The Governments of Malaysia & the State of Johor

Johor tenggara

5 conservation & forestry

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THE GOVERNMENT OF MALAYSIA AND THE STATE OF JOHOR

JOHOR TENGAH AND TANJONG PENGGERANG
REGIONAL MASTER PLAN

SUPPORTING VOLUME 5

CONSERVATION AND FORESTRY

AUGUST 1971

PREFACE

This volume has been produced in three parts. Part 1 deals with The Johor Tengah Forestry Project, Part 2 with the Overall Forest Resource and Part 3 Conservation in the Project Area.

The review group set up to study the Draft Project Report proposals agreed that the forestry project in Johor Tengah should be a priority project, and therefore a feasibility report was required. Part 1 of this volume constitutes that feasibility report. It was felt that the detailed proposals for Johor Tengah Forestry Project should be read against the background of both the conservation proposals and the forestry resource base, for this reason Volume 5 includes all three parts and Part 1 has not been bound separately as were the two parts of Volume 6 (which were also feasibility reports).

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PART I
JOHOR TENGAH FORESTRY PROJECT

SUMMARY

1.   The project is the establishment of a timber logging and processing complex in Johor Tengah

          The logging of the Project Area and the sale or further processing of the timber will be a linked operation.

2.   The Project Area is a block of 92,000 acres of undisturbed lowland dipterocarp forest in the Johor Tengah region. A substantial part of the area, 71,000 acres, will progressively be cleared for agricultural development. The remaining 21,000 acres constitutes water catchment reserves in which timber may be logged but cultivation will not take place.

3.   The Project Area forms part of a larger area of 149,000 acres in which an inventory was carried out in 1969/70 as part of the Johor Tenggara Master Plan study. From the results of this inventory it has been estimated that a yield, Reliable Minimum Estimate, of at least 20 Forest Department (FD) tons per acre of utilisable timber from trees of good form may be expected.

4.   The extraction of utilisable timber from the agricultural area will be integrated with the phasing for subsequent agricultural development. The logging of the remaining 21,000 acres which follow. Logging would commence in mid-1974. The programme will be completed in 15 years. Annual coupes from 6,000 acres will provide an estimated
          yield of 120,000 FD tons. Logging roads will be established as necessary, utilising alignments along which permanent highways required for later development will subsequently be constructed.

5.   Of the total annual coupe of 120,000 FD tons some 35,000 tons of peeler logs will be disposed of to existing plymills which have an adequate capacity to deal with it efficiently.

          The remaining 85,000 FD tons will be processed in the timber complex. First through a sawmill which will therefore have an output of 51,000 cubic tons. Of this tonnage 28,000 cubic tons will be sold as rough sawn air-dried timber. A further 7,000 cubic tons will be further processed and sold as pressure-treated timber. The balance of 16,000 cubic tons will be kiln-dried and of this 5,000 cubic tons will be sold as rough sawn kiln dried timber. The remaining 11,000 cubic tons will be processed through moulding and planing equipment to give 7000 cubic tons of mouldings for sale (See Fig.1.1).

6.   Work will commence on establishing the timber complex in mid 1972 and production is schedu-
led to start not later than mid 1975. It will have a minimum operating life of 15 years but there are further possible supplies of logs in nearby areas which would prolong the mill life by at least another 8-9 years and logs could be purchased from outside Johor State.

7.   This feasibility report provides for implementation and operation by a public sector company employing overseas personnel if necessary.

8.   The capital required by the project amounts to $16 million which is required between 1972 and 1974 inclusive. Of this $9.5 million is attributable to logging and $6.5 to processing facilities (See Table 2.3).

9.   The financial rate of return for the project before the deduction of royalties and premia is estimated at 28 percent. Assuming royalties and premia to be paid equivalent to $275 per acre worked, the financial rate of return would be 18 percent. The social rate of return is over 40 percent.

10. In order to make the fullest possible contribution to the objectives of the new economic policy of Malaysia substantial provision is made for the cost of training Malays in the operations of the complex.

          The project would also act as a market leader among the less popular species by creating a market for high value-added timber products.

11. In submitting the project for international finance it will be necessary to include a statement of the state government's policy on the system of royalty and premia payments to be used on this project.

