acreage of 2.28 million hectares (5.6 million acres). The Survey Area is well endowed with the Pegu Yoma, the major teak producing zone in Burma. The forests of the Pegu Yoma are mainly composed of an evergreen-decidous mixed forest, teak as well as valuable hardwoods, whereas the Arakan Yoma has more rainfall than the Pegu Yoma, presenting a forest type of much more hardwood and sparser teak (See Table H-3). Further details of the types of forest by the Forest Division are shown in Appendix H-3.

The forest area in the Survey Area comprises 0.87 million hectares (2.1 million acres) of a reserved forest and 1.41 million hectares (3.5 million acres) of an unclassed forest. Although the reserved forest includes a protection forest as a part, it is a commercial forest while the unclassed forest is mainly for local supply, though a part of it in good forest regime is a commercial forest.

The ratio of the reserved forest to the total forest acreage is 38% and it is considerably higher comparing with average rate of 27% within the jurisdiction of concerned Forest Divisions (See Table H-4). The population of the Area is approximately 7.6 million and the breakdown is as shown in Table H-5.

The number of the reserved forests in the Area is 39 and a total stock of hardwood, more than four inches girth in size, is about 2.53 million cu.m (14 million tons). The greater part of the reserved forest is at the Pegu and Arakan Yomas, and each reserved forest is divided into compartments and controlled by working circle.

TABLE H-3 LIST OF MAJOR HARDWOOD

Name	Scientic Term
TEAK	TECTONA GRANDIS
PYINCADO	XYILA DOLABRIFORMIS
THITYA	SHOREA OBLONGIFOLIA
INGYIN	PENTACME SIAMENSIS
KOKKO	ALBIZZIA LEBBEK
HNAW	ADINA CORDIFOLIA
TAUKKYAN	TERMINALIA TOMENTOSA
IN	DIPTEROCARPUS TUBERCULATUS
KANYIN	DIPTEROCARPUS ALATUS
PINMA	LAGERSTROEMIA SPECIOSA
TAUNGTHAYET	SWINTONIA FLORIBUNDA
TAYAW	GREWA SPP.

TABLE H-4 AREA OF RESERVED AND PUBLIC FORESTS BY FOREST DIVISION

(Unit: 1,000 acres)

Forest Division	Division Area		Reserved Forest		Unclassed Forest	
	Total	Project Area	Total	Project Area	Total	Project Area
1. Prome(East Bank	1,246	(1,246)	330	(330)	916	(916)
1. Prome(West Bank	601	(601)	342	(342)	259	(259)
2. Zigon	479	(479)	290	(290)	189	(189)
3. Tharrawaddy	893	(893)	221	(221)	672	(672)
4. Insein	1,770	(446)	301	(292)	1,469	(154)
5. Henzada/	1,857	(1,857)	565	(565)	1,292	(1,292)
Bassein	2,640	(101)	508	(101)	2,132	(-)
Total	9,486	(5,623)	2,557	(2,141)	6,929	(3,482)

Source: Forestry Department

TABLE H-5 POPULATION IN THE PROJECT AREA

Forest Division	Urban		Rural		Total	
	Population	Household	Population	Household	Population	Household
1. Prome	149,327	29,865	561,024	112,205	710,351	142,070
2. Zigon	68,821	13,764	430,813	86,163	499,634	99,927
3. Tharrawaddy	73,925	14,785	345,822	69,164	419,747	83,949
4. Insein	2,478,579	495,716	1,083,710	216,742	3,562,289	712,458
5. Henzada/ Bassein	408,412	88,785	1,994,051	433,489	2,402,463	522,274
Total	3,179,064	642,915	4,415,420	917,763	7,594,484	1,560,678

Source: Forestry Department

The unclassed forest is a term used by the Forest Department representing the area other than the reserved forest and is located in the plain area, upland areas and undeveloped land. The land use pattern in the area conforms to the general topographical slope shifting from lowlying paddy zone in the plain to the Ya land in the hilly land, further into shrub and tree up to the reserved forest in the mountaneous zone.

It is understood that the undeveloped land and land of shrubs were once a forest zone but were denuded in consequence of extraction of timber, felling of log for fuel and for building of houses and shifting agriculture during a long time. At the present acreage and stock of shrub and tree except farm land in the unclassed forest have not investigated and the actual condition is unknown.

II.2. Organization and Ownership

General forestry administration, forest management, preparation and renewal of forest plan and plantation are under the jurisdiction of Forest Department (See Figure H-1), while the Timber Corporation (See Figure H-2), is responsible for extraction, processing, marketing and related operations. The Forest Department controls 15 Administrative State and Divisions and two other directors under Director General.

The Project Area extends over the three jurisdictions of these Administrative State and Divisions, and five Forest Divisions are under these three. They are Prome, Zigon and Tharrawaddy Forest Divisions within the jurisdiction of East Pegu Administrative State and Division, Insein Forest Division of Rangoon State and Division, and Henzada Bassein Forest Division of Irrawaddy Administrative State and Division.

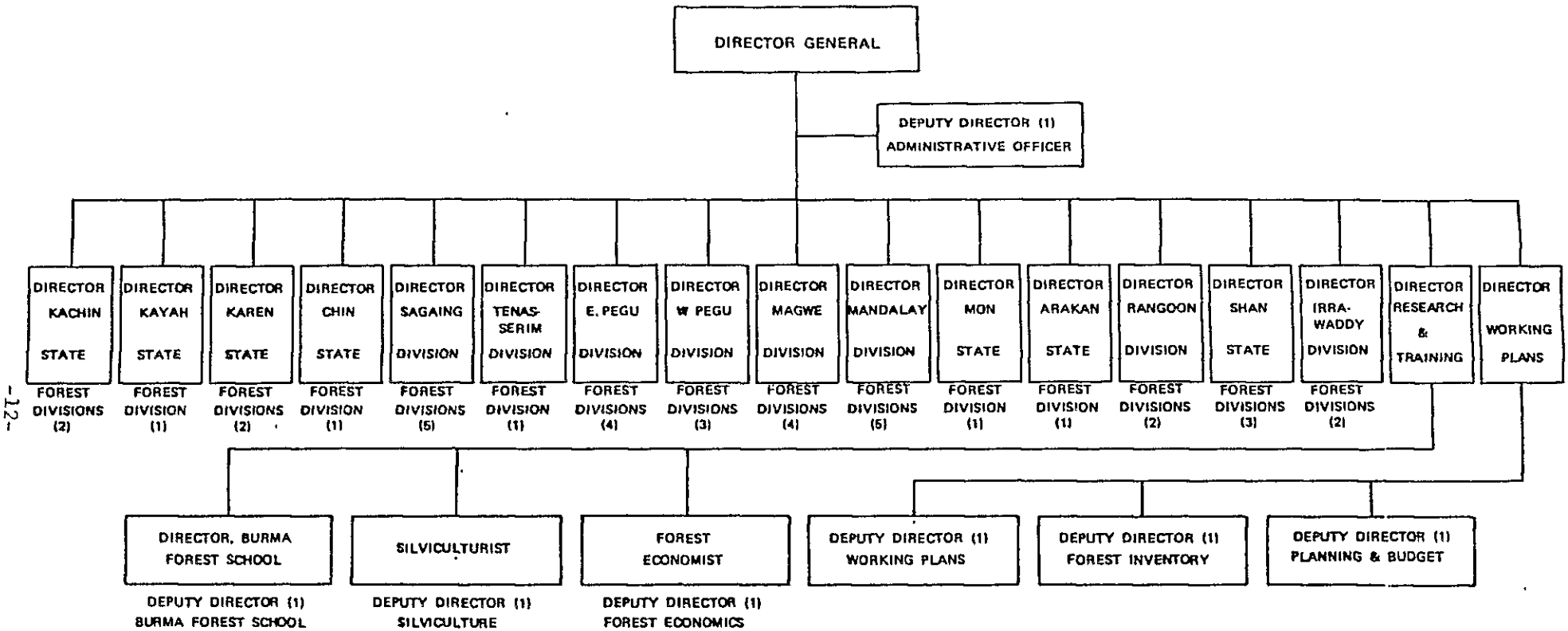
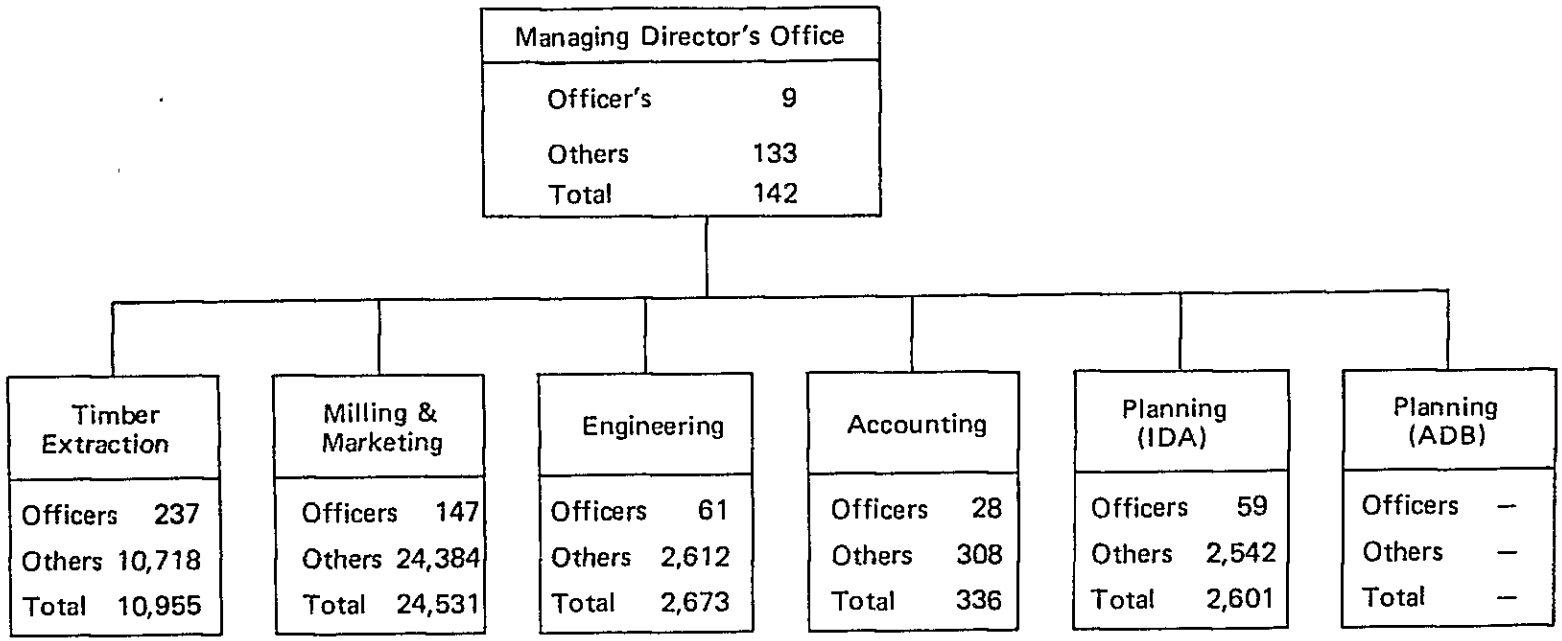


FIGURE H-1

FOREST DEPARTMENT ORGANIZATION CHART

STAFF		
1	DIRECTOR GENERAL ...	1
2	DIRECTORS	17
3	DEPUTY DIRECTORS ...	35
4	ASSISTANT DIRECTORS ...	94
5	RANGE OFFICERS ...	216
6	DEPUTY RANGE OFFICERS	414
7	FORESTERS	1,615
	TOTAL	2,392



Total	41,238
Officers	541
Others	40,697

FIGURE H-2
ORGANIZATION AND MANNING OF STATE TIMBER CORPORATION

In each Forest Division the Deputy Director is the chief of the Division. A part of the region of both Insein and Henzada Bassein Forest Divisions is outside of the Area. All forests, lands and trees are owned by the state, but the local people is allowed to get forest products such as fuel-wood, posts and poles for houses and bamboo in the unclassed forest within the radius of 34 km (20 miles) from the villages only for their own use under the authorization of the Forest Department.

For harvest of forest products for trade, a license issued through the Forest Division is indispensable in both reserved and unclassed forests. The local people has to pay royalty for the license. The teak forests are strictly controlled by the Government since they are considered as the national assets, and in case of teak growing in a private land permission by the Forest Division is required for its cutting. There exists no public and private forests neither public and private plantation lands.

II.3. Forest Condition

Through aerial survey and site investigation, conditions of the forest and proposed irrigation dam sites are follows. In the reserved forests of the Pegu Yoma, the selection logging operation for the teak and hardwood production is performed. Generally, the forests are in good close stands without any bare lands. The basin areas of the proposed reservoir sites located in well-conserved forests provide an adequate water regulation function.

The renewal of the forest is mainly under natural one. An overall felling is a dominant practice whereby the poorly stock forest while the teak plantation by the Taunya Method is undertaken along forest roads.

Non-tree lands and shrub lands in the unclassed forests have been converted to farm lands where agriculture and forestry are

competitively co-existing. The unclassed forest has been slowly devastated year by year due to over cutting for domestic use.

In the meanwhile, the reserved forest along the Arakan Yoma closely situated to the Irrawaddy river is precipitous comparing with that of Pegu Yoma, but both reserved and unclassed forests are densely growing. However, it has not been fully exploited yet due to sparsity fo teak. In the west side of the Irrawaddy river the forests are well reserved because of sparse population and less belling for the fuel-wood.

II.4. Forest Working Plans

The forest working plans have a long history and have been formed on the basis of stand types, stocks and increment as the result of forest survey, and through this, effective forest management is done. Records proved that the first working plan around Prome was established in 1856. A ten-year plan formulated at each Forest Division has been updated every ten years.

Several working circles are provided depending on the forest types. They are (1) teak selection working circle, (2) hardwood selection working circle, and (3) local supply working circle. For instance, the teak selection working circle has been systematically implemented as to ensure the constant supply of the teak all the time conforming to the growth volume of the preserved stock in the reserved forest.

II.5. Forestry Production

The forestry production in the Area inclusive of the Insein and Bassein Division amounts to 190,000 cu.m (105,000 tons) accounting for 14.7% of the total products in the country. The production of teak and hardwood comes up to 87,000 cu.m (48,000 tons) and 103,000 cu.m (57,000 tons) accounting for 15.3% and 14.2% out of the national products, respectively (See Table H-6).

TABLE H-6 TIMBER PRODUCTION

(Unit: 1,000 ton)
(1975/76)

Area	District	Teak	Hardwood	Total
Project Area	Prome	24	6	30
	Zigon	10	19	29
	Tharrawaddy	4	12	16
	Insein	5	4	9
	Henzada/Bassein	5	16	21
	Total	48	57	105
Other Area	Total	265	344	609
	Grand Total	313	401	714

Source: Forest Feasibility Study Forest Resources Report

TABLE H-7 ANNUAL ALLOWABLE CUT
(1975/76)

District	Teak			Hardwood		
	AAC 1/ (No.)	AC 2/ (No.)	Ratio (%)	AAC (1,000ton)	AC (1,000ton)	Ratio (%)
Prome	9,740	11,769	121	27.9	5.6	20
Zigon	3,500	5,234	150	26.0	19.8	76
Tharrawaddy	3,100	1,768	57	14.5	12.0	83
Insein	1,150	2,442	212	11.7	3.7	32
Henzada/ Bassein	2,080	2,357	113	95.8	16.3	17
Total	19,570	23,570	120	175.9	57.4	33

Remarks: 1/ Annual Allowable Cut
2/ Actual Cut

Source : Forest Feasibility Study Forest Resources Report

And annual allowable cut of teak and hardwood is estimated at each Forest Division (See Table H-7). When the annual allowable cut is compared with products in the Area, teak products are 120% of the annual allowable cut showing 20% overcut. On the contrary, hardwood products are only 33% of the annual allowable cut. Teak production in the Zigon and Insein Forests Divisions is respectively 150% and 212% of the annual allowable cut (See Table H-7). The following two are considered as the reasons of short cut. (1) As the market of hardwood is mainly for domestic consumption, the importance of hardwood production is less compared with that of teak wood for export. (2) As hardwood is difficult to be transported by floating using small rivers the extraction is difficult in the region where forests roads are not developed.