1.1 Usable Timber

Detailed results of the forest inventory which covered 149,000 acres are in Appendix C. This inventory was carried out in 1969/70 as part of the Johor Tenggara Master Plan study. The project has been restricted to 92,000 acres of lowland forest because methods of extraction have not yet been devised for logging the 65,000 acres of hill forest, where slopes are an average greater than 20 degrees, without creating a serious conservation hazard.

The Reliable Minimum Estimate (R.M.E) of utilizable timber, Table 1.1, is 1848 thousand tons of timber (2126 thousand tons true volume measure), or 20 FD tons per acre.

Table 1.1   Reliable Minimum Estimates of Timber
92,000 acres

Timber over 4ft. in girth	True Volume Measure thousand tons	FD tons	Per- cent
Inventoried volume after allowing for defect.	3146	2735	100
Of which utilizable timber	2496	2170	79
Utilizable timber adjusted for form class	2126	1848	67

Table 1.2 shows the composition of this in terms of species and species groups and in terms of sawlogs and peeler logs. It should be noted that the volumes of individual species are not Reliable Minimum Estimates but are mean values for each species less the overall error of estimate of about 10 percent.

1.2 Clearance Requirements and Phasing

The agricultural programme for the Johor Tengah area was drawn up to meet the constraints of FLDA requirements and to enable a logging and timber processing programme to be drawn up which would provide as extensive a utilisation of the timber as possible. A logging programme of 6,000 acres per annum starting in mid-1974 has been proposed Figure 1.1 . This will enable most of the sawlogs to be processed (within the complex) and will at the same time meet the requirements of the agricultural development programme.

Table 1.3 shows the clearance and logging requirements for the 71,000 acres which are to be developed for agriculture and which are part of the 'project area'. This programme gives suffi-

cient leeway to allow for small delays.

1.3 Logging

The capacities and costs of the processing facilities have been calculated on the basis of a logging programme of 6,000 acres per annum and a yield of about 20 FD tons per acre.   For individual logging areas of 6,000 acres, and even more so in respect of individual species, significant variations in yield may occur. But float between the logging and agricultural programme is large enough to allow for such a variation without the clearance programme being held up: and in any case, any variations in the flow of logs to the processing facilities could be compensated by outside purchases and sales of logs.

The detailed logging programme and the location of the principal roads through the logging areas are shown in Figure 1.3 . It is recommended that the main logging roads should be constructed on the same alignments as the agricultural roads and that the logging company should be compensated for any additional cost incurred as a result of building roads to a higher standard than is necessary for logging purposes alone (see Appendix I). Because this type of integrated logging and processing operation, extracting higher yields than the existing industry, is relatively new to West Malaysia, field scale comparison is not available on the relative cost and performance of the two main logging systems, the skidder system and the local San Tai Wong system (Appendix I).

A decision will have to be taken in 1973 on the system to be used and it is most unlikely that any more data on their relative performance in the type of operation proposed here will be available. In view of the greater potential of the skidder system to realize economies of scale with higher yields of timber and its robustness to weather conditions, the skidder system has been proposed. The detailed plant requirements and cost are in Appendix I.

1.4 Processing Facilities

The capacity of sawmills in Johor (Appendix G) would be more than adequate to process the timber from the 'complex area'. But the existing sawmills are not geared to extensive processing and if the sawlogs from the 92,000 acres are sold to the existing sawmilling industry, little will have been done to improve the average quality and grades of Johor timber. On the other hand, it would be difficult to justify extra plymilling capacity,

<div align="center">TABLE 1.2</div>

Reliable Minimum Estimates of Conventional and Utilisable Timber: 92,000 acres of Lowland Virgin Forest to be Logged in the Johor Tengah area