In addition, the annual allowable cut of teak and hardwood was modified in August of 1978 (See Table H-8). As is seen in Table H-8, the revised annual allowable cut of the teak increased remarkably due to the modified criteria which lowered the breast height girth from 7'6" to 6'6".

TABLE H-8 REVISED ANNUAL ALLOWABLE CUT
(August 1978)

District	Teak		Hardwood	
	Revised (No.)	Former (No.)	Revised (1,000ton)	Former (1,000ton)
Prome	9,740	9,740	77.0	27.9
Zigon	6,530	3,500	22.8	26.0
Tharrawaddy	6,790	3,100	10.6	14.5
Insein	4,820	1,150	6.0	11.7
Henzada/ Bassein	1,650	2,080	73.7	95.8
Total	29,530	19,570	190.1	175.9

Source: Forestry Development Requirement Nov. 1978.

II.6. Girdling, Extraction and Haulage

There are two kinds of producing methods of teak wood. One is dry teak producing method. By this method the Forest Department determines the amount of extraction for each compartment according to the annual allowable cut and conducts girdling of teak consulting with the Timber Corporation. The Timber Corporation cuts woods three years after the girdling. The other method is green teak producing method on which a live tree is cut without girdling.

For hauling of the teak, elephants, buffaloes and wheeltype skidders are used. The labour hour of the elephant starts from early morning up to around 11:00 a.m. since it cannot work during the hot day time. Moreover, it does not work during dry season. Amount of extraction per elephant for one season is said to be approximately 181 cu.m (100 tons). Teakwoods are transported from the forest to rafting depot at the Irrawaddy river by floating for dry teak and by truck for green teak. The dry teaks stocked at rafting depot at the Irrawaddy river are rafted and towed by a boat to Rangoon, but where rivers cannot be used the railroad is used.

Past records show that in 1975/76 the loss rate of logs amounts to as high as approximately 25%. Most of the loss is happened when the log is singly floated along small streams. On the one hand, the green teaks are mixed with dry ones to Rangoon, but the mixed ratio of the green teaks should be less than 25%.

The cutting and transportation of hardwoods are almost same as those of green teaks, but through the Irrawaddy river a raft of hardwoods is towed holding between small boats. Transportation by truck is increasing to minimize the loss during the single log floating and to tide over the increased amount of hardwood extraction. Despite and enough distance of 64-80 km (40-50 miles) for the overland transportation, small type trucks, low in efficiency and high in cost are still employed in the Pegu Yoma sites due to some advantages of locally produced vehicles.

For a long time teakwoods have been produced by the dry teak method through selection logging in Burma but recently production of green teak is increasing due to price advantage.

II.7. Forest Road

As the main transporting means are floating through rivers and cutting cycle is as long as 30 years for selection logging, the forest road network is not adequately arranged. There are only two all weather roads, one of which goes across the Pegu Yoma and the other the Arakan Yoma, and the remainders are the feeder roads, passable during dry season. The all weather roads are bitumen-paved, while the feeder roads are not gravel-paved because gravel is not available at the rivers.

II.8. Repair Shop

A repair shop for overhaul of engines supported by the World Bank is located in Prome. The repair shop is well equipped with lathes, drills and pump testers but for the body mostly repaired at field.

II.9. Saw Mill

There are 15 saw mills in the Area as shown in Table H-9 and their total processing capacity is approximately 8,000 cu.m (4,400 tons). The outline of the Paukkaung No. 83 Saw Mill which represents the above saw mills is as follows. It was established in 1972 for hardwood saw mill and its processing capacity is approximately 43 cu.m (24 tons = 12 sawn tons) per day.

The major facilities consist of a Diesel engine of 180 HP, one set of seven inches break down saw and three sets of four inches and three inches circular saws. Employees are 70 including a manager. Furthermore, a hand saw is only at a teak saw mill in Rangoon City and no hand saw is used at other mills.

TABLE H-9 LIST OF SAW MILL

State/ Division	Township	Saw Mill Location	Saw Mill Name	Capacity (ton)	No. of Employee	Annual Income (Ks. 000)
Pegu	Paukkaung	Paukkaung	No. (83) Saw Mill	6,500	78	2,179
	Paungde	Paungde	No. (29) "	2,500	58	1,491
	Padaung	Nyaungchedauk	Mobile (2)	2,000	27	705
	Paungde	Tamangyi	No. (23) Saw Mill	6,000	60	2,186
	Natalin	Natalin	No. (30) "	3,500	53	1,638
	Gyobingauk	Gyobingauk	No. (63) "	6,000	86	2,795
	Minhla	Minhla	No. (66) "	6,000	46	2,237
			Total	32,500	408	13,231
Rangoon	Taikkyi	Taikkyi	U Mya Mg Saw Mill	1,000	17	391
			Total	1,000	17	391
Irrawaddy	Henzada	Henzada	Hla Htain Win	1,500	19	849
			Tun Ne Win	1,500	18	846
			Aung Theikdi	1,500	19	839
			No. (31) Nationalized	2,500	39	1,438
	Kyangin	Kyangin	Mobile (5)	1,500	20	757
			Thein Thaung	800	17	439
			Yadana	1,200	18	249
			Total	10,500	150	5,417
			Grand Total	44,000	575	19,039

Source: The First Stage Survey Report

The annual production in 1978/79 was expected to be 11,800 cu.m (6,500 tons) but the actual receipt was as much as 3,000 cu.m (1,700 tons) due to acute shortage of raw log supply. Since the Timber Corporation puts emphasis on export of teak, the hardwood supply was subsequently depressed.

Waste timbers are sold to local pepple for fuel use but saw dust is piled beside the mill left unused. As forestry related industry, a timber saw mill is principal and no other industries have been yet developed.

II.10. Plantation Area

Felling of natural forests are mainly performed by selection logging operation, but the natural renewal is not necessarily in good condition. In the forest of poor stock after felling of all woods, artificial afforestation is done and to take a countermeasure for devastation of the unclassed forests, eucalyptuses of short maturing species have been planted for fuel use since seven years ago (See Table H-10).

Records of 1977/78 show that teaks are approximately 550 hectares (1,360 acres) equivalent to 39% of the total plantation acreage of the country and that eucalyptuses are 450 acres accounting for 12% of the country basis. The teak plantation is concentrated in the area along the Pegu Yoma. The major eucalyptus plantation area is in the central part of Burma, the dry zone, another words less importance in the Area. In the divisions of Prome, Zigon and Tharrawaddy, the teak is preferable for nursery management and also due to shortage of staff, the plantation of eucalyptuses was suspended but in Insein and Bassein divisions it is continued.

TABLE H-10 AREA OF PLANTATION

(Unit: acre)

Year	Teak and Others		Pyinkado		Eucalyptus		Total	
	Nation-wide	Project Area	Nation-wide	Project Area	Nation-wide	Project Area	Nation-wide	Project Area
1974/75	2,470	598	148		4,669	536	7,287	1,134
1975/76	2,423	605	730	75	4,607	683	7,760	1,363
1976/77	2,520	750	1,000		4,335	705	7,855	1,455
1977/78	3,485	1,360	1,500	300	3,840	450	8,825	2,110
Sub-total	10,898	3,313	3,378	375	17,451	2,374	31,727	6,062
1978/79	4,600	1,700	1,000		5,250	600	10,850	2,300
1979/80	6,100	2,350	1,000		6,900	900	14,000	3,250
1980/81	7,650	2,500	1,000		7,950	1,350	16,600	3,850
1981/82	9,100	2,500	1,000		11,300	3,000	21,400	5,500
Sub-total	27,450	9,050	4,000		31,400	5,850	62,850	14,900
Total	38,348	12,363	7,378	375	48,851	8,224	94,577	20,962

Source: Forest Department

Concerning the organization for the plantation of teaks, the Prome Forest Division has four assistant directors under the deputy director and five sub-assistant directors under the each assistant director. By this system each assistant director executes the plantation of approximately 200 hectares (500 acres) per annum with sub-assitant directors. Consequently, the Prome Forest Division, performs the plantation of 800 hectares (2,000 acres) annually through this system.

Increased yields of teak and other hardwoods from the natural forests may also be required in future because of additional demands for export as well as domestic consumption due to population increases. The increased production can only be met by establishment of teak and other hardwood plantations expanding the scale in the current four-year plan initiated in 1978/79 as is shown in the Table H-11. In the four-year plan the area of teak plantation is expected to be about 3,700 hectares (9,050 acres) and eucalyptuses approximately 2,400 hectares (5,850 acres) in the Area.

TABLE H-11 FOUR-YEAR PLANTATION PROGRAM

(Unit: acre)

Division	1978		1979		1980		1981		Total	
	Teak	E.C.	Teak	E.C.	Teak	E.C.	Teak	E.C.	Teak	E.C.
Prome	1,500		2,000		2,000		2,000		7,500	
Insein		300		500		750		2,000		3,550
Henzada/ Bassein	200	300	350	400	500	600	500	1,000	1,550	2,300
Total	1,700	600	2,350	900	2,500	1,350	2,500	3,000	9,050	5,850

Source: Forestry Requirement as a Component of the Irrawaddy Project - Nov. 7, 1978 Forestry Dept.

Note: E.C. denotes Eucalyptus.

II.11. Teak Plantation

Teak plantation begins with distribution of a plantation lands of about 1.2 - 2.0 hectares (3.0 - 5.0 acres) to each Taunya worker in November of the following year after the Timber Corporation felled and logged in the rainy season. The Burmese 'Taun' means a mountain and 'Ya' cultivation. The 'Ya' workers start felling residual trees in December and finish the work in February.

After felling, the teaks are dried for 20 - 30 days and in March the first burning is done. In April wood residue and pieces are collected and again burning is done. Planting is between the end of April and the middle of June.

Personnel of the Forest Department put a stake and sow nine seeds directly to the land. Germination yield ratio is average 30% and usually a seed buds 20 to 30 days after sowed. In case of bad germination stumps are filled in August. However, when much rain is expected at the time of direct sowing stumps are planted concurrently.

Planning spacing is 2.7m x 2.7m. As the rainy season ends in October, the rainfall lasts for more than four months after plantation. The 'Ya' workers plant such upland crops as groundnuts, sesame, upland paddy etc. between the rows of saplings. It takes, therefore, almost two years from felling by the Timber Corporation till plantation by the Forest Department.

The 'Ya' workers do weeding for saplings as well as the crops three times in the first year, twice in the second and once in the third. Every year between February and May fire protection is performed. The 'Ya' workers acquire rights to cultivation for two years in return for site preparation. The wage for weeding is about Kyat 37 per hectare but when high rate of the survival percentage of the teak sapling was attained, they can receive an additional payment.

As mentioned above, the direct sowing is the dominant practices in seeding, the seedling demand for saplings is not large and accordingly nursery fields are very limited and poorly equipped. Saplings are dilivered from the nursery fields when they have grown in the stage of 10 cm long in root and 2.5 cm long in stem.

An yield table of teak saplings is made according to the site quality. The site quality is classified into I to V, but there are middle qualities between said qualities, totaling nine ranks on the whole. In most part of plantation forests in the Area, the site quality is II, II/III or III (See Table H-12). In the land of quality II/III, the stump yield at 60 years, is approximately 240 cu.m/ha (3,420 cu.ft/ac) by main cutting and thinning (See Table H-13). The direct cost of plantation is approximately 500 Kyat/ha (200 Kyat/ac) (See Table H-14).

TABLE H-12 SITE QUALITY

(Unit: Nos of Place)

Site Quality	I	I/II	II	II/III	III	III/IV	IV	IV/V	V
Insein	-	-	1	12	14	-	1	-	-
Prome	1	4	5	1	5	4	-	-	-
Tharrawaddy	-	-	8	7	8	2	2	-	-
Zigon	-	3	17	5	5	8	7	-	1

TABLE H-13 YIELD AND STAND TABLES FOR PLANTATION TEAK

(Unit: True cu.ft)

Age (Year)	Main Crop: Ave. Dia. (inch)	Ave. Height (ft)	No. of Trees (No.)	Standing vol. of Stem	Standing vol. of small Wood	(C)	Thinning (A)	Thinning (B)	Thinning (C)	Final Yield (A)	Final Yield (B)	Final Yield (C)	Accumulated Yield of Training (A)	Accumulated Yield of Training (B)	Accumulated Yield of Training (C)	Total Yield (A)	Total Yield (B)	Total Yield (C)	Mean Annual Increment: Stem Timber	Mean Annual Increment (C)	Current Annual Increment: Stem Timber	Current Annual Increment (C)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
5	3.3	32	532	0	450	450	0	260	260	0	710	710	0	260	260	0	710	710	0	142		
10	5.3	50	288	0	1,030	1,030	0	440	440	0	1,470	1,470	0	700	700	0	1,730	1,730	0	173	0	204
15	6.8	60	198	200	1,220	1,420	0	390	390	200	1,610	1,810	0	1,090	1,090	200	2,310	2,510	13	167	40	156
20	8.0	67	149	400	1,140	1,540	20	340	360	420	1,480	1,900	20	1,430	1,450	420	2,570	2,990	21	150	44	96
25	9.0	73	120	610	1,030	1,640	40	290	330	650	1,320	1,970	60	1,720	1,780	670	2,750	3,420	27	137	50	86
30	9.9	78	101	830	900	1,730	80	260	340	910	1,160	2,070	140	1,980	2,120	970	2,980	3,850	32	128	60	86
60	16.2	100	53	2,440	550	2,990	120	70	190	2,560	620	3,180	980	2,800	3,780	3,420	3,350	6,770	57	113		
80	22.2	110	36	3,450	680	4,130	70	30	100	3,520	710	4,230	1,300	2,950	4,250	4,750	3,630	8,380	59	105		

Note: (A): Volume of Stem (B): Volume of Small Wood (C): Stem & Small Wood Total

Source: Site Quality II/III INDIAN FOREST RECORDS (NEW SERIES) SILVI CULTURE FRI 24 IV-A-1

TABLE H-14 DIRECT COST OF TEAK PLANTATION
(Planting Spacing 9 x 9 ft)

(Unit: Kyat/acre)

Description	Amount
Taung Ya Cut	73
Removal of Wood Residue	45
Staking	8
Sowing	12
Stump	30
Preparation of Stake	15
Planting	7
Transportation	2
Camp	7
Total	199

Source: Information from Ass't. Director U Zaw Win No. 18, 1978

II.12 Forest for Local Supply

The reserved and unclassed forests are the supply sources of bamboo, fuel-wood, posts and poles to the local people. Fuel-wood is also supplied to the people in southern delta area such as Rangoon and Bassein as well as those in the Area.

Since the population is expected to increase annually by 2.4% and there is no substitutable fuel sources, the Area holds an important position as a supply sources for all domestic wood requirements. However, as the unclassed forest has been devastated in shrub, the supply of fuel-wood has been confronted with critical condition year by year.

To take measures for this, the Forest Department is trying to encourage people in planting eucalyptuses around houses by free supply of the seedlings on every Arbor Day, 1 of July since 1976. In the whole country, 340,000 eucalyptus seedlings in 1977, 410,000 in 1978 and 3,750,000 in 1979 were distributed, of which 700,000 are expected to be supplied to this Area inclusive of the Bassein and Insein Divisions. This is equivalent to approximately 930 hectares (2,300 acres) under planing spacing of 3.6m x 3.6m (12' x 12').

Furthermore, every year after 1980 seedling supply of 5,000,000 is intended (See Table H-15). Further details on the teak and eucalyptus plantation are presented in Appendix H-4.

TABLE H-15 SEEDLING SUPPLY

(Unit: 1,000 Nos.)

Year	Nation-wide	Project Area
1976	340	50
1977	340	50
1978	410	90
1979	3,750	70
1980	5,000	not decided
1981	5,000	not decided

III. FORESTRY DEVELOPMENT

III.1. Wood Supply for Domestic Use

It is reported that fuel-wood for heating is not needed in Buama but roughly 4.5 cu.m (2.5 tons) per household of wood for cooking and other domestic use are required.[1/] The number of the households that are supplied for domestic use from this Area is 1.56 million both inside and outside of the Area and accordingly annually 7.11 million cu.m (3.93 million tons) is required (See Table H-16).