GROUPS AND SPECIES	THOUSAND TONS TIMBER			
	True Volume Measure[3]		FD Measure[3]	
	S/Logs	P/Logs	S/Logs	P/Logs
HEAVY HARDWOODS				
Balau	103		90	
Chengal	54		47	
Keranji	58		50	
Membatu	13		12	
Merbau	9		8	
Resak	58		50	
Sub Totals:	295		257	
MEDIUM HARDWOODS				
Kapur and Keladin	147		127	
Kelat	98		85	
Keledang	3		3	
Kempas	132		115	
Keruing	194		169	
Merawan Batu and Simput Jantan)	6		5	
Rengas	13		20	
Simpoh	—	16	–	13
Sub Totals:	603	16	525	13
LIGHT HARDWOODS				
Jelutong	12		11	
Kedondong	141		122	
Kumbang Semangkok	49		43	
Machang	9		8	
Mata Ulat	16		14	
Medang	54		47	
Melunak	6		5	
Mengkulang	–	62		54
Merpauh	4	–	–	4
Merawan	–	32		28
Mersawa	–	19		16
Nyatoh	68		59	
Pelong	2		–	
Ramin	3		3	
Red Meranti	(348)	(223)		
M. Melanti	33	40	29	35
M.R. Daun	16	19	14	16
M.S. Punai	20	25	17	22
M. Tembaga	43	54	38	47
Seraya	78	–	68	–
Nemesu	80	–	69	–
Other Spp.	68	85	59	74
Sepetir	13	–	11	–
Bintangor	43	–	37	–
Durian	–	29	–	25
Geronggang	9	–	8	–
Terentang	4	–	4	–
White Meranti	–	16	–	13
Yellow Meranti	–	59	–	51
Sub Totals:	771	440	672	381
TOTALS TIMBER	1669	456	1454	394
IN THOUSAND TONS	2,125		1,848	
TOTAL ACREAGE (1)	92,000		92,000	
TONS PER ACRE	23.1		20	

NOTES: (1) The figures for individual species are based on the proportion of the species to the mean inventorial volume and are not therefore RME's of the volumes of individual species.

(2) The 92,000 acres includes 21,000 acres of water catchment, which will not be cleared for agriculture.

(3) For definitions of these measures, see Appendix K.

FIGURE 1.1 <u>Logging and Processing in the Johor Tengah</u>
<u>'Complex Area'</u> - Each Year From 1976[1] Onwards

<u>Logging</u> -
120,000 FD Tons[2]
Extracted

Logs Sold To
Plymills -
35,000 FD Tons

<u>Sawmill</u> - Input
Of 85,000 FD Tons -
Output of 51,000
Cubic Tons

Rough-sawn Air-
Dried Timber
Sold - 28,000
Cubic Tons

<u>Pressure-</u>
<u>Treated</u>
Timber
Sold -
7,000
Cubic Tons

<u>Kiln Drying</u>
- Input/Output
of 16,000
Cubic Tons
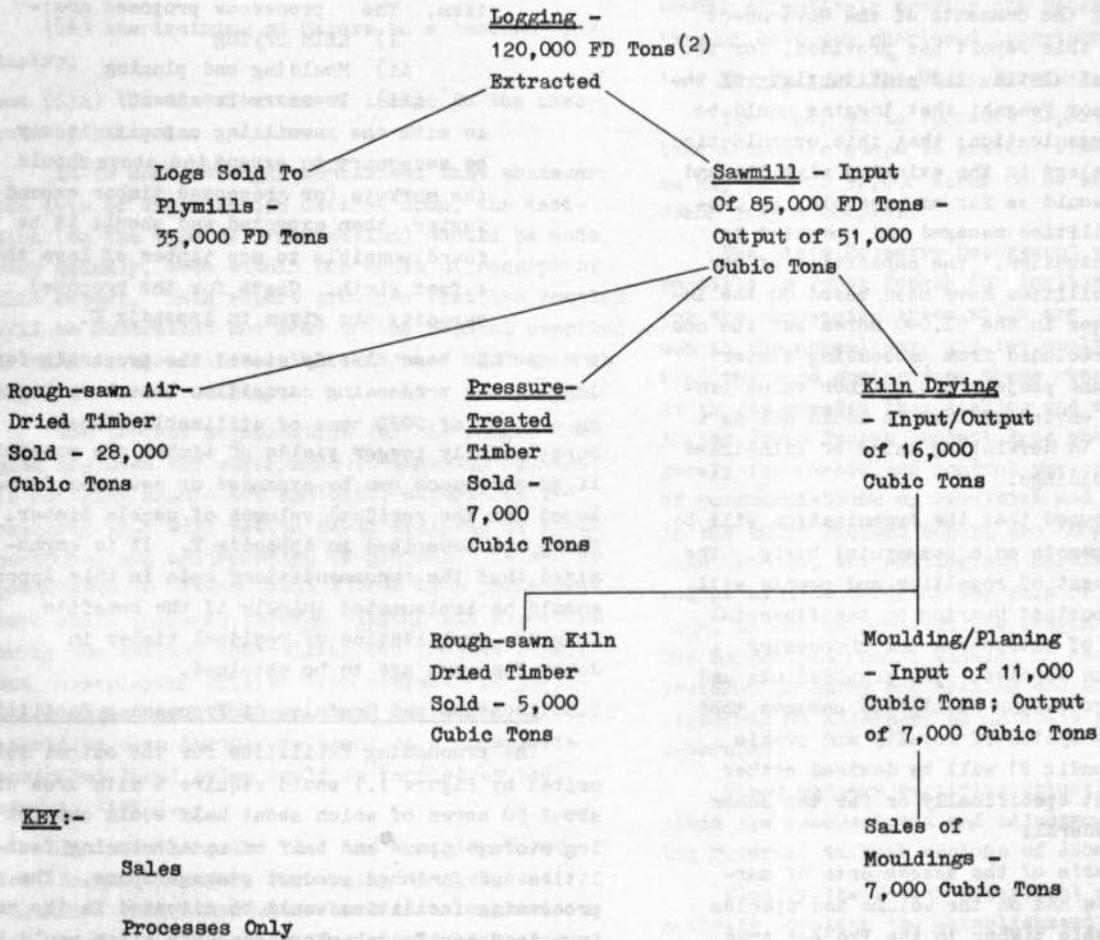
KEY:-