TABLE H-16 POPULATION FOR DEMAND OF FUEL WOOD

(Unti: 1,000)

Forest District	Urban Area		Rural Area		Total	
	Population	Household	Population	Household	Population	Household
Prome	149	30	561	112	710	142
Zigon	69	14	431	86	500	100
Tharrawaddy	74	15	346	69	420	84
Insein	2,479	496	1,083	217	3,562	713
Henzada/ Bassein	408	89	1,994	433	2,402	522
Total	3,179	644	4,415	918	7,593	1,561

Though the entire stock volume of the unclassed forest in the area is not clearly assessed, the Forest Department estimated that an annual wood supply for domestic use in the area would be equivalent to 180,000 cu.m (100,000 tons), if the unclassed forest was well preserved. This amount of supply is, however, far below the demand of 7.11 million cu.m (3.93 million tons).

1/ FAO Report No. FAO/57/11/7529
Report on Integrated Forest Indusries in Burma by
Dr. Von Honroy

Consequently, each year the unclassed forest is over cut and destruction of the forest is progressing and in future destruction of the reserved forest might be unavoidable. As average stock of the reserved forest is said to be roughly 224 cu.m/ha (50 ton/ac), assuming that the total volume of domestic use wood is supplied from the reserved forest, it could cause destruction of 32,000 hectares (80,000 acres) per year and great effect would be brought on water regulation function and soil conservation.

Although the Forest Department has executed the four-year plantation program and free supply movement of eucalyptus seedlings on Arbor Day as the countermeasures, a nursery is becoming issue. On execution of the program and movement the nursery for free supply movement of eucalyptus seedlings started in 1976 was a temporary nursery with little equipment because it supplied 50,000 to 90,000 in this Area.

The temporary nursery is a seasonal one to produce seedlings and is abandoned after the demand season. The nursery provides only pumping facilities and delivery pipes, not large scale as a whole, and accordingly seedling production is limited. Supply of seedlings in the Project Area increases to 700,000 in 1979 and after 1980, five million of seedlings will be planted in the whole country.

Assuming that supply of the seedlings will continue at the same rate in the Area, the supply will be 930,000 seedlings in the Area, then the permanent nurseries with adequate equipment will be required. At present the Project Area has only one permanent nursery but the Forest Department has constructed several permanent nurseries in the dry zone of the central Burma, where seedling demand is large. Furthermore, in outskirt of Rangoon a permanent nursery is being constructed but proposed equipment of this nursery is only pumping facilities, taking water from adjacent pond, water storage tanks, delivery pipes, store houses, office and lodgings, and actual condi-

tion is far behind the increases in productivity, stability of production, quality control and development of nursery techniques.

Several new permanent nurseries are expected to be provided in this Area taking account the fact that the seedlings are free-supplied to cover the whole area. It is desirable that employing the past experience, the nurseries constructed in future have to be provided with facilities such as sprinkler, and are adequate for effective production and successful quality control. However, in this Area it is recommended to establish one model nursery and to apply the results to the construction of other nurseries. Followings are considered as aims of the model nursery.

(1) high productivity using mechanical power
(2) quality control of seedlings
(3) seedling production and cost management
(4) investigation and research system on seedling and nursery

III.2. Forest Plantation Project

A number of dams have been proposed in the project area for the regulation of water supply to raise the agricultural production. As such, the forests in the watershed areas of these dams must be protected and maintained to fulfill their objectives. In order to effectively protect these forests from denudation, areas more accessible for extraction of timber as well as fuel-wood must be forested to supply the needs of the local populace.

With these objects in view, the previous planting scheme in the Project Area has been revised and the following 5-year planting program is proposed. Though the program is for 5 years, it will have to be continued beyond the period in order to meet the needs of the poeple in the Area. The plantation areas and estimated project cost is as below.

Plantation Programme

(Unit: acre, 1,000 Kyat)

Year	1st	2nd	3rd	4th	5th	Total
Project Area	7,200	9,100	10,900	12,000	12,700	51,900
Teak	4,600	5,500	6,500	6,900	7,500	31,000
Others	2,600	3,600	4,400	5,100	5,200	20,900
No. of Centres	14	18	21	24	25	25
Project Cost	44,787	21,293	20,950	23,445	20,529	131,004

Further details on the project, see Appendix H-5

III.3. Pilot Plantation Project

The forest Department is planning to provide plantation of approximately 1,000 hectares (2,500 acres) every year so as to supply domestic use wood for 30 - 40 years. The general description is as follows.

(1) Species: Eucalyptus Camaldulensis of E. Tereticornis
(2) Rotation Age: 12 - 15 years
(3) Yield: 220 cu.m/ha (50 ton/ac)
(4) Since E. Camaldulensis is available from coppice it is expected to have plantation land of 30,000 hectares (75,000 acres) 30 years after planting.
(5) An expected annual yield is estimated at 6.6 million cu.m (3.75 million tons).

Four-year eucalyptus plantation program has a main purpose of supplying domestic use wood and at the same time has another purpose of harvesting pulp wood and general use wood. Considering the anxiety in slow maturation rate in free supply of seedling movement, the program holds important position in the domestic use wood supply project and is worthy of promotion.

However, in the Project Area it is hard to say that early maturing species and plantation technique for suitable domestic use wood are surely available. That is, first, E. Camaldulensis was introduced as early maturing species in the dry zone of central Burma with about 760 mm (30 inches) of annual rainfall and has had a good result, but it is doubtful to plant the species as major plantation species for a long period in Prome or Bassein with rainfall of 1,300 - 2,500 mm (50 - 100 inches). The said species has been planted for several years in the Project Area and is going to be planted by the four-year program, but as mentioned before, in some part of the area the plantation is discontinued.

Moreover, the species seems to be known as dry resistent eucalyptus. Consequently, examination on more suitable species will be required. Secondly, in the past this species was planted in the land suitable to it because the plantation area was small but considering the long-term and large scaled plantation of the future, it is expected that various kinds of lands such as hilly land, waste land, swamp and others may be included. Accordingly, early maturing species suitable to the condition of each of lands will be required and further, it will be also necessary to distinctively plant seedlings in each land for the purpose of effective utilization of the land.

Besides, a study on damages by blight and harmful insects will be also required. Thirdly, an examination on harvesting method of domestic use wood (especially for fuel-use, early harvest at low cost) is required, which means an investigation on dense plantation.

Fourthly, how to manage the plantation land will be another problem to examine to cope with the secret felling of wood as a result of extension of planting period (now from the end of May to the beginning of June) and nearness of the plantation land to the villages. Considering above issues, prompt execution of the program for a long time on a large area seems to be dangerous. Therefore,

it is recommended to establish a pilot plantation grove prior to execution of the program.

The Forest Department has a nursery at Hmawbi where teak and other hardwood as well as several kinds of early maturing species are planted as test woods. These early maturing species are E. Camaldulensis, E. Tereticornis, E. Torelliana, Albizia SPP., Anthocephalus SPP., Leucaena SPP etc. and the area is as small as eight hectares (20 acres) and involves above-mentioned problems.

Since the Forest Department has not executed systematic test plantation and collection of data at dry-zone of central Burma, the pilot plantation land in this Project Area has great significance. The Forest Department has implemented the fuel-wood plantation from early stage, but the acreage of plantation land is not sufficient. Further, even if plantation is continuously performed for 30 - 40 years, it will take more than 10 years to supply fuel-wood and it cannot meet the need of domestic use wood at present.

III.4. Model Nursery Project

Nurseries are desirable to constructed one or two at each Prome, Zigon, Tharrawaddy, Insein and Henzada/Bassin Districts according to the Domestic Use Plantation Project planned at the Forest Department (See Table H-17). Accordingly, nurseries to be constructed are more than five, one of which should be constructed as model nursery. The general outline of proposed nursery will be as follows.

(1)	Seedling Production Capacity	300,000 - 500,000 seedlings
(2)	Location	In Tharrawaddy or Insein District according to traffic condition
(3)	Construction Period	September 1980 - December 1980
(4)	Acreage	1 - 2 hectares (2.5 acres)
(5)	Site Condition	(a) availability of water and drainage
		(b) suitable soil and cow-dung supply

(c) near to plantation sites

(d) easy to employ the seasonal labourers

(e) protected with wood zone

(f) access road during rainy season

In addition to the construction of a model nursery, staff training is also very important subject.

TABLE H-17 PLANTATION PROGRAM FOR LOCAL CONSUMPTION

(First Stage, 10-years)

(Unit: ac)

Year	Each Forest Division	Project Area
1st	500	2,500
2nd	1,000	5,000
3rd	1,500	7,500
4th	2,000	10,000
5th	2,500	12,500
6th	3,000	15,000
7th	3,500	17,500
8th	4,000	20,000
9th	4,500	22,500
10th	5,000	25,000

III.5. Industrial Plantation Project

With the present level of forest resources in the country inclusive of the Proejct Area, it is reasonable to assume that a fair number of wood-based industries can be established in the near future. This kind of development could take place within a period of about ten years, though feasibility studies may have to be undertaken to indicate the nature and the extent of these industries. The kind of industries that might be given priority may be on the follow-

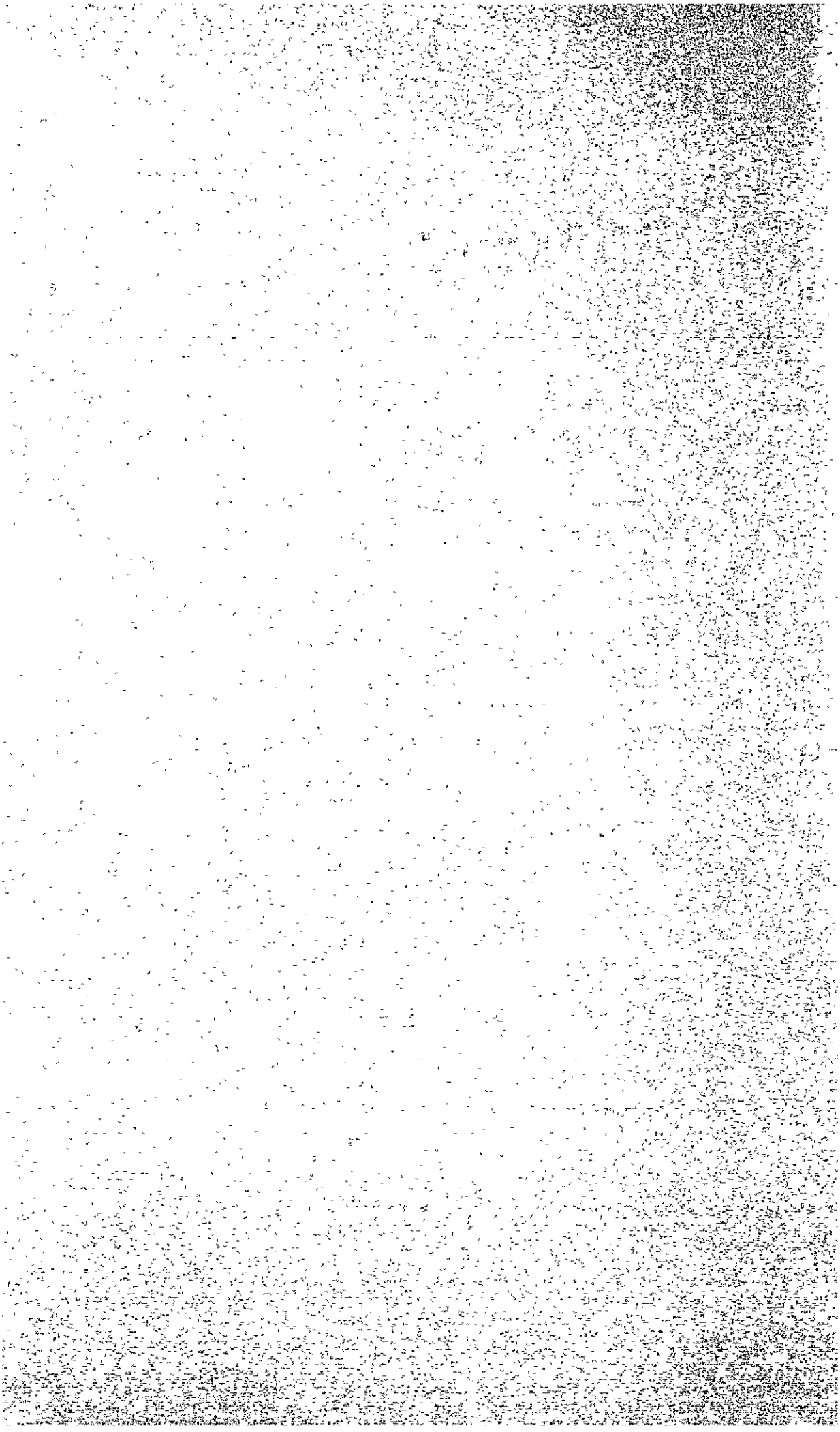
ing lines.

(1) panel board industry
(2) veneer industry
(3) furniture and parquet industry
(4) laminated wood industry
(5) pulp and paper industry

It appears that there are good possibilities for the pulp and paper industry using a mixture of hardwood (short fibre) and bamboo (medium/long fibre). However, the hardwoods are so heterogenous in composition and sometimes of difficult access, that the possibility of establishment of industrial plantations of quick-growing species in close proximity to factory sites may have to be considered at an early stage. These plantations will have to both of short and long fibre tree species for sustained supplies of raw materials at low cost.

In the Project Area, the location for such plantations would be the Bassein/Henzada forest division where plans are afoot for construction of paper pulp/rayon pulp mills. It is recommended that a start be made with such plantations of about 2,000 acres per year during a 10-year period. The cost is estimated to be around Kyat 1,200 per acre at current prices.

APPENDICES



APPENDIX H-1 FORESTRY DEVELOPMENT REQUIREMENT

FORESTRY DEVELOPMENT REQUIREMENT AS A COMPONENT OF THE IRRAWADDY BASIN AGRICULTURAL INTEGRATED DEVELOPMENT PROJECT

PROJECT AREA

1. The project area comprises five forest divisions with a total of about 5.7 million acres of forest land as shown below:

TABLE AREA OF THE RESERVED AND PUBLIC FORESTS

(Unit: ac)

Forest Division	Total division area	Reserved forest area		Public forest area	
		Total	Project area	Total	Project area
a) Prome					
(East bank)	1,245,790	330,118	330,118	915,672	915,672
(West bank)	601,194	341,738	341,738	259,456	259,456
b) Zigon	479,070	289,684	289,684	189,386	189,386
c) Tharrawaddy	892,700	221,182	221,182	671,518	671,518
d) Insein	1,769,575	301,133	291,764	1,468,442	153,847
e) Henzada	1,857,388	564,753	564,753	1,292,635	1,292,635
Bassein	2,640,641	508,218	101,325	2,132,423	-
TOTAL	9,486,358	2,556,826	2,140,564	6,929,532	3,482,514

Total project area = 2,140,564 + 3,482,514 = 5,623,078 ac

POPULATION

2. The population of the area is about 7.6 million and distributed as shown under:

TABLE - POPULATION IN THE PROJECT AREA

Forest division	Urban		Rural		Total	
	Population	Household	Population	Household	Population	Household
1. Prome	149,327	29,865	561,024	112,205	710,351	142,070
2. Zigon	68,821	13,764	430,813	86,163	499,634	99,927
3. Tharrawaddy	73,925	14,785	345,822	69,164	419,747	83,949
4. Insein	2,478,579	495,716	1,083,710	216,742	3,562,289	712,458
5. Henzada/ Bassein	408,412	88,785	1,994,051	433,489	2,402,463	522,274
TOTAL	3,179,064	642,915	4,415,420	917,763	7,594,484	1,560,678

YIELD

3. The yield of teak and other hardwoods annually from the project area is shown separately in the following table. These annual yields are mainly for commercial utilization. Most of the teak is for export while the bulk of the hardwoods for local/internal consumption, mostly in urban centres.

TABLE - ANNUAL ALLOWABLE CUT

Forest division	Annual Allowable Cut	
	Teak (Trees)	Non-Teak Hardwood (Hoppus tons)
a) Prome (East bank), (West bank)	9,740	77,000
b) Zigon	6,530	22,800
c) Tharrawaddy	6,790	10,600
d) Insein	4,820	6,000
e) Henzada/Bassein	1,650	73,700
TOTAL	29,530	190,100

FORESTRY SUPPLY SITUATION

A. Commercial Supply

4. The yields of teak and other hardwoods from the natural forests may require to be increased in the future because of additional demands for export as well as internal consumption due to population increases. The increases can only be met by establishment of teak and other hardwood plantations on an increasing scale in the years ahead. The present scale of planting programme for the current 4-year period is shown in the table below:

TABLE - FOUR-YEAR PLANTING PROGRAM

	1978		1979		1980		1981		Total	
Division	Teak	Eucalypt	Teak	Eucalypt	Teak	Eucalypt	Teak	Eucalypt	Teak	Eucalypt
Prome	1,500	-	2,000	-	2,000	-	2,000	-	7,500	-
Insein	-	300	-	500	-	750	-	2,000	-	3,550
Henzada/ Bassein	200	300	350	400	500	600	500	1,000	1,550	2,300
TOTAL	1,700	600	2,350	900	2,500	1,350	2,500	3,000	9,050	5,850

B. Rural/Urban Domestic Consumption of Fuel

5. By far the greatest consumption of forest produce in the country as well as the project area is fuelwood for the domestic needs of the rural/urban population, and to some degree the housing needs of the rural population. The current rate of consumption of fuelwood for the rural/urban population is conservatively estimated at about 125 c.ft. (2.5 tons) per annum per household. On this basis, the annual requirement works out to about 3.9 million tons. As against this, the annual potential supply from the natural forests is about 100,000 (0.1 million) tons annually. Thus, there is a great deficit in the potential supply. This means that the forested areas will be cut and consumed far beyond their capacity to meet the demand, and

hence result in progressive destruction and denudation of the forests. This situation will be aggravated in the years ahead with steady increases in population (2.4% each year), and the dwindling of forests. To meet the ever increasing demand situation, an extensive program of plantation establishment will have to be adopted with the utmost urgency. Suitable tree species with fast growing performance must be selected for such plantations, so that harvesting can be done on relatively short rotations, preferably in the 12 to 15-year range.

6. The annual requirement as shown above is of the order of 3.9 million tons against the supply of 0.1 million tons, which is almost negligible. Therefore, the entire supply will have to be met by the yield from plantations to be established within as short a time as possible. Any delay will obviously result in the destruction of the natural forests at an ever-increasing rate.

7. The scale of such plantation establishment to meet the demand can be estimated from experience with Eucalyptus plantations in Burma, from which the following data have been formulated.

(1) Species - *Eucalyptus camadulensis/ tree ticornis*
(2) Rotation age - 15 years
(3) Yield per acre - 50 tons

8. With the above data, the extent of such plantation required to meet the demand will be about 75,000 acres annually. To establish such extensive plantations will not be feasible in the project area within a short period of time, but will require an extended program of planting each year over the next 30 to 40 year period. It is therefore recommended that in the 5 forest divisions comprising the project area a planting program be launched in the next 10 years on the following lines.

TABLE - ANNUAL PLANTING PROGRAM

(Unit: ac)

Year	For one division	Five divisions in the project area
1st year	500	2,500
2nd year	1,000	5,000
3rd year	1,500	7,500
4th year	2,000	10,000
5th year	2,500	12,500
6th year	3,000	15,000
7th year	3,500	17,500
8th year	4,000	20,000
9th year	4,500	22,500
10th year	5,000	25,000

9. This recommended scale of planting will have to be continued in the next second 10-year period as well as the third 10-year period to catch up with the demand. Failing such an urgent plantation program of a continuing nature, the natural forest will suffer destruction to an extent that could bring about disastrous consequences to the agricultural economy in the project area, in the foreseeable future.

It is estimated that, at prevailing rates, the cost of plantation establishment is about K. 1,200 per acre.

10. The discovery of two Eucalyptus species is rather fortunate in that these are not only suitable for fuelwood, fast growing in habit, but also capable of yielding no less than 3 coppice rotations after the initial establishment from seed. Thus if the planting program is continued for upwards of 30 years, the eventual supply can be expected to catch up with demand.

C. Industrial Plantations

11. With the present level of forest resources in the country inclusive of the project area, it is reasonable to assume that a fair number of wood-based industries can be established in the near future. This kind of development could take place within a period of about 10-years, though feasibility studies may have to be undertaken to indicate the nature and the extent of these industries. The kind of industries that might be given priority may be on the following lines.

(a) Panel board industry
(b) Veneer industry
(c) Furniture and parquet industry
(d) Laminated wood industry
(e) Pulp and paper industry

12. It appears that there are good possibilities for the pulp and paper industry using a mixture of hardwood (short fibre) and bamboo (medium/long fibre). However, the hardwoods are so heterogenous in composition and sometimes of difficult access, that the possibility of establishment of industrial plantations of quick-growing species in close proximity to factory sites may have to be considered at an early stage. These plantations will have to be both of short and long fibre tree species for sustained supplies of raw materials at low cost. In the project area, the location for such plantations would be the Bassein/Henzada forest division where plans are afoot for construction of paper pulp/rayon pulp mills. It is recommended that a start be made with such plantations of about 2,000 acres per year during a 10-year period. The cost is estimated to be around Kyats 1,200/- per acre at current prices.

STRENGTHENING OF THE FORESTRY DEPARTMENT

13. The forestry department as constituted in its present form is capable of undertaking only the following tasks.

(a) Conservation of the natural forests
(b) Protective functions
(c) Harvesting control
(d) Revenue assessment and collection

14. Future development by way of extensive plantation establishment outlined above will require a considerably expanded staff of trained men both at the professional and sub-professional levels. In addition it will be necessary to provide the requisite machinery and equipment to tackle the tasks efficiently and ensure success. It may be pointed out that substantial investment in this field is fully justifiable, and could pay handsome dividends within a short time, thus contributing most effectively as well as strengthening the agricultural economy of the project area.

APPENDIX H-2 OUTLINE OF FORESTRY COMPONENT

FORESTRY

1.01 General description of forest industry in Burma

Burma has a forest area of approximately 388.5 million hectares (15,000 sq.miles), equivalent to about 57 percent of the whole country land. The forest industry of the country, though sharing only a small part of its gross national products, has greatly contributed to its national economy as one of the vitally important export items, and occupied about 25.4 percent of the total export in 1974/75, which was the second largest foreign currency earner next to rice. The teak production has been tending upward since 1976/77, not yet reaching the level before the war.

1.02 Present conditions in the Project Area

1) Forest resources

Most of the forest in the Project Area extends along the Pegu Yoma, the east of the Area, and the Arakan Yoma, the west, and the total acreage is estimated at (2.3 M ha 5.6 M ac). Involving the Pegu Yoma, the main teak producer of Burma, the Project Area is considered as one of the important area in forest industry in the country.

The forests of the Pegu Yoma are mainly composed on an ever-green-deciduous mixed forests type including such valuable harwoods and teak, whereas that of the Arakan Yoma presents a forest type growing teak sparasely.

Of the total forest acreage of the Project Area, about 0.9 M ha (2.1 M ac) is a reserved forest[1/] (hereinafter referred to as RF), and about 1.4 M ha (3.5 M ac) is an unclassed forest[2/] (hereinafter referred to as UCF). A stock of valuable species in the above RF is estimated at about 25.3 M cu.m (14 M H tons). The actual forest area and stock in the above UCF have not been surveyed yet.

Note: 1/ The RF is managed as commercial forest, though partly protection forest exists.

2/ The UCF supplies domestic use woods for the local people.

2) Forestry organization and forest ownership

The Forest Department is responsible for forest management and the Timber Corporation for cutting, transportation and sales.

The Forest Department controls 15 Administrative Divisions in the whole country, and the forest of the Project Area has been administered by three Administrative Divisions involving five divisions.

All forests in Burma are national forests, forest lands and trees belong to the state. However, those forest products produced from UCF within a range of 32 km (20 miles) from villages can be freely harvested by the said villagers for their own use and not for trade.

3) Forest condition

A. Forest Zone in the Pegu Yomas

a) The RF is in good close stands.

b) The proposed dam site is located in such a well-conserved forest and the catchment area seems to have an adequate water regulation function.

c) Non-tree lands and shrub lands in the UCF have been mostly converted to farm lands, and in places agriculture and forestry are competitively co-existing, but trends show the UCF are being increasingly depleted year by year.

B. Forest Zone in the Arakan Yomas

The RF area, providing a dense forest, has not been fully exploited yet due to sparsity of teak.

4) Forest working plans

The forest working plans in Burma have a long history since establishment of the Forestry Department fostering effective forest management on the basis of stand types, stocks, and annual increment. The forest plans are implemented by every working circle provided in regions.

5) Forestry production

The forestry production of the Project Area reached 1,900,000 cu.m (105,000 H tons) in 1975/76, which occupies about 14.7 percent of the total produciton of the country. (The above figures include the production from the whole Bassein and Insein areas).

Each Forest division has its own annual allowable cut imposed. In some areas, actual annual cut of teak exceeds the allowable level, but other hardwood cut is still below the annual allowable cut in the whole Project Area. The level of annual allowable cut was revised to a new one in August, 1978.

Dry teak are felled after girdling and air drying and generally transported by floating. However, truck transportation has been increased in frequency recently to effect saving of some 25 percent loss taking place in the course of transportation by floating. Green teak and hardwood are also transported by trucks, however, scarcity of forest road networks and a suitable type of logging trucks seem to be bottlenecks in effective land transportation.

In the Project Area there are no forestry-related industries with the exception of several saw mills which provide much labour-intensive work but it is necessary to improve the system and efficiency for productivity increases.

6) Plantation work

Natural forest has been harvested on the basis of tree-selection operations, and for the poorer forests clear cutting and artificial planting are carried out.

The teak plantations are concentrated in the area along the Pegu Yomas, and these constitute about 39 percent of the total teak plantation acreage of the country. It can be said that the nursery and plantation techniques for teak and Eucalyptus Camaldulensis have been already established in the country, and seem assured of success in the future.

7) Forest for local supply

The RF and the UCF in the Project Area are the supply sources of bamboo, fuel-wood, posts and poles to the local people including inhabitants of southern big municipalities like Rangoon and Bassein. In the future with expected population increases and no other substitute fuel available these forests will play increasing important roles as supply sources for all domestic wood requirements. However, the UCF has deteriorated considerably and such a critical situation will result in encroachment on the RF. Therefore, the Forest Department has been trying to promote increase planting of Eucalyptus year by year and further encouraging people in planting the said trees around houses by free supply of the seedlings on every Arbor Day (1st July) since 1976.

1.03 Problems and development strategy

1) Wood supply for domestic use

A) Construction of model nursery

In order to meet the increasing demand for domestic use wood and to conserve the forests, both the RF and UCF, from destruction, the Forest Department has carried out free supply of Eucalyptus seedlings every year for the people to plant them around their houses.

The Project Area has been the source of supply for domestic use wood to roughly 1,560,000 households, and the total volume required annually is estimated at 7.11 M cu.m (3.93 H tons), whereas the allowable cut and supply is far below the actual consumption volume. Without taking some effective countermeasures to solve this problem, approximately 32,000 ha (80,000 ac) of forest would be destroyed every year.

As countermeasures, the Forest Department has executed the four-year plantation programme and free supply movement of Eucalyptus seedlings. Actually, however, shortage in number of nurseries has become a bottleneck for successful implementation of these plans.

In the free supply movement in the Project Area, temporary nurseries had supplied 50,000 - 90,000 seedlings to meet the local requirement, but the increased demand for seedlings is estimated at about 700,000 in 1979 and 930,000 in 1980 and onwards. Under the circumstances, premanent nurseries should be provided to meet sharp increases of seedling demand from now on.

The permanent nursery can produce a very large number of seedlings with mechanized system and modern equipment, and will also permit quality control as well as saving of time. Furthermore, a wide variety of study and research can make efficient production more easy with a permanent nursery than with a temporary one.

There is one permanent nursery for Eucalyptus in the Project Area, a few in the dry zone of the Central-Burma, and another one is now under construction near Rangoon.

However, these nurseries provide only pumping facilities, water storage tanks and delivery pipes, and these may not be adequate for production increases and successful quality control.

Several new permanent nurseries should be provided in the Project Area taking into account the fact that the seedlings are free-supplied to cover the whole Project Area and the road network in the Area is so poor.

However, if the nurseries, are to produce quality seedlings with high productivity, they require adequate facilities and application of rational production and management techniques. Therefore, it is recommended to establish one model nursery as the first step and build up an effective organization and to apply the results obtained from the model nursery to the other nurseries.

B) For the same purpose as mentioned in A), the Forest Department has made a long-range plan for 30 - 40 years to provide plantation of 1,000 ha (2,500 ac) every year so as to supply domestic use wood.

The descriptions of the plan are as follows:

Species: Eucalyptus Camaldulensis or Tereticornis
Cutting period: 12 - 15 years
Harvests yield: 220 cu.m/ha (50 H tons/ac).

Since Eucalyptus is also available from coppice, it is expected to cover about 30,000 ha (75,000 ac) plantation for 30 years after planting, to be harvested at the rate of 6.6 M cu.m (3,750,000 H tons) per annum.

Eucalyptus has been successfully planted in some of the suitable lands in the dry zone of the Central-Burma; however, it may present a problem to plant in the Project Area successfully. The problems likely to be encountered in the plantations in the Project Area are as follows:

i) to select the major best-suited species for plantation in the Project Area,

ii) to select the best-suited species for special areas such as
- swampy lands, hilly lands, etc., and

iii) to establish a method of plantation for local supply areas so as to achieve early maturity and a quick harvest.

The Forest Department provides an experimental forest of early maturing species as well as a nursery in Hmawbi. The experimental forest has only eight hectares (20 ac), which will be too small to conduct a successful experiment for resolving the problems.

On the other hand, there have been a little effort made to provide a systematic experimental forest and obtain related data and records on increment, etc. So, it is recommended that an experimental plantation in the Project Area should be originally established and an experimental program to carry out various research and studies.

2) Consolidation of forest roads and provision of machinery

The networks of forest roads should be consolidated to facilitate the harvesting operations under the system of Selection Logging, and capacities of both roads and bridges should be increased for efficient transportation of the products. In other respect, the best-suited type of trucks should be employed to meet the purpose and the repairshop for vehicles also should be constructed.

3) Consolidation of saw mills

To achieve high productivity of the saw mills and high quality of the products it is necessary to improve the mill facilities and to apply a system of sufficient and continuous supply of the logs to the mills.

4) Development of the forests in the Arakan Yoma

Cable-logging or any other system available will be helpful to

develop the forests in the Arakan Yoma, if the hardwood market is adequately secured for their products.

5) Development of forestry-related industries

Not only saw mills but other industries such as paper mills should be developed for the effective utilization of the forest resources.

1.04 Outlines of programmes to be formulated

1) Model nursery construction programme

The descriptions of proposed nursery are as follows:

Production capacity: 300,000 - 500,000 seedlings/year

Location: Tharrawaddy or Insein in terms of transportation availability

Nursery acreage: 1 - 2 ha (2.5 - 5 ac)

Environmental conditions of nursery:

i) availability of water intake and drainage
ii) suitable soil and cow-dung or ganic manure
iii) possibly close to areas with demand for seedlings (a center of such demand areas preferable)
iv) easy employment of seasonal laborers
v) free from transportation troubles in the rainy season
vi) flat lands with shelter forest-belts, etc.

Equipment and materials required:

i) sprinkler system
ii) water intake and drainage facilities
iii) small-size dumptrucks and water wagons
iv) tractors with necessary attachment
v) concrete-made nursery beds
vi) sunshades
vii) germination room
viii) refrigerator for seed stock

ix) various measuring equipment and devices
x) working lot and warehouse
xi) office space and necessary equipment
xii) various facilities for staff and labourers
xiii) vehicles for manager and staff
xiv) vehicles for labourers and for seedling transportation
xv) Fire extinguishers and others.

Further study will clarify the details of the design of nursery, necessary construction costs and operation costs, and specifications of the facilities and materials required.

With construction of model nursery, it will become necessary to train nursery engineers and experts, for whom necessary educational facilities should be provided, or it may be required to send such staff to Japan for training and education.

2) Experimental forest programme for domestic use wood

The descriptions of proposed experimental forest are as follows:

Acreage: 200 ha (500 ac) for each sub-division per year:
total 1,000 ha (2,500 ac) in the Project Area
Period : 5 years
Grand total acreage: 5,000 ha (12,500 ac)
Location: Any suitable site available in the respective UCFs
Experiment items:
i) land type and species
ii) close planting and sparse planting; thinning and final cutting; and harvest volume forecast
iii) various works, i.e. mechanized land preparation, etc.
iv) extension of planting season
v) fertilizing and weed control
vi) construction and maintenance of forest roads
vii) nursery works and techniques
viii) management of plantation and others.