Sales

Processes Only

Rough-sawn Kiln
Dried Timber
Sold - 5,000
Cubic Tons

Moulding/Planing
- Input of 11,000
Cubic Tons; Output
of 7,000 Cubic Tons

Sales of
Mouldings -
7,000 Cubic Tons

(1) 1976 is likely to be the first fully operational year for
the processing facilities.

(2) All figures are rounded for simplicity of presentation -
detailed figures are shown in Table 6 of Appendix F.

since the plymills in Johor are thought to be efficient and can provide sufficient capacity to handle the assumed sales of plylogs from the 92,000 acres.

Following the comments of the Government Review Group, this report has provided, for the purposes of calculating the profitability of the complex in Johor Tengah; that logging would be done by one organisation; that this organisation would sell peelers to the existing plymills and that sawlogs would as far as possible, be processed in facilities managed and operated by the same organisation. The capacities of the processing facilities have been based on the inventory tonnages in the 92,000 acres but the complex is not precluded from processing timber from outside the project into higher value products. It is envisaged that it would act as a leading agent in developing sales of kiln-dried timber and mouldings.

It is assumed that the organization will be required to operate on a commercial basis. The system of payment of royalties and premia will have a very important bearing on the financial profitability of extracting and processing the lower value species. The proposed mix and capacity of processing facilities assumes that a satisfactory system of royalty and premia payments (Appendix F) will be devised either for the project specifically or for the Johor industry in general.

On the basis of the assessments of markets and prices and on the volume and species mix of utilizable timber in the Project Area, the recommended processing plan (Figure 1.1) shown below is:-

a) All peeler logs will be sold to existing plymills.

b) All the remaining timber will be put through the sawmill requiring on annual capacity of 85,000 FD tons of logs and an output of 51,000 cubic tons of sawn timber. It may be necessary to expand sawmilling capacity should markets for timber of less than 4 ft. in girth be identified, or logs from outside the Project Area be processed. Costs are given in Appendix J.

c) The other processes would absorb only a proportion of the sawmill's output, the remainder being sold as rough sawn air dried timber. The capacities of these other processes have been based on the projected

market situation. It will be necessary to review the mix of capacity immediately prior to ordering plant in late 1972 in the light of the latest market situation. The processes proposed are:-
   i) Kiln Drying
   ii) Moulding and planing
   iii) Pressure Treatment
As with the sawmilling capacity it may be necessary to expand the above should the markets for processed timber expand faster than expected, and should it be found possible to use timber of less than 4 foot girth. Costs for the proposed capacity are given in Appendix K.

As has been already stated the proposals for logging and processing capacities have been based on a yield of 20FD tons of utilizable timber. Substantially larger yields of timber are possible if present uses can be expanded or new uses developed for the residual volumes of usable timber. These are described in Appendix E. It is emphasized that the recommendations made in this Appendix should be implemented quickly if the benefits from the exploitation of residual timber in Johor Tenggara are to be obtained.

1.5 Location and Training of Processing Facilities

The processing facilities for the output described by Figure 1.1 would require a site area of about 50 acres of which about half would consist of log storage space and half of manufacturing facilities and finished product storage space. The processing facilities would be situated in the new town in Johor Tengah where adequate sites would be available offering soil stability, space, water and power supply, sewage disposal and services. The sawmill would therefore be about 25-30 miles from Kluang and about 35-40 miles from Johor Baharu.

Table 1.4 shows the phasing programme for the complex which, based on the Jengka experience, is feasible. The programme shows that the time between the receipt of this report and the first runs through the sawmill is 3 years 4 months. The time between the receipt of this report and the first extraction of logs is only two and a half years.

1.6 Organisation

The characteristics of the logging and sawmilling organisations in Malaysia and Indonesia, the experience of Sharikat Jengka Sdn. Bhd. in the Jengka Triangle, the timing of the project and finally the advantages and disadvantages of various types of possible organisation for the 'complex area' are discussed in Appendix H. The organisa-

tions were considered in the light of three objectives:

(i) maximisation of the rate of return to the Malaysian economy;

(ii) the training of Malays in a 'modern' industry;

and (iii) the distribution of income to the have-nots in Malaysia.

It is most strongly emphasised that whatever the type of organisation decided upon, the decision (on the type of organisation) should be made very quickly, even within one month of receipt of this report. This report provides that the complex will be controlled and most of the capital supplied by MARA in association with the Johor SEDC through a public sector company.

The present organisation for the Jengka Complex includes the employment of managing agents. If managing agents are employed, safeguards are required that will ensure rapid training of local personnel and maximisation of profits. It may be preferable to obtain these either by a joint venture which includes foreign capital and expertise or by the company controlling the project itself but employing experts from overseas in particular positions. The marketing of export sales should be done through an agent on a commission basis but local sales would be handled by the company itself.

It is anticipated that the Managing Director, Logging Manager, Processing Manager, and Financial Controller would have to be expatriate staff; in any event they should be recruited in early 1972. An outline organisation chart has been drawn up (Figure 1.2) indicating the proposed structure. The middle management and senior production personnel should be Malaysians recruited in 1972 and 1973. This would enable them to be given at least one year's training. One of the early tasks of the senior management would be to recruit these staff and to draw up detailed training programmes for them.

1.7 Training

The training programme will vary according to the individual tasks of the staff employed but the programmes should combine short courses at home and overseas technical institutes, secondment to logging and processing companies in West and East Malaysia and again if necessary overseas, and attendance at courses and seminars organised by UNIDO and similar agencies.   (Appendix H). The total training cost for the whole complex including the wages

and salaries of staff during their periods of training is   about one million dollars, and the cost of the senior management   about $0.24 million per annum. This should effectively provide the necessary expertise in both the short-and long-terms.

1.8 The Role of The State Forestry Department

The Johor State Forestry Department should take immediate steps to prevent illegal logging on any part of 92,000 acres to be worked by the Johor Tengah complex.

The State Forestry Department would be responsible in Johor Tengah for inviting tenders for the concession areas which are to be licensed in the normal way, and for scaling and marking the logs coming from these concessions. It is recommended that scaling and marking in the Johor Tengah Project Area should continue purely for record and control purposes if recommendations on royalties and premia made in the Draft Project Report are accepted. If this is done, the scaling and marking should not be allowed to delay the sale or use of the logs, as has happened in the Jengka Triangle. The Forest Department should, if necessary, be prepared to carry out scaling and marking continuously as necessary to maintain processing schedules.

Other matters requiring attention will include new reservations and adjustments to existing reserves in both regions of Johor Tenggara.

Finally the Forest Department should actively consider the establishment of an experimental unit to produce block-board, using small trees below four feet GBH of mixed species including the tiup2 found in Tanjong Penggerang. The experimental unit might be located at the New Town site near to the processing facilities of the complex, since trial work should also be done on sawing small trees for small dimension timber using small gangsaws and edgers. The emphasis of the experimental work should be on problems of marketing and commercial production rather than on the purely technical properties and the experimental unit should work in close liaison with the Marketing and Development Division of the complex.