Further study will clarify the details of locations, species, cost, test items of nursery, equipment and materials required, etc.

The development of the forestry proejct from the experiment stage will require the increase of necessary staff of the Forest Department in both numbers and capability; so, engineers/experts including those who cover the statistics should be trained. It may be, therefore, required to provide the related educational facilities or opportunities to send such staff to Japan for training and education.

3) Others

Consolidation of forest roads, provision of machinery and equipment, etc. shall be studied in details in forthcoming survey.

1.05 Study items in future

1) Construction of model nurseries and experimental forest programme
2) Growing stock and annual allowable cut in the UCF
3) Forest road networks, capacity increase of the roads, and transportation facilities
4) Productivity increase of the saw mills
5) Development of the forest in the Arakan Yoma
6) Encouragement of forestry-related industry (Pulp and Paper mills, etc.), in the vicinity of the Project Area, and conservation of forestry resources.

APPENDIX H-3 TYPES OF FOREST

I. Prome Forest Division

A. Upper Mixed Deciducus Forest

(i) Moist

This type is characterized by the presence of the bamboos, Kyathaung (Bambusa polymorpha) or tin (Cephalostachyum pergracile) and occurs on all the areas of alluvial loam in the Yoma reserves and in the Chaungzauk and Bwet reserves. Teak and pyinkado (Xylia dolabriformis), the species of most value in the division, are well distributed throughout this type of forest and show better height growth and girth than elsewhere. Owing to the dense bamboo the natural regeneration of these two species is usually unsatisfactory. In valleys where the soil contains an excessive amount of sand, the bamboo wapyu (Oxytenanthera albociliata) waya (Dendrocalamus longispathus) and thaik (Bambusa tulda) are not uncommon. Tree growth in such areas is not as lixuriant as in those area where kyathaung bamboo predominates.

Besides teak and pyinkado, the following trees are common:-

Taukkyan (Terminalia tomentosa), myaukchaw (Homalium tomentosum), didu (bombax insigne), panga (Terminalia chebula), yemane (Gmelina arborea), binga (Mitragyna diversifolia), zaungbale (Legerstroemia villosa), knaw (Adina cordifolia), yon (Anogeissus acuminata) and pyinma (lagerstroemia flos-reginae).

(ii) Dry

The varieties of this type are to be found, the variation being caused by soil conditions.

(a) Dry forest-Champion's type 4a/C1-Dry teak forest on exposed ridges and moderately steep slopes, where, owing to excessive rainfall, the surface soil has been washed away and only a stiff clay remains.

This occurs throughout the Yoma reserves and in the Chaungzauk and Bwet reserves and is characterized by the presence of myin (Dendrocalamus strictus) bamboo. On comparatively flat hill tops, where a shallow surface soil still remains, thaik bamboo is found either pure or mixed with myin. Teak and pyinkado are again the most common species of value though they do not attain such large sizes. Where the clay soil is very stiff, these species give way to cutch and lein (Terminalia pyrifolia), such as is to be found in the west of the Chaungzauk and Shwele reserves, whilst on ridges containing a preponderance of sandstone outcrops, ingyin (Pentaome suavis) is usually the only species growing to marketable dimensions. Where the clay soil is not too stiff, natural regeneration of teak is very abundant.

(b) Dry forest-Champion's type Tr. D/2S/1-Secondary dry deciduous forest on sandy soil of a permeable nature allowing the rainfall to percolate through. Myin is again the characteristic bamboo but is usually stunted. This type occurs in the foothills forest and seldom contains tree species of value in marketable sizes. In (Dipterocarpus tuberculatus), thitya (Shorea obtusa), ingyin, yon thinwin (Millettia pe dula), panga, binga, myaukchaw, taukkyan, yindaik (Dalbergia cultrate) and didu are the most common tree species but seldom grow to more than six feet in girth.

B. Lower Mixed Deciduous Forest

This type is found in small patches throughout the Yoma reserves on low ground containing alluvial soil and is characterized by the absence of bamboos. Pyinkado, teak and tsukkyau are usually very common. Species of less importance and frequence also characteristic of the type are zaunghale, myaukohaw, yon and sit (Albizzia procera).

In the foothills reserves where the drainage on low flat areas is bad and the soil water-logged during the rains, a very poor variation of this type occurs in which stunted taukkyan is the prevailing species.

C. In Forest

(i) High forest

This type is characterized by the prevalence of in, ingyin and thitya. In the Yoma reserves ingyin is usually the prevailing species. In the foothills reserves, myin bamboo, if present is usually stunted and there is an understorey of small pyinkado.

(ii) Scrub

This variation of the type covers all the shallow sands to be found in the Plains reserves in the west of the division such as Tayokhmaw, Shabyin and Tonyo reserves. In, thitya and ingyin are the prevailing tree species and bamboo are seldom found.

II. Zigon Forest Division

A. General Description

Evergreen forest is very rarely found and is confined exclusively to the edges of small head water-feeders in the Yoma reserves. The area is such a small fraction of the whole that it may be dismissed from further consideration.

Moist teak forest is characterized by the preponderance of kyathaung (Bambusa polymorpha) among the bamboos and of teak and pyinkado (Xylia dolabriformis) among the timber trees. Tin (Cephalostachyum pergracile) is frequently found in association with Kyathaung, more especially in Bawbin. Other bamboos found in this forest are waya (Dendrocalamus longispathus) along the banks of small streems and wapyu (Oxytenanthera albo-ciliata). On the flatter patches of ground where the soil is clayey, especially near the banks of streams, thaik (Bambusa tulda) is common, and where there are considerably areas of such

ground, e.g., in compartment 19, Taungnyo, taukkyan (Terminalia tomentosa) of very fine quality grows almost pure.

After teak and pyinkado, perhaps the commonest trees are taukkyan, yindaik (Dalbergia cultrata), thitpok (Dalbergia kurzii), shaw (Sterculia sp.) thande (Stereospermum sp.), nabe (Lannea grandis syn Odina Wodier), leza (Lagerstroemia tomentosa), myaukchaw (Homalium tomentosum), yon (Anogeissus accuminata) and, much less common, pyinma (Lagerstoemia flos-reginae). Hnaw (Adina cordifolia) is generally scarce.

B. Dry Teak Forest

Characteristic trees of both forms of dry forests are teak and pyinkado, which though very common do not attain the dimensions found in moist forest, and taukkyan (Terminalia tomentosa), binga (Stephegyne diversifolia), gwe (Spondias mangifera), lein (Terminalia pyrifolia), ingyin (Pnetacme suavis), nabe, seikchi (Bridelia sp.) and myaukchaw.

Indaing, is found in small isolated patches inside Bawbin reserve and as a broad strip frequently edging the western boundary of this reserve and Gamon. The forest in the latter is mostly of very poor quality.

In, and ingyin are the characteristic trees and bamboos are typically absent.

III. Tharrawaddy Forest Division

A. Dry Upper Mixed Deciduous Forest

Dry upper mixed deciduous forest is typically recognizable by an undergrowth of myin (Dendrocalamus strictus) bamboo, although poor tin (Cephalostachyum pergracile) and occassional stunted Kyathaung bamboos (Bambusa polymorpha) also occur. Tree species extremely

numerous, but competition tends to restrict the proportion of the more valuable species. Growth is not so luxuriant as in moist forest. Teak predominates, with taukkyan (Terminalia tomentosa), binga (Stephegyne Syn. Mitragyna diversifolia), cutch (Acacia catechu), pyinma(Lagerstoemia speciesa), yon (Anogeissus acuminata) and similar species. Pyinkado (Xylia dolabritformis) is comparatively scarce. Height growth and shape are generally poor and it is seldom possible to get more than 40 feet of clear bole.

B. Moist Upper Mixed Deciduous Forest

This is the alternative type of dry forest on the Yomas, and occurs on the sandstone layer on the Peguan beds. It forms the most valuable type of forest in the division, as almost all the good timber species, except the dipterocarpus, attain their maximum development in it, and clear boles of 60 or 70 feet are not uncommon.

The best areas are characterised by an undergrowth of Kyathaung bamboo over 70 or 80 feet in height, but any area with Kyathaung, except of the most stunted variety, or with well grown tin bamboo may included in the type. Less characteristically both waya (Dendrocalamus longispathus) and wapyu (Dendrocalamus membranaceus) bamboo also occur. Among the tree species, teak and pyinkado are the most common and the most valuable. Pyinkado usually preponderates with 15 to 25 percent of the corp to the 10 to 15 percent of teak. Other common tree species are thinwin (Mellettia pendula), myaukohaw (Hemalium tomentosum), dwani (Erioloena candollei) panga (Terminalia chebula), yon, nabe (Lannea grandis), bambwe (Careva arborea), hnaw (Adina cordifolia) and binga. Taukkyan is relatively scarce.

C. Indaing

Indaing is characterised by an almost complete absence of bamboos, and the dominants are confined to a single species, in this division almost entirely in except in the case of the Taukkyan semi-indaing areas. Other species found are inbo (Dipterocarpus obtusifolius),

teak, Pyinkado. ingyin (Pnetaome suavis) and a number of comparatively useless species such as kabaung (Strychnos nux-blanda) and hmanni (Gardenia erythroclada).

D. Evergreen (Champion's type 1a/C2-Eastern tropical evergreen forest)

Evergreen is characterized by a comparatively open overwood with a dense middle and underwood of canes, palms, etc., generally of a throny nature. The more common of the tree species are kanyin (Dipterocarpus alatus), baing (Tetrameles nudiflora), thingan (Hopea odorata), thabye (Eugenia spp.), bawzagaing (Leuoaena glauca), thingadu (Parashorea stellata), thitsein (Terminalia belerica), kaunghmu (Scaphula glabra), Kanazo (Baccaurea spp.), maniawga (Carallia lucida), thitni (Amoora rohitrka) and kyanza (Casyanopsis diversifolia).

E. Lower Mixed Deciduous Forest - (Champion's type 3a/C3-Burma tropical lower mixed deciduous forest)

This type of forest covers the whole of the alluvial plain together with those portions of the foothills where a sufficient admixture of clay exists in the Irrawaddian sands.

Bamboo in this type are confined to fringes of thaik bamboo along the edges of streams. Three species vary: in the north, teak, Pyinkado, Myaukchaw (Homalium tomentosum), ingyin (Pentacme suayis) yon, taukkyan, binga, lein (Terminalia pyrifolia), seikchi (Bridelia retusa), pyinma. gyo (Scheleichera trijuga), Kabaung, zinbyun (Dillenia pentagyna), etc., are numerious; while in the south, moist forest types like knayin, myatya (Grewia microcos), mahlawa (Dolichandrone stipulata), petthan (Haplophragma syn, Heterophragma adenophllum), thande (Stereospermum sp.), nagye (Pterospermum semisagittatum), bonmeza (Albizzia stipulata), yon, tauksha (Vitex sp.), bambwa, thitsein, etc. predominate.

IV. Insein Forest Division

A. Swamp Forest

The only considerable area of this type definitely located is in compartment 38 of the Mahuya reserve where 18 acres occur and Kyi (Barringtonia acutangula) is the dominant species, forming indeed almost a pure crop. Traces of the type are not uncommon in various places and in addition to Kyi a characteristic species is thitpyaw (Xanthophyllum glaucum).

B. Evergreen Forests

(i) Large Tree Evergreen

Large tree evergreen is characterized by the presence of a more or less heavy average stocking of trees over 5 ft. in girth and an absence of bamboos other than wanwe (Dinochloa sp.) and wathabut (Neohouseana Helferi) which occur but are much less plentiful than in the next form to be described. Characteristic tree species present are kanyin (Dipterocarpus spp.) kaunghmu (Parashorea stellata) and (Anisoptera glabra), sawbya, (Sterculia campanulata), taungthayet or shitle (Swintonia floribunda), pyinma (Lagerstroemia Flos-Reginae Syn. L. speciosa), thitka (Pentace burmanica), Kanasoe (Baccaurea sapida), kywedanyin (Millettia atropurpursea), maniawga (Carrallia lucida). Canes and creepers are very plentiful and the general conditions are extremely moist. Thickets of danon (Calamus arborescens) are common along the stream and valley bottoms. Salu (Licuala peltata) and taungtan (Livistona speciosa) are plentiful.

(ii) Wanwe or Creeping Bamboo

Wanwe or creeping bamboo evergreen is characterized by apparently poor stocking of trees standing over very dense thickets of creeping bamboo, either wanwe or wathabut, the former being much the commoner. The trees commonly found include kanyin (especially Dipterocarpus duperreanus which can tolerate very heavy shade and actually struggle

up through the smothering tangle of straggling bamboo), sawbya and thitpok or baing (Tetrameles nudiflora). The girth of the trees present varies widely and may be large.

(iii) Small Trees Evergreen

Small trees evergreen is not a very sharply defined type but merges into large tree evergreen in one direction and lower mixed deciduous forest in the other extreme. Its characteristic is an absence or at least a relative scarcity of trees over 5 ft. in girth and a generally drier and thinner appearance than large tree evergreen. Bamboo is almost entirely absent. Creepers are extremely abundant. Salu and taungtan are very plentiful, perhaps rather more so than in the large tree evergreen. Common trees are thabye (Eugenias sp.) petthan (Heterophragma adenophyllum) lettok (Holarrhena anti-dysenterica), linyaw (Dillenia sp.), sawbya (Sterculia campanulata), myatya (Grewia microcos).

C. Mixed Deciduous Forests

(i) Moist upper mxied deciduous sub-type includes the best teak forests of the division. Its characteristic bamboos are kyathaung (Bambusa polymorpha) and tin (Cephalostachyum pergracile). Its common trees are teak (Tectona grandis), pyinkado (Xylia dolabriformis), pyinma (Lagerstroemia speciosa), yon (Anogeissus acuminata), myaukchaw (Homalium tomentosa) taukkyan (Terminalia tomentosa), Leza (Lagerstroemia tomentosa), binga (Stephegyne diversifolia) nabe (Odina Wodier), chinyok (Garuga pinnata), panga (Terminalia Chebula), etc. Kanyin (Dipertocarpus) occurs but only in the moisture parts and as an over flow from adjoining evergreen.

V. Henzada/Bassein Forest Division

A. General Description

Evergreen Forests. This extends from the top of the Arakan Yomas

for about a distance of 4-5 miles to the east in the north of the division and right down to the foothills in the south. Three classes may be distinguished.

(i) Hill Evergreen

This is mainly confined to ridge tops in the interior of the Yomas. It is usually associated with long grass, but kayinwa (Melocanna bambusoides) is present over large areas of this forest. The characteristic species are oaks (Quercus fenestrata, helferiana and spicata), Bauhinia, Dalbergis spp., wetshaw (Sterculia spp.) and dwani (Erioliaena condollei). Growth is stunted on ridges and trees are often covered with mosses and orchids.

(ii) Typical Evergreen

This contains a scanty undergrowth of herbaceous species while among the trees may be found taungthayet (Swintonia floribunda), and pyinkado (Xylia dolabri formis).

(iii) Kayinwa Forest

Over enormous areas of the Yomas this bamboo occurs pure with practically no trees at all associated with it. It forms impenetrable thickets over square miles and from a favourable view-point one gets the impression of miles of cornfields grown to nightmare height.

Upper Mixed Moist Deciduous Forest. This type is characteristic of the greater part of the foothills of the Yomas. It does not extend into plains forests at all. The type is fairly clearly defined as regards the bamboos normally associated with it, though tree growth shows considerably variation. The chief bamboos are kyathaung Bambusa polymorpha) and tinwa (Cephalostachyum pergracile), which may occur pure or mxied. Also found are wapyu (Dendrocalamus longispathus) and kayinwa (Melocana bambusoides). These latter two are associated with this forest mainly in steepsided moist valleys, thanawa

(Thyrsostachys oliveri) is also occasionally found. At times the mixture of bamboos is very striking all the above-mentioned species being found growing within the space of a few yards.

The tree growth varies considerably. The only species which occurs constantly everywhere is pyinkado (Xylia dolabriformis). Teak (Tectona grandis) is confined to a narrow strip along the foothills.

Upper Mixed Dry Deciduous Forest. The characteristic bamboos everywhere are myinwa and thaikwa (Bambusa tulda), while thanawa occurs sporadically on steep ridge sides in the Yomas.

The species found are very similar to those in the moist forest. Teak is common in the Kayngin and Yenandaung reserves and the north of the Yomas. Pyinkado is abundant everywhere. Taukkyan (Terminalia tomentosa) is moderately common. Cutch (Acacia catechu) is characteristic of drier forest in the Kyangin and Yenandaung reserves. Nabe, gwe and didu are all common. On many ridge tops in the Yomas they form almost pure forest of stunted growth. In places on ridge tops thitya (Shorea oblongifolia) and ingyin (Pentacme siamensis) form almost pure forest, generally of stunted growth. Lac is often found on these trees.

Lower Mixed Deciduous. Bamboos are almost entirely absent though occasional clumps of myinwa and thaikwa are to be found.

Indaing. This type is mainly confined to the plains reserve, though small patches of it are to be found here and there along the foot of the Yomas. It is of great importance in the plains as furnishing a supply of house posts for which there is a big demand.

PROJECT AREA OF AFFORESTATION

(Unit: ac)

Year	Forest Division																			
	Prome				Zigon				Tharrawaddy				Insein				Henzada/Bassein			
	Te	P	E	To	Te	P	E	To	Te	P	E	To	Te	P	E	To	Te	P	E	To
'74/'75	415	-	10	425	104	-	-	104	2	-	148	150	77	-	223	300	-	-	155	155
'75/'76	605	-	-	605	-	-	-	-	-	-	153	153	-	75	325	400	-	-	205	205
'76/'77	750	-	-	750	-	-	-	-	-	-	150	150	-	-	400	400	-	-	155	155
'77/'78*	1,200	-	-	1,200	100	-	-	100	-	100	150	250	-	150	150	300	60	50	150	260
'78/'79*	1,500	-	-	1,500	-	-	-	-	-	-	-	-	-	-	300	300	200	-	300	500
'79/'80*	2,000	-	-	2,000	-	-	-	-	-	-	-	-	-	-	500	500	350	-	400	750
'80/'81*	2,000	-	-	2,000	-	-	-	-	-	-	-	-	-	-	750	750	500	-	600	1,100
'81/'82*	2,000	-	-	2,000	-	-	-	-	-	-	-	-	-	-	2,000	2,000	500	-	1,000	1,500

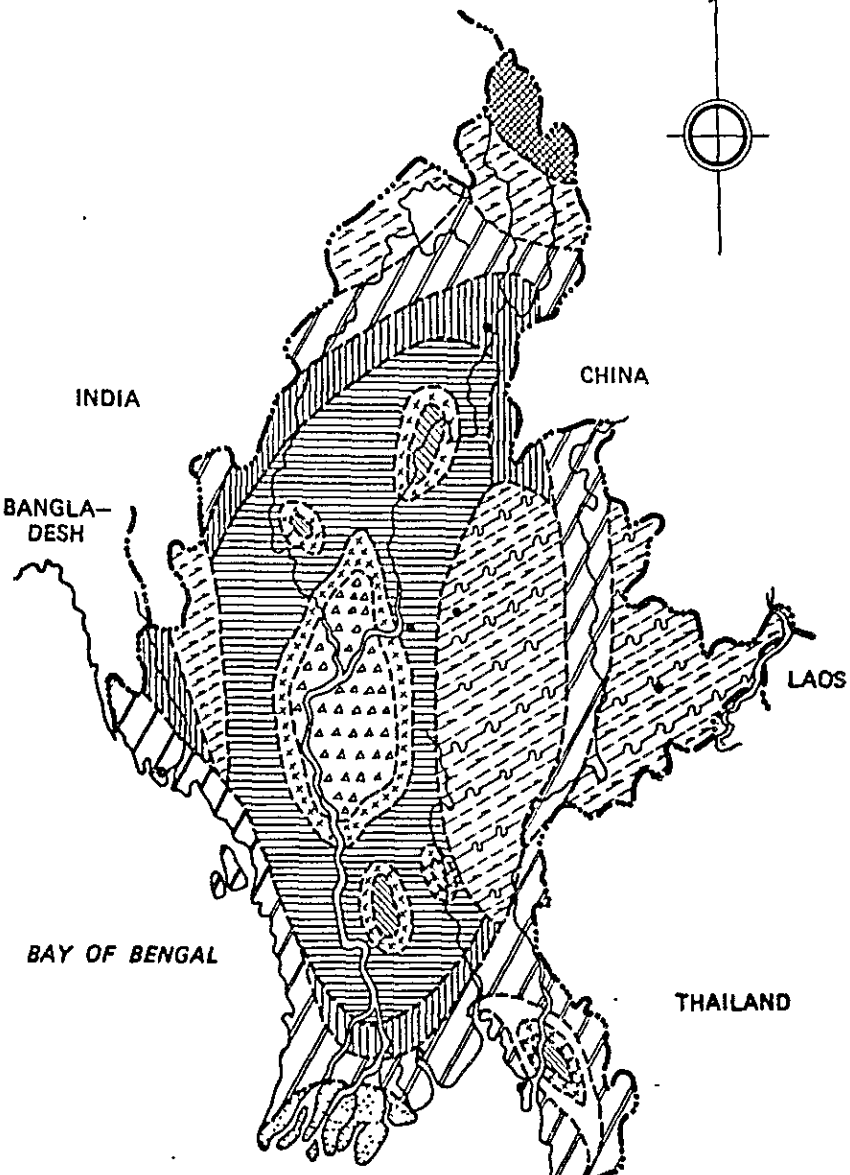
Note: Te... Teak & Others
P ... Pyinkado
E ... Eucalypts
To... Total

* Planting Programme

NATION-WIDE AFFORESTATION

Year (1)	Species and Acreage: Teak and Others (2)	Pyinkado (3)	Eucalypts (4)	Total (5)
		Planted		
1974-75	2,470	148	4,699	7,287
1975-76	2,423	730	4,607	7,760
1976-77	2,520	1,000	4,335	7,855
1977-78	3,485	1,500	3,840	8,825
		PLANTING PROGRAMME		
1978-79	4,600	1,000	5,250	10,850
1979-80	6,100	1,000	6,900	14,000
1980-81	7,650	1,000	7,950	16,600
1981-82	9,100	1,000	11,300	21,400

MAP OF BURMA SHOWING DOMINANT TYPES OF FORESTS



LEGEND

			Relative % coverage
1.	Tidal Forests		4%
2.	Beach and Dune Forests		
3.	Swamp Forests		
4.	Evergreen Forests	Tropical Wet Evergreen	16%
		Tropical Semi Evergreen	
5.	Mixed Deciduous Forests	Moist Upper Mixed	34%
		Lower Mixed	
		Dry-Upper Mixed	5%
6.	Dry Forests	Than-dahat Forests	10%
		Thorn Forests	
7.	Deciduous Dipterocarp or Indaing Forests		5%
8.	Hill and Temperate Evergreen Forests	Sub-tropical Wet Hill	26%
		Sub-tropical Hill Savannah	
		Alpine	

Note; Forest-covered area is 57% of the country.

APPENDIX H-4 ARTIFICIAL REGENERATION WITH TEAK AND EUCALYPTUS SPP

SOME ASPECTS OF ARTIFICIAL REGENERATION IN BURMA WITH PARTICULAR REFERENCE TO TEAK (TECTONA GRANDIS LINN F.) AND EUCALYPTUS SPP.

S U M M A R Y

The economy of Burma is greatly dependent upon its natural resources, particularly timber, and the Forests of Burma have for over a century, been managed under the Burma Selection System. The system, however was considered inadequate and as such extensive establishment of man-made forests was suggested.

Plantation techniques for the major species namely teak (Tectona grandis Linn f.) and Eucalyptus species are outlined. Their major problems, i.e. economic and labour, are emphasised and a solution is suggested.

SOME ASPECTS OF ARTIFICIAL REGENERATION IN BURMA WITH PARTICULAR REFERENCE TO TEAK (TECTONA GRANDIS LINN F.) AND EUCALYPTUS SPP.

Introduction

Burma depends mainly upon the export of rice, other agricultural products, mineral products and timber. The trade section is heavily dependent on these commodities as they are the only products presently able to compete in foreign markets and capable of earning substantial quantities of foreign exchange.

Rice constitutes the main export of the country and has done so for many years. From 1955 to 1957, Burma's rice export accounted for approximately 30% of the world's total, with the country being the world's largest rice exporter. However, export of rice has steadily declined since 1962. The export of other agricultural products has also declined. Thus, in the absence of any indication of mining development and with the steady decline in rice export Burma may need to depend more heavily on timber export in future.

Like many tropical countries, Burma is faced with the problem of the management of extensive mixed natural forests. A management system known as the Burma Selection System was adopted since the introduction of Scientific management of the forests over a century ago. This management system being a system of exploiting just one tree species (ie. teak) from multi-species forest, is neither enriching these forests nor fulfilling silvicultural requirements (Aung Din 1956. Kermode 1964). There are also theoretical and practical arguments which indicate a reduction in teak storking following the use of the Burma Selection System. Thus in order to compensate for the decreasing teak stock and the short coming of this system, artificial regeneration work has to be carried out. Although artificial regeneration work has been done since the prewar

days, planting was stopped and again resumed from 1941-42 to 1946-47 and in 1947-48.

Teak (Tectona grandis linn f.) and Pyinkado (Xylia dolabriformis, Benth) were the major species planted up till 1970. Starting from 1971 Eucalyptus, particularly Eucalyptus camaldulensis was also planted extensively. However it was not meant for quality timber. The object was mainly to supply posts, poles and fuel for the local inhabitants, and it was thus planted only in the local supply working circle. Other Eucalyptus species, namely E. grandis, E. citridora, E. robusta, E. teriticornis etc. were also planted. However, these are being planted only on an experimental scale and their suitability for extensive planting still needs to be assessed.

Teak

The use of man-made forests for production of teak has many advantages compared to the present use of natural forests. There will be substantial improvement in management control, in access, in production levels and in extraction procedures.

Since work in plantation is concentrated, management and the control of operations would be simplified. Plantation sites can be selected so that the topography is not too steep for mechanized operations, and the construction of a network of raods within the plantation would be justifiable. This would facilitate a more convenient and intensive degree of forest management.

Produciton levels would be much higher in a plantation than in natural teak forests. Natural teak forests in Burma are estimated to have a stock of one yield tree in 3.2 hectares (Ko Ko Gyi 1972), whereas in plantations of Site Quality III approximately 130 trees per hectare would be left after the final thinning. Thus, the final yield alone from plantation could be much higher than that from natural forests.

With the possibility of construction of a network of roads, and the application of mechanized units, extraction work in plantation could be more efficient. Plantations also permit the immediate application of the results of tree breeding research. Improvement could thus be anticipated both in production levels and in quality control of the timber produced.

The extent of teak plantations established in the country beginning from the early times can be seen below.

TEAK PLANTATIONS

(Unit: ha)

Period	Planted Area	Average per year
1895-96 to 1926-27	27,658	864
1927-28 to 1940-41	9,272	662
1941-42 to 1946-47	-	War years
1947-48 to 1954-55	20	2
1955-56 to 1976-77	14,300	650
1977-78	1,338	1,338
1978-79 (Target)	1,862	1,862
1979-80 "	2,469	2,469
1980-81 "	3,096	3,096
1981-82	3,683	3,683
Total	63,698	

Plantation work

Success depends on organization and straight adherence to plantation time table for all items of works. A typical working schedule in Burma, is shown below.

1) Area allotment to the 'ya' cutters - 15th December
2) 'Ya' cutting and fire protection - 17th Dec.-25th February
3) Burning - 3rd April
4) Kyunkwe - 6th April

5) Staking	- 12th April
6) Direct sowing	- 7th May
7) Stump planting	- 1st June
8) 3-weedings	- 1st, 2nd Year
9) 2-weedings	- 3rd Year
10) 1-weeding	- 4th Year

Weeding in the 2nd, 3rd and 4th years is carried out by the forest department with hired labourers.

Nursery Technique

Both temporary and permanent nurseries are used in the regeneration of teak. Each and every forest division has its own temporary nursery. Permanent nurseries in Burma are meant mainly to supplement the stock produced by temporary nurseries in case of any shortage or failure.

Seed

Although Southern Burma seeds give better germination (Ko Ko Gyi 1972), seeds or sowing are usually collected from the locality where they are to be planted.

Generally, germination of teak seed is very poor, being 35-59% for lower and central Burma origin and 7-20% for upper Burma origin (Kermode 1937, Ng Gale (2) and Nyunt Kaing 1967). Various pretreatment methods have been tried and so far, the method of alternate soaking and drying was found to be the most practicable. (Ko Ko Gyi, 1973).

Experiments by Bryndum (1966) in Thailand showed that the removal of the leathery exocarp by exposure to attach by ants improved germination considerably. This probably improves permiability and gaseous exchange (Ko Ko Gyi, 1973). A machine for removal of the exocarp of teak seed has been constructed by Thai Danish Teak Improvement Centre in Bangkok and the results obtained were encouraging (Hedegart 1971).

Seed Sowing

Teak seedlings are very hardy and fairly easy to raise in nurseries. In Burma sowing usually commences at the beginning of the rains in April. The seeds are either broad-cast or sown in lines 15 cm apart. After sowing, it is preferable to roll the beds lightly so as to press the seed slightly into the bed before covering up. Generally approximately 1.0 cm soil cover is used in most teak nurseries.

Sowing density depends upon the germination % of the seed lot used. In Burma, generally a density of 190 seeds per square meter is used, aiming at a density of 43 - 86 seedlings in that area (Mg Gale (2) and Nyunt Naing, 1957).

Lifting and Stump Preparation

Generally, over one year old seedlings are lifted for planting at the beginning of the rains in June. The stumps for planting are prepared by cutting off and discarding the stem at about 2.5 cm above the collar. The tap roots are cut approximately 10 - 20 cm below the collar, using a sharp knife to get a clean cut. The lateral roots are also removed. Stumps one to two centimeters in diameter at the collar are considered to be the best (Venkataramaung, 1956, Kermode, 1964).

In Burma, stumps are normally planted out within two or three days after preparation. However if necessary, stumps can be stored for a much longer period. Mg Gale (2) and Soe Ting (1969) found that stumps bundled in hessian cloth and kept in the shade can stand storage for 14 days with no watering, without affecting survival % significantly.

Field Establishment

The taungya method was commonly used for the establishment of

teak plantation in Burma. However, due to the difficulty in recruting the "ya" cutters, the method was abolished in 1974 and all plantation work is now being done departmentally.

Site Preparation

The area to be planted is clear felled in January or early February. Burning is carried out before the first light shower in April. Any unburnt debris are collected piled up and burnt again, and this is called "kyunkwe" in Burma.

Initial Spacing

The initial spacing adopted for teak used to be 1.8 m x 1.8 m and this is marked by bamboo stakes. Although 1.8 m x 1.8 m was found to be the best silviculturally as well as from the point of view of timber quality, (Anderson, 1958; Laurie and Griffith, 1942), it has now been replaced by a spacing of 2.74 m x 2.74 m since 1974-75 due to both financial and labour problems. Teak stumps are then planted at each stake.

Direct Sowing

Direct sowing of seed is also being done in parts of Burma where the distribution of rainfall is not regular. In this case three seeds are sown at each stake.

Time of Planting or Sowing

Time of planting varies with the area. In the major part of the country, the best time for planting is generally about the last week of May or early June. Direct sowing is usually carried out in April during which both the temperature and rainfall are the most suitable for germination.

Weeding

Weed has been a problem in most tropical countries and so far,

weeding is still being done manually in Burma. With the initial spacing of 1.8 m x 1.8 m three weedings were prescribed in the first year, three in the second year two in the third year, and one in the fourth year. However, due to financial and labour problems, it became necessary to reduce the intensity and cost of weeding. This was done by adopting a much wider spacing of 2.74 m x 2.74 m and prescribing spot weeding at a frequency of two weedings in the first year, and two weedings in the second year as the final weeding. These are in the trial stage and the results are not known yet.

Thinning

For the initial spacing of 1.8 m x 1.8 m a thinning regime of 5-year interval for the first 15 years, and 10-year interval later up to the age of 40 is prescribed. The plantations beyond this age limit were treated as part of the natural forests for felling and utilization along with those from the natural forests on attaining the fixed exploitable girth sizes. Under this system/practice of plantation establishment, the average results of growth and yield on average sites tend to be in the region of 1.549 meters g.b.h., 34.146 meter height and 26.60 m^3 per hectare at age 60 or a M.A.I. of about 0.44 m^3 per hectare. The standard "D" grade thinning was practiced for the selection thinnings.