TABLE 1.3 Land Clearing and Logging in the Timber
Complex Area

Year	Land required for clearing by October		Logging completed by May		Logging Plan Reference
	Each year	Cumulative	Each year	Cumulative	
1974	–	–	–	–	⎫
1975	–	–	6.0	6.0	⎬ 1
1976	9.1	9.1	6.0	12.0	2
1977	8.2	17.3	6.0	18.0	3
1978	6.8	24.1	6.0	24.0	4
1979	3.5	27.6	6.0	30.0	5
1980	4.4	32.0	6.0	36.0	6
1981	2.0	34.0	6.0	42.0	7
1982	6.7	40.7	6.0	48.0	8
1983	5.8	46.5	6.0	54.0	9
1984	3.5	50.0	6.0	60.0	10
1985	5.0	55.0	6.0	66.0	11
1986	9.0	64.0	5.0	71.0	12
1987	6.5	70.5	–		13
+	+0.5	+0.5			14 and 15 *

+ includes small area of floodable river valley not scheduled for
   immediate development.
+ Logging years 13, 14 and 15 are catchment areas for the logging of
   large timber only.
Note: (a) The logging year for each 'block' runs for 12 months
              commencing in June.
      (b) Clearance year for agriculture commences in October.

TABLE 1.4 The Phasing of the Forestry Complex in Johor Tengah

TYPE OF OPERATION AND STAGE	YEAR	1971			1972				1973				1974				1975		
	MONTH	J	S	D	J M	J	S	D	J M	J	S	D	J M	J	S	D	J M	J	S

SEJP Report Presentation

Access Road to Sg. Sayong Crossing and New Town (Sawmill) Site   6   9

Design and Construction of Sg. Sayong Crossing   12

Establishment of Company   6

Recruitment of Senior Personnel   6

Design of Sawmill   8

Preparation of Site and Construction of Sawmill   18

Recruitment of Middle Management   6

Training of Middle Management   12

Tenders for Road Construction and Logging Equipment   6

Awaiting Delivery of Logging Equipment   6

Tenders for Sawmill Equipment   6

Awaiting Delivery of Sawmill Equipment   6

Roads Construction and Logging Proceeds -

Installation of Sawmill Equipment   8

Trial Runs of Sawmill   4

Sawmill Production Proceeds

Latest Date For Logging To Start

KEY:-

Likely Duration of Activity   o————o

Likely Spare Time or "Float"   o—·——·—o

Critical Path   o━━━━o

FIGURE 1.2 Johor Tengah Timber Project — Tentative Organisation

Date of Appointment (Company Formed in 1971/72)	Number of People
1972	1
1972	22
1972	2
1972/73	40
1973/74	15
	580
	660

Share — and Debt-holders (IBRD, MARA, JOHOR SEDC)

Board of Directors

Managing Director

Financial Controller and Personal Dept.

Agents for Export Sales

Logging and Road Construction Manager

Processing Manager

Admin. and Camp Supervision

Road Construction and Quarry Managers — 25–30

Logging Foremen/Superintendent — 175

"Planning" (Inventory Supervisor and Surveyor) — 22

Repair and MTCE. Shop Manager — 40–50

Saw Mill Manager — 170

Kiln Manager — 45

Pressure Treatment Manager — 12

Moulding Plant Manager — 24

Repair and MTCE Shop Manager — 50

Development and Marketing Manager — 10

Administration

FIGURE 1.3
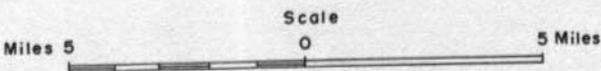
LOGGING & ROAD PLAN

The expected prices, sales volumes and sales revenue are shown in Table 2.1. In 1974 and part of 1975 it will be necessary to sell 70,000 FD tons of logs since the processing facilities will not be installed until the latter half of 1975.

Table 2.1 Prices, Volumes and Revenue

	Units	Price/ Unit	Annual 000 Units	Sales $ mn	1970-1990 Total $ mn
Sawlogs	FD Ton	63	(1)	(1)	4.4
Peeler logs	"	71	35	2.5	38.4
Rough sawn Air dried }	Cubic Ton	161	28	4.5	65.4
Rough sawn Kiln dried }	"	269	5	1.4	19.6
Mouldings	"	450	7	3.1	45.5
Pressure Treated Timber }	"	155	7	1.1	15.8
Total Sales Value				12.6	189.1