For the initial spacing of 2.74 m x 2.74 m mechanical thinning is being applied now, consisting of a first one at the age of 5 - 7 years, reducing the stock by 50% and a second/final selection thinning at the age of 15 years reducing the final stock to around 124 - 173 stems per hectare (approximately 7.62 m x 7.62 m spacing). The plantation after this are will be regarded as firmly established and henceforth treated as part of the natural forest.

It is of interest to note that in recent years, the trial system of elite thinning carried out in India (Madras - 1955/56) consisting of an initial espacement of 2.59 m x 2.59 m (Quality I/II).

With the remaining elites being about 7.32 m apart, showed expectional growth over trees thinned under the conventional system (0.356 m d.b.h. against 0.254 m d.b.h.). The average difference in diameter development was found to be as large as 40% at 20 years of age. One can almost say that this serves to illustrate that the thinning regimes of the past for teak may have been too cautious, and conservative, and that substantial yield increases may perhaps be obtained by suitable changes in thinning schedule.

Eucalyptus

Eucalyptus have greatly been used as exotics. This is mainly due to their being easily adaptable to environmental conditions different from those of their natural range (Metro, 1955). Moreover, their rapid rate of growth can meet most of the requirements of modern forestry.

In Burma, the species is used mainly to regenerate artificially in the local supply working circle for supplying the local inhabitants with post, poles and fuelwood. It is also being used with success in the afforestation of the central dry zone of Burma.

Nursery Technique

In Burma, either seed beds or seed boxes are being used for sowing Eucalyptus seeds. The size of seed boxes used is 0.61 m x 0.61 m x 0.15 m. Although it is cheaper to use seed beds, there are many advantages in the use of seed boxes.

1. Seed boxes can be put on a rock and this facilitates control of insects preventing them from destroying or carrying away the seeds.
2. The seed boxes can be moved to any convenient places for pricking out operation or for shading purposes.

Soil Mixture

Sand or soil mixture such as sand, cow dung and soil are used in seed boxes or seed beds for sowing Eucalyptus. In order to have a thorough mixture, cow dung, sand and soil are first sieved through a 5 mm x 5 mm sieve and then mixed in the proportion of 1 : 2 : 3. (Sein Mg Wint, et al. 1970).

Seed boxes are then filled with the mixture up to 10-15 cm. Thirteen to 31 mm deep of pure fine sand is added on top of this. The method gives good germination and strong and healthy seedlings.

Sowing

The soil mixture is sprayed with endrine one day before sowing.

Lines not deeper than 13 mm to 52 mm aprt are drawn on the sand in the seed box. Mixture of Eucalyptus seed and sand in the proportion of 1 : 4 is then sprinkled on these lines. The lines are then filled with just enough light sand so as to make the surface even.

Watering

Great care is taken in watering as minute Eucalyptus seeds can be easily washed away. Moreover, both over-or under-watering can affect germination. Normally fine spray gives the best results.

Shading

Generally, the seed boxes or the seed beds are placed under 50% shade. Shading is done mainly to protect the seedlings from excessive heat or from frost in hilly areas.

Pricking out

Seedlings are pricked out and planted in pots or plastic bags when they are 25 - 75 mm tall and have 2 - 3 pairs of leaves. Time required to reach this size ranges between $1\frac{1}{2}$ to 2 months. The soil

used in the pots or plastic bags is sand, cow dung and soil mixed in the proportion of 1 : 2 : 3. The mixture is well watered one day before being pricked out.

The pricked out seedlings are placed under 50% shade and watered twice a day. Care should, however, be taken that there is no water logging in the plastic bag.

The seedlings after pricking out usually grow up into different sizes. In order to avoid suppression of the small seedlings by the big ones, the pots or the plastic bags are usually sorted into lots of approximately equal sizes. Sorting out and moving the bags also help in preventing the roots from penetrating into the soil.

Hardening off

The seedlings are ready for planting out in the field when about 5 - 6 month old. In order to avoid or minimize the shock when palnting out in the field, they are first "hardened off" for about two weeks. During this period, the seedlings are gradually exposed to full sunlight and watering is also reduced gradually. However, they should be well watered twice before being planted out.

Field Establishemnt

(1) Site Preparation (For plantation in Local Supply nursery.)

This is carried out in the same manner as in preparing site for teak plantation. In dry zone, uprooting, harrowing, plowing, trenching etc., have to be done.

(2) Time of Planting (Time of planting varies with the area.)

It depends greatly upon the rain and soil moisture. In areas with high rainfall, planting operation is usually carried out by about the end of May or in early June. In dry areas deficient in

soil moisture, a break in rain after planting can cause high rate of mortality. However, it is safe to plant if there is soil moisture up to a depth of 0.46 m.

Planting

In Burma, the method of planting Eucalyptus varies with the area (1) Normal planting method

(2) Planting method in the dry zone.

(1) Normal planting method: This method is applied in the areas of the country with sufficient rainfall for the growth of the spp. Initial spacing adopted is 4.9 m x 4.9 m. The plastic bags containing the seedlings are first removed and then the seedlings are planted in previously dug pits.

(2) Planting method in the Dry Zone: In the dry zone areas, seedlings are planted either in pits or in ploughed up areas. An initial spacing of 4.9 m x 4.9 m is adopted. Ploughing gives very good results, but cost of establishment incurred is a bit too high. At present, planting in the dry zone area is being done in 1.2 m x 1.2 m x 0.3 m pits.

Weeding

Intensity of weeding in Eucalyptus plantation is less than that in teak due to the rapid height growth of the species. Presently two weedings are done in the first year and only one in the second year.

Conclusion

It is clear that timber is one of the most important export items in Burma and that the economy of the country is greatly dependent upon it.

Consequently, a silvicultural system to get a maximum production in perpetuity is greatly needed.

The present Burma Selection System can not be fully considered as a satisfactory system to induce natural regeneration of teak. Thus, extensive establishment of high production man-made forests to supplement the Burma Selection System or, a gradual conversion to clear cutting system where site factors are favourable is needed.

Although, the present plantation technique is quite successful from the point of view of survival, it is evident that emphasis could not be placed on timber quality due to economical and labour problems. These problems can be solved only by investing more on the forestry sector and by mechanization of, at least, the major part of the plantation work.

APPENDIX H-5 FOREST PLANTATION COMPONENT

IRRAWADDY BASIN AGRICULTURAL INTEGRATED DEVELOPMENT PROJECT

FOREST PLANTATION COMPONENT

FOREST DEPARTMENT

A write-up on "Forestry Development Requirement as a Component of the Irrawaddy Basin Agricultural Integrated Development Project" has been forwarded to JICA members. Sufficient details on population, forest area, household needs of fuelwood of the area, and the requirement of formation of forest plantations to meet these needs have been mentioned there-in.

The following is brief account of the objects of formation of forest plantations in the project area.

A number of dams have been proposed in the project area for the regulation of water supply to raise the agricultural production. As such, the forests in the watershed areas of these dams must be protected and maintained to fulfill their objectives. In order to effectively protect these forests from denudation, areas more accessible for extraction of timber as well as fuelwood must be forested to supply the needs of the local populace.

With these objects in view, the previous planting scheme in the project area has been revised and the following 5-year planting program is proposed. Though the program is for 5 years, it will have to be continued beyond the period in order to meet the needs of the people in the area.

SUMMARY OF ESTIMATED PROJECT COSTS

(Unit: millions)

Category		Kyat(K)			US$		
		FE	Local	Total	FE	Local	Total
Nursery	- Capital	6.02	5.66	11.68	0.90	0.84	1.74
	- Annual	-	9.52	9.52	-	1.42	1.42
Plantation	- Capital	10.52	9.88	20.40	1.57	1.47	3.04
	- Annual	-	34.69	34.69	-	5.18	5.18
Headquarters & Regional offices							
	- Capital	4.60	4.53	9.13	0.69	0.68	1.36
	- Annual	-	3.07	3.07	-	0.46	0.46
Other annual costs		2.11	22.27	24.38	0.31	3.32	3.64
Technical assistance		0.70	-	0.70	0.10	-	0.10
Training		0.35	-	0.35	0.05	-	0.05
Contingency		3.64	13.44	17.08	0.54	2.01	2.55
TOTAL		27.94	103.06	131.00	4.17	15.38	19.55

Note: 1 US$ = 6.70 Kyats

PLANTATION PROGRAMME

Forest division	Species	Plantation area (acre) and number or centres in year										Total	
		1st		2nd		3rd		4th		5th			
		Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.
Prome	Teak	2,400	5	2,500	5	2,500	5	2,500	5	2,500	5	12,400	5
	Others	500	1	550	1	950	2	1,100	2	1,200	2	4,300	2
	Total	2,900	6	3,050	6	3,450	7	3,600	7	3,700	7	16,700	7
Zigon	Teak	500	1	700	1	1,000	2	1,200	3	1,500	3	4,900	3
	Others	500	1	600	1	700	1	1,000	2	1,000	2	3,800	2
	Total	1,000	2	1,300	2	1,700	3	2,200	5	2,500	5	8,700	5
Tharrawaddy	Teak	500	1	700	1	1,000	2	1,200	2	1,500	3	4,900	3
	Others	500	1	1,000	2	1,000	2	1,000	2	1,000	2	4,500	2
	Total	1,000	2	1,700	3	2,000	4	2,200	4	2,500	5	9,400	5
Insein	Teak	600	1	800	2	1,000	2	1,000	2	1,000	2	4,400	2
	Others	500	1	650	1	750	1	1,000	2	1,000	2	3,900	2
	Total	1,100	2	1,450	3	1,750	3	2,000	4	2,000	4	10,300	4
Henzada/ Bassein	Teak	600	1	800	2	1,000	2	1,000	2	1,000	2	4,400	2
	Others	600	1	800	2	1,000	2	1,000	2	1,000	2	4,400	2
	Total	1,200	2	1,600	4	2,000	4	2,000	4	2,000	4	8,800	4
Project Area	Teak	4,600	9	5,500	11	6,500	13	6,900	14	7,500	15	31,000	15
	Others	2,600	5	3,600	7	4,400	8	5,100	10	5,200	10	20,900	10
	Total	7,200	14	9,100	18	10,900	21	12,000	24	12,700	25	51,900	25

NURSERY FOR 500 - ACRE PLANTATION

Particular	Unit Cost (K)	Teak (Temporary) No.	FE (K)	Local (K)	Total (K)	Others (Semi-permanent) No.	FE (K)	Local (K)	Total (K)
I. Capital									
A. Building									
Deputy ranger	20,000	1	-	20,000	20,000	2	-	40,000	40,000
Forest guard	15,000	2	-	30,000	30,000	4	-	60,000	60,000
Barrack. (5-units)	30,000	1	-	30,000	30,000	2	-	60,000	60,000
Driver	10,000	1	-	10,000	10,000	2	-	20,000	20,000
Pump/Generator house	10,000	1	-	10,000	10,000	1	-	10,000	10,000
Pump house & Generator house	3,000	-	-	-	-	1	-	3,000	3,000
Store house	10,000	1	-	10,000	10,000	1	-	10,000	10,000
Nursery shed	9,000	-	-	-	-	1	-	9,000	9,000
Garage	3,000	1	-	3,000	3,000	2	-	6,000	6,000
Shade shed	25,000	-	-	-	-	1	-	25,000	25,000
Tube well & Pipes	20,000	-	-	-	-	1	-	20,000	20,000
Overhead tank	3,500	-	-	-	-	1	-	3,500	3,500
Fence	1,500	-	-	-	-	1	-	1,500	1,500
Total A.		8	-	113,000	113,000	20	-	268,000	268,000
B. Equipment & vehicle									
Sprinkler system	28,000	-	-	-	-	1	28,000	11,200	39,200
Farm tractor with trailer & ploughing equipment	110,000	1	110,000	-	110,000	1	110,000	-	110,000
Tipper truck	240,000	-	-	-	-	1	240,000	96,000	336,000
Knapsack sprayer	700	-	-	-	-	5	3,500	-	3,500
Shovel	70	10	-	700	700	20	-	1,400	1,400
Mattock	35	10	-	350	350	20	-	700	700
Knife	30	10	-	300	300	20	-	600	600
Pump	14,000	-	-	-	-	1	14,000	-	14,000
Compressor	25,000	-	-	-	-	1	25,000	10,000	35,000
Generator	14,000	-	-	-	-	1	14,000	5,600	19,600
Rain gauge etc.	2,000	1	-	-	-	1	2,000	800	2,800
Total B.			110,000	1,350	111,350		436,500	126,300	562,800
Total capital cost			110,000	114,350	224,350		436,500	394,300	830,800

NURSERY FOR 500 - ACRE PLANTATION (Cont'd)

Particular	Unit Cost (K)	Teak (Temporary) No.	FE (K)	Local (K)	Total (K)	Others (Semi-parmanent) No.	FE (K)	Local (K)	Total (K)
II. Annual cost									
A. Staff	(Pay+CLA)+TA								
Deputy ranger	4,300+2,400	1	-	6,700	6,700	2	-	13,400	13,400
Forest guard	2,000+2,400	2	-	8,800	8,800	4	-	17,600	17,600
Permanent Labour	1,800	5	-	9,000	9,000	10	-	18,000	18,000
Driver	2,000+2,400	1	-	4,400	4,400	2	-	8,800	8,800
Pump/Generator Operator	2,000+2,400	1	-	4,400	4,400	1	-	4,400	4,400
Total A.			-	33,300	33,300		-	62,200	62,200
B. Material & labour									
Seed	K12/ac.		-	6,000	6,000		-	6,000	6,000
Manure, soil & sand	K25/ac.		-	12,500	12,500		-	12,500	12,500
Polythene bags	K40/ac.		-	25,000	25,000		-	25,000	25,000
Temporary labour (800 mandays per 500 acres)	K4,320/500 ac.		-	4,320	4,320		-	4,320	4,320
Total B.			-	47,820	47,820		-	47,820	47,820
Total annual cost			-	81,120	81,120		-	110,020	110,020
Grand Total			110,000	195,470	305,470		436,500	504,320	940,820

500 - ACRE PLANTATION WORK

Particular	Unit Cost (K)	Teak No.	Teak FE (K)	Teak Local (K)	Teak Total (K)	Others No.	Others FE (K)	Others Local (K)	Others Total (K)
I. Capital cost									
A. Building									
Office	35,000	1	-	35,000	35,000	1	-	35,000	35,000
Assistant Director	35,000	1	-	35,000	35,000	1	-	35,000	35,000
Deputy ranger	20,000	4	-	80,000	80,000	4	-	80,000	80,000
Forest Guard	10,000	6	-	60,000	60,000	6	-	60,000	60,000
Permanent Labourer (5-units)	30,000	1	-	30,000	30,000	2		60,000	60,000
Driver	10,000	2	-	20,000	20,000	2	-	20,000	20,000
Pump/generator operator	10,000	1	-	10,000	10,000	1	-	10,000	10,000
Garage	3,000	1	-	3,000	3,000	1	-	3,000	3,000
Store	20,000	1	-	20,000	20,000	1	-	20,000	20,000
Pump & Generator house	3,000	1	-	3,000	3,000	1	-	3,000	3,000
Clerk (I & II)	10,000	2	-	20,000	20,000	2	-	20,000	20,000
School	10,000	1	-	10,000	10,000	1	-	10,000	10,000
Dispensary	5,000	1	-	5,000	5,000	1	-	5,000	5,000
Total A.		22	-	331,000	331,000	24	-	361,000	361,000

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Particular	Unit Cost (K)	Teak No.	Teak FE (K)	Teak Local (K)	Teak Total (K)	Others No.	Others FE (K)	Others Local (K)	Others Total (K)
B. Equipment & vehicle									
Inspection vehicle	100,000	1	100,000	-	100,000	1	100,000	-	100,000
Truck (6 1/2 ton)	190,000	1	190,000	-	190,000	1	190,000	-	190,000
Trailer·bowser	50,000	1	50,000	20,000	70,000	1	50,000	20,000	70,000
Rotary slasher	7,000	1	7,000	2,800	9,800	1	7,000	2,800	9,800
Chain saw	3,000	5	15,000	6,000	21,000	5	15,000	6,000	21,000
Cross-cut saw	150	25	2,750	1,500	5,250	25	3,750	1,500	5,250
Axe	50	25	1,250	500	1,750	25	1,250	500	1,750
Chain saw file	200	3doz.	600	240	840	3doz.	600	240	840
Cross-cut saw file	200	6doz.	1,200	480	1,680	6doz.	1,200	480	1,680
Pump	14,000	1	14,000	-	14,000	-	-	-	-
Compressor	25,000	1	25,000	10,000	35,000	-	-	-	-
Office equipment, Field equipment	20,000	1 lot.	20,000	8,000	28,000	1 lot.	20,000	8,000	28,000
Generator	14,000	1	14,000	5,600	19,600	-	-	-	-
Furniture	3,500	1 lot.	-	3,500	3,500	1 lot.	-	3,500	3,500
Total B.			441,800	58,620	500,420		388,800	43,020	431,820
Grand Total			441,800	389,620	831,420		388,800	404,020	792,820

Note: Custom duty, etc. = 40% of FE (Foreign Exchange) Cost.