(1) 70,000 FD tons sold in 1974-5

The pattern of sales revenue rising from $2.6 million in 1974 to $12.6 million in 1976 can be seen from Table 2.2. The sales prices for individual species are shown in Appendix G. These are prices delivered to the consumer or to the point of export. The split into domestic and export sales is also derived from the same source. (Table G.2). The average ex-mill price for all sawmills in West Malaysia in 1968 was about $150 per ton compared to an average price in this evaluation for processed products of about $215 per cubic ton. The difference arises because of the higher degree of processing proposed. But the average delivered price of log sales from the project is about $70 per FD ton, which is somewhat lower than the average price for logs exported from Malaysia in recent years. This is because the logs that are currently exported are of a high standard whereas the best logs from the Project Area will be processed in the complex. Total sales at delivered prices and before allowing for export sales commission and bad debts are about $189 million over the period from 1974 to 1990.

The working capital requirements have been accounted for in the cash flows by allowing for a two months' stock of logs at any one time, and a lag of three months between the production of sawn timber, mouldings, etc. and the receipt of cash from their sale. This means that the

stock of logs averages about 20,000 FD tons, and the stock of finished products and debtors outstanding are jointly equivalent to about 12,000 cubic tons of finished products. This would amount to about,$1.85 million.

The export sales commission is estimated to be 5 percent of export sales value and bad debts are estimated to average about 2½ percent of total sales.

Transport costs are expected to be about $15 per cubic ton for exports and about $8 per ton for local sales to Johor Baharu or Kluang. The transport cost for exports includes the cost of handling at the port. Approximately one-third of sales by volume would consist of exports; thus the average transport cost is $10 per ton of sales.

The logging and processing costs have been calculated in detail (Appendix I, J and K). The annual cost of the financial control and personnel department has been allocated to the logging and sawmilling divisions as are the costs of the 'Local Marketing and Development Division'. The Head office costs have not been allocated; these comprise the costs of the Managing Director, the secretarial staff attached to the Managing Director's office, the cost of establishing the company, the cost of auditing and the allowances and expenses of the Board of Directors. The total of these is estimated at $250,000 in 1972, and $200,000 per annum from 1973 onwards. Project Costs are summarized in Table 2.2:-

Table 2.2 Project Costs.

	Capital $ million	Annual Operating $ million
Logging road construction	2.14	0.53
Felling, bucking loading	2.29	1.08
Transport and landing	1.60	0.48
General	0.50	0.40
Sub total	6.53	2.49
Processing site and buildings	1.00	1.39
Sawmilling	3.00	
Kiln drying	1.10	0.21
Moulding	0.54	0.14
Pressure treatment	0.25	0.21
Sub total	5.89	1.95

Head office and general Management	-	0.20
Total	12.42	4.64

Extensive training costs have already been allowed for in the logging and sawmilling estimates. The cost of training, including the wages and salaries of the personnel being trained, is about $1.1 million and the cost of the four most senior management positions of managing director, logging/road construction and processing managers and the Finance Director for the first four years would be up to one million dollars if recruited directly from overseas. Therefore the cost of training and senior management for the first four years should not exceed two million dollars.

The cash flows for the complex for the period from 1972 to 1990 are shown in Table 2.3. The costs are calculated on the basis of the timing shown in Table 1.4 and the logging programme shown in Table 1.3. The net cash flow for the project is negative until 1975 and is shown before the payment of any royalties, premia, interest on loans or company taxes. The rate of return before the deduction of these items is about 28 percent per annum.

The recommendations on royalties and premia made in the Draft Project report have been further reviewed (Appendix F). It is recommended that a licensee should pay a fixed sum for the right to work a particular area of forest, and, where the forest is to be cleared for agriculture, as few restrictions as possible should be placed on his operations. For the area to be worked by the company managing the complex, this means that the company would pay a fixed sum in lieu of royalties and premia, and that there should be no restrictions on the logs that can be extracted.

If royalties were levied on the present basis it is unlikely that the company would find it worthwhile to extract the species Kempas and there would be an even smaller incentive to extract species such as Keranji and those other species referred to in Appendix F as 'other light hardwoods', and 'other medium hardwoods'. Thus the logs extracted from each acre would be at least 5 FD tons and could be as much as 7 or 8 FD tons less than if a lump sum or fixed royalty per acre logged was payable by the company.