Particular	Unit Cost (K)	Teak No.	Teak FE (K)	Teak Local (K)	Teak Total (K)	Others No.	Others FE (K)	Others Local (K)	Others Total (K)
II. Annual cost									
A. Staff	(Pay+CLA)+TA								
Assitant director	8,400+2,400	1	-	10,800	10,800	1	-	10,800	10,800
Deputy ranger	4,300+2,400	4	-	26,800	26,800	4	-	26,800	26,800
Forest guard	2,000+2,400	6	-	26,400	26,400	6	-	26,400	26,400
Clerk I	4,300	1	-	4,300	4,300	1	-	4,300	4,300
Clerk II	3,000	1	-	3,000	3,000	1	-	3,000	3,000
Messenger	1,800+2,400	2	-	8,400	8,400	2	-	8,400	8,400
Permanent labourer/ Night wachman	1,800	2	-	3,600	3,600	2	-	3,600	3,600
School master	4,300	2	-	8,600	8,600	2	-	8,600	8,600
Nurse	4,300	1	-	4,300	4,300	1	-	4,300	4,300
Driver	2,000+2,400	2	-	8,800	8,800	2	-	8,800	8,800
Pump/Generator operator	2,000+2,400	1	-	4,400	4,400	1	-	4,400	4,400
Temporary Labourer	2,000	2	-	4,000	4,000	2	-	4,000	4,000
Total A.		25	-	113,400	113,400	25	-	113,400	113,400

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Particular	Unit Cost (K)	Teak No.	Teak FE (K)	Teak Local (K)	Teak Total (K)	Others No.	Others FE (K)	Others Local (K)	Others Total (K)
B. Land clearing, burning & reburning	170/ac	-	-	85,000	85,000	-	-	85,000	85,000
Planting	72/ac	-	-	36,000	36,000	-	-	36,000	36,000
Comping .	10/ac	-	-	5,000	5,000	-	-	5,000	5,000
Total B.		-	-	126,000	126,000	-	-	126,000	126,000
C. Weeding (one time)	27/ac	-	-	13,500	13,500	-	-	13,500	13,500
Fire-protection	20/ac	-	-	10,000	10,000	-	-	10,000	10,000
Total C.		-	-	23,500	23,500	-	-	23,500	23,500
Total annual cost		-	-	262,900	262,900	-	-	262,900	262,900
Total plantation work cost		441,800		652,520	1,094,320	-	388,800	666,920	1,055,720

Note:		Year 1	Year 2	Year 3	Year 4
Weeding frequency	- Teak	3	2	2	1
	- Others	2	2	1	-
Fire protection	- Teak	for 5 years			
	- Others	throughout the rotation			

CLA = Cost of living allowance TA = Travelling Allowance

HEADQUARTERS AND REGIONAL CENTRES

Particular	Unit Cost (K)	No.	Total Cost (K) FE	Local	Total
I. Capital cost					
A. Building					
Office					
- Director	90,000	1	-	90,000	90,000
- Deputy Director	70,000	5	-	350,000	350,000
Residence					
- Director	90,000	1	-	90,000	90,000
- Deputy Director	70,000	5	-	350,000	350,000
- Assistant Director	35,000	7	-	245,000	245,000
- Assistant Engineer	35,000	1	-	35,000	35,000
- Mechanic	20,000	2	-	40,000	40,000
- Clerical Staff	15,000	53	-	795,000	795,000
- Others	10,000	40	-	400,000	400,000
Store	25,000	6	-	150,000	150,000
Garage	3,000	17	-	51,000	51,000
Total A		-	-	2,596,000	2,596,000
B. Equipment & vehicle					
Crawler tractor 140HP with dozer & winch	500,000	5	2,500,000	1,000,000	3,500,000
Inspection vehicle (D)	100,000	3	300,000	120,000	420,000
Inspection vehicle (DD)		5	500,000	200,000	700,000
Light truck (D)	100,000	2	200,000	80,000	280,000
" " (DD)		5	500,000	200,000	700,000
Truck (6 1/2 ton)(D)	190,000	2	380,000	152,000	532,000
Motor-boat (DD)	100,000	1	100,000	40,000	140,000
Office, Field equipment	20,000	6 lots	120,000	48,000	168,000
Furniture	15,000	6 lots	-	90,000	90,000
Total B			4,600,000	1,930,000	6,530,000
(Total capital cost)			(4,600,000)	(4,526,000)	(9,126,000)

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Particular	Unit Cost (K)	No.	Total Cost (K) FE	Local	Total
II. Annual cost					
A. Staff	(Pay+CLA)+TA				
Director	15,600+2,400	1	-	18,000	18,000
Deputy Director	14,400+2,400	5	-	84,000	84,000
Assistant Director	8,400+2,400	7	-	75,600	75,600
Office Superintendent	5,460	1	-	5,460	5,460
Accounts Officer	8,400	1	-	8,400	8,400
Assistant Engineer	8,400+2,400	1	-	10,800	10,800
Mechanic	4,260+2,400	2	-	13,320	13,320
Assistant Mechanic	3,060+2,400	4	-	21,840	21,840
Clerk I (D)	4,300	2	-	8,600	8,600
" (DD)	4,300	15	-	64,500	64,500
Clerk II (D)	3,000	5	-	15,000	15,000
" (DD)	3,000	25	-	75,000	75,000
Draftsman	4,300	1	-	4,300	4,300
Assistant Draftsman	3,000	1	-	3,000	3,000
Messenger (D)	1,800+2,400	6	-	25,200	25,200
" (DD)	1,800+2,400	15	-	63,000	63,000
Driver (D)	2,000+2,400	7	-	30,800	30,800
(DD)	2,000+2,400	12	-	52,800	52,800
Total A.			-	579,620	579,620
B. Stationery, etc.	5,000	7	-	35,000	35,000
Total Annual cost			-	614,620	614,620
Total cost for headquarters and regional offices			4,600,000	5,140,620	9,740,620

Note: D = Director's office
DD = Deputy Directors' office
CLA = Cost of living allowance
TA = Travelling allowance

WEEDING AND FIRE-PROTECTION SHEME FOR TEAK

Species	Unit	Year 1st	2nd	3rd	4th	5th	Total
Teak	Area (acre) for Weeding	4,600	4,600	4,600	4,600		18,400
		4,600	4,600	4,600			13,800
		4,600					4,600
			5,500	5,500	5,500	5,500	22,000
			5,500	5,500	5,500		16,500
			5,500				5,500
				6,500	6,500	6,500	19,500
				6,500	6,500	6,500	19,500
				6,500			6,500
					6,900	6,900	13,800
					6,900	6,900	13,800
					6,900		6,900
						7,500	7,500
						7,500	7,500
						7,500	7,500
	TOTAL	13,800	25,700	39,700	49,300	54,800	183,300
	Area (acre) for fire-protection	4,600	4,600	4,600	4,600	4,600	23,000
			5,500	5,500	5,500	5,500	22,000
				6,500	6,500	6,500	19,500
					6,900	6,900	13,800
						7,500	7,500
	TOTAL	4,600	10,100	16,600	23,500	31,000	85,800

WEEDING AND FIRE-PROTECTION SCHEME FOR SPECIES OTHER THAN TEAK

Species	Unit	Year 1st	2nd	3rd	4th	5th	Total
Others	Area (acre) for weeding	2,600	2,600	2,600			7,800
		2,600	2,600				5,200
			3,600	3,600	3,600		10,800
			3,600	3,600			7,200
				4,400	4,400	4,400	13,200
				4,400	4,400		8,800
					5,100	5,100	10,200
					5,100	5,100	10,200
						5,200	5,200
						5,200	5,200
	TOTAL	5,200	12,400	18,600	22,600	25,000	83,800
	Area (acre) for fire-protection	2,600	2,600	2,600	2,600	2,600	13,000
			3,600	3,600	3,600	3,600	14,400
				4,400	4,400	4,400	13,200
					5,100	5,100	10,200
						5,200	5,200
	TOTAL	2,600	6,200	10,600	15,700	20,900	56,000

ROAD MAINTENANCE PROGRAMME

Forest division	Length (mile)
Prome	60
Zigon	10
Tharrawaddy	25
Insein	20
Henzada/Bassein	30
TOTAL	145

TABLE TOTAL ESTIMATED COST FOR THE PLANTATION PROJECT IRRAWADDY BASIN AREA

Type of Work	Type of Cost	Species	Category	Total Cost (K) in Year 1 FE	1 Local	1 Total	2 FE	2 Local	2 Total	3 FE	3 Local	3 Total	4 FE	4 Local	4 Total	5 FE	5 Local	5 Total	Total Cost (K) for 5 Years FE	Local	Total
Nursery	Capital	Teak	Building	-	1,017,000	1,017,000	-	226,000	226,000	-	226,000	226,000	-	113,000	113,000	-	113,000	113,000	-	1,695,000	1,695,000
			Equipment & vehicle	990,000	12,150	1,002,150	220,000	2,700	222,770	220,000	2,700	222,700	110,000	1,350	111,350	110,000	1,350	111,350	1,650,000	20,250	1,670,250
		Others	Building	-	1,340,000	1,340,000	-	536,000	536,000	-	268,000	268,000	-	536,000	536,000	-	-	-	-	2,680,000	2,680,000
			Equipment & vehicle	2,182,500	631,500	2,814,000	873,000	252,600	1,125,600	436,500	126,300	562,800	873,000	252,600	1,125,600	-	-	-	4,365,000	1,263,000	5,628,000
	Annual	Teak	Staff	-	299,700	299,700	-	366,300	366,300	-	432,900	432,900	-	466,200	466,200	-	499,500	499,500	-	2,064,600	2,064,600
			Material & labour	-	439,944	439,944	-	526,020	526,020	-	621,660	621,660	-	659,916	659,916	-	717,300	717,300	-	2,964,840	2,964,840
		Others	Staff	-	311,000	311,000	-	435,400	435,400	-	497,600	497,600	-	622,000	622,000	-	622,000	622,000	-	2,488,000	2,488,000
			Material & labour	-	248,664	248,664	-	344,304	344,304	-	420,816	420,816	-	487,764	487,764	-	497,328	497,328	-	1,998,876	1,998,876
Plantation	Capital	Teak	Building	-	2,979,000	2,979,000	-	662,000	662,000	-	662,000	662,000	-	331,000	331,000	-	331,000	331,000	-	4,965,000	4,965,000
			Equipment & vehicle	3,976,200	527,580	4,503,780	883,600	117,240	1,000,840	883,600	117,240	1,000,840	441,800	58,620	500,420	441,800	58,620	500,420	6,627,000	879,300	7,506,300
		Others	Building	-	1,805,000	1,805,000	-	722,000	722,000	-	361,000	361,000	-	722,000	722,000	-	-	-	-	3,610,000	3,610,000
			Equipment & vehicle	1,944,000	215,100	2,159,100	777,600	86,040	863,640	388,800	43,020	431,820	777,600	86,040	863,640	-	-	-	3,888,000	430,200	4,318,200
Plantation	Annual	Teak	Staff	-	1,020,600	1,020,600	-	1,247,400	1,247,400	-	1,474,200	1,474,200	-	1,587,600	1,587,600	-	1,701,000	1,701,000	-	7,030,800	7,030,800
			Land clearing etc.	-	1,159,200	1,159,200	-	1,386,000	1,386,000	-	1,638,000	1,638,000	-	1,738,800	1,738,800	-	1,890,000	1,890,000	-	7,812,000	7,812,000
			Weeding	-	372,600	372,600	-	693,900	693,900	-	1,071,900	1,071,900	-	1,331,100	1,331,100	-	1,479,600	1,479,600	-	4,949,100	4,949,100
			Fire protion	-	92,000	92,000	-	202,000	202,000	-	332,000	332,000	-	470,000	470,000	-	620,000	620,000	-	1,716,000	1,716,000
		Others	Staff	-	567,000	567,000	-	793,800	793,800	-	907,200	907,200	-	1,134,000	1,134,000	-	1,134,000	1,134,000	-	4,536,000	4,536,000
			Land clearing etc.	-	655,200	655,200	-	907,200	907,200	-	1,108,800	1,108,800	-	1,285,200	1,285,200	-	1,310,400	1,310,400	-	5,266,800	5,266,800
			Weeding	-	140,400	140,400	-	334,800	334,800	-	502,200	502,200	-	610,200	610,200	-	675,000	675,000	-	2,262,600	2,262,600
			Fire protion	-	52,000	52,000	-	124,000	124,000	-	212,000	212,000	-	314,000	314,000	-	418,000	418,000	-	1,120,000	1,120,000

Type of Work	Type of Cost	Species	Category	Total Cost (K) in Year 1 FE	1 Local	1 Total	2 FE	2 Local	2 Total	3 FE	3 Local	3 Total	4 FE	4 Local	4 Total	5 FE	5 Local	5 Total	Total Cost (K) for 5 years FE	Local	Total
Head quarters regions	Capital	-	Building	-	2,596,000	2,596,000	-	-	-	-	-	-	-	-	-	-	-	-	-	2,596,000	2,596,000
			Equipment & vehicle	4,600,000	1,930,000	6,530,000	-	-	-	-	-	-	-	-	-	-	-	-	4,600,000	1,930,000	6,530,000
			Staff	-	579,620	579,620	-	579,620	579,620	-	579,620	579,620	-	579,620	579,620	-	579,620	579,620	-	2,898,100	2,898,100
			Stationery, etc.	-	35,000	35,000	-	35,000	35,000	-	35,000	35,000	-	35,000	35,000	-	35,000	35,000	-	175,000	175,000
			Spares for equipment & vehicle	1,369,270	547,708	1,916,978	-	110,168	385,588	192,890	77,156	270,046	220,240	88,096	308,336	55,180	22,072	77,252	2,113,000	845,200	2,958,200
			Petrol, oil & lubricants	-	540,000	540,000	540,000	540,000	540,000	-	540,000	540,000	-	540,000	540,000	-	540,000	540,000	-	2,700,000	2,700,000
			Vehicle maintenance	-	324,000	324,000	-	324,000	324,000	-	324,000	324,000	-	324,000	324,000	-	324,000	324,000	-	1,620,000	1,620,000
			Building maintenance	-	-	-	-	486,850	486,850	-	594,150	594,150	-	670,000	670,000	-	755,100	755,100	-	2,506,100	2,506,100
			Road maintenance	-	2,920,000	2,920,000	-	2,920,000	2,920,000	-	2,920,000	2,920,000	-	2,920,000	2,920,000	-	2,920,000	2,920,000	-	14,600,000	14,600,000
			Technical assistance	350,000	-	350,000	350,000	-	350,000	-	-	-	-	-	-	-	-	-	700,000	-	700,000
			Training	175,000	-	175,000	175,000	-	175,000	-	-	-	-	-	-	-	-	-	350,000	-	350,000
	TOTAL			15,586,970	23,357,966	38,944,936	3,554,620	14,961,342	18,515,962	2,121,790	16,095,462	18,217,252	2,422,640	17,964,106	20,386,746	606,980	17,243,890	17,850,870	24,293,000	89,622,766	113,915,766
	Contingency 15%			2,338,046	3,503,695	5,841,741	533,193	2,244,201	2,777,394	318,269	2,414,319	2,732,588	363,396	2,694,616	3,058,012	91,047	2,586,584	2,677,631	3,643,951	13,443,415	17,087,366
	Total for the whole project			17,925,016	26,861,661	44,786,677	4,087,813	17,205,543	21,293,356	2,440,059	18,509,781	20,949,840	2,786,036	20,658,722	23,444,758	698,027	19,830,474	20,528,501	27,936,951	103,066,181	131,003,132

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