Payments of a lump sum will mean higher royalties and premia receipts per acre of forest worked because the utilisation will be greater. With this greater utilisation, the sum received by the State (if calculated on the basis of the present royalty rates) would amount to about $25 million for the project and is equivalent to $275 per acre worked. This compares with a present average for forest reserves in Johor State of about $200-250 per acre worked. If royalties and premia to be levied on the present basis. The total obtained from the 92,000 acres under consideration here would probably be less than $20 million because of the lower utilization expected.

This project is based on a high utilization and therefore it has been assumed that royalties will be paid in accordance with the acreage worked each year, at the rate of $275 per acre. On this basis the financial rate of return to the company before tax would be about 18 percent.

It is envisaged that part of the finance for this project would be provided by the World Bank. The conditions specified by the Bank for the loan for the forestry project in Jengka are examined in Appendix H and it appears likely that this project would meet all the IBRD's requirements. The amount of capital provided by the World Bank is here assumed to be $8 million, or half the finance required repayable over years 5-12, year 1 being 1972, the first year of disbursement. Interest is calculated to accrue on the loan at the rate of 7 percent. The loan from the IBRD is assumed to meet half the capital needed, rather than the foreign exchange requirements, since the latter are difficult to define and identify.

It is unlikely that the company would pay any tax other than timber royalties to Johor State during the period from 1972 to 1990. The company would almost certainly qualify for pioneer status and would therefore be eligible under the Investment Incentives Act 1968, and previous legislation, for a tax holiday of at least 5 years and possibly as much as 8 years. After the 5 or 8 year period, it would be able to charge depreciation on all capital expenditure incurred during the tax relief period as well as making other additional claims under Part III of the Investment Incentives Act.

Thus the capital to be contributed by the Johor SEDC and MARA would amount to some $8 million over the period from 1972 to 1975 and the amounts receivable by the Johor SEDC and MARA as equity shareholders would be as shown in Table 2.2. Because of the gearing provided

by the loan from the IBRD the rate of return on the equity investment would be more than 24 percent per annum.

Logging and timber processing are labour-intensive activities and approximately one-third of the total costs of the operation would be represented by payments to unskilled and semi-skilled labour. The annual wage bill for unskilled and semi-skilled labour would be about $2.3 million per annum when the complex is working at full capacity. More than 600 unskilled and semi-skilled people would be employed. If this labour is charged to the project at a 'shadow' or opportunity cost of about $40 per month, and if all taxes and transfer payments are added back the social rate of return is more than 40 percent

per annum. The labour intensive nature of timber processing emphasises the need to encourage domestic processing of the logs presently exported.

No year-by-year Balance Sheets have been projected for the complex since these will depend on the depreciation and dividend policies followed by the company. The fixed asset cover for the World Bank's loan would, however, be more than adequate, as would the income cover for the interest and debt repayment. Furthermore, as in Jengka, the loan could be channelled through and guaranteed by the Malaysian government.

The rates of return appear satisfactory. The effect of being able to sell only two thirds of the light hardwoods other than Meranti species and only one third of the majority of the heavy hardwoods would be to reduce sales by $2 million per annum. Costs, mainly logging and sawmilling, could be reduced by about $0.6 million so long as a decision to stop logging these species took place quickly. In this case the rate of return before royalty payments would be reduced from 28 percent to about 21 percent. However, it must also be borne in mind that the mean estimate of timber volume is 10 percent above the RME used here. Thus 21 percent represents the most pessimistic situation.

Additional benefits will also arise from this project in the form of training of personnel and the creation of a Malay operated organization in the timber industry. Equally important, the project would act as a market leader in high value-added products and in consequence a market leader in less popular species. The latter is most important if Malaysia is to reap the maximum benefit from timber extraction on land to be cleared for agriculture.

TABLE 2.3 Johor Tengah Timber Complex – Estimated Cash Flows; 1972-1990

	Unit	1972	1973	1974	1975	1976[2]	1988	1989	1990	TOTAL[1]
Production details					*thousand units*					
Log extraction	Acres	-	-	3	6	6	6	5	-	92
Sawmilling Input	FD Tons	-	-	60	120	120	120	100	-	1,848
Sawmilling Output	FD Tons	-	-	-	43	85	85	70	-	1,235
Kiln drying Input	FD Tons	-	-	-	26	51	51	42	-	732
Mouldings Input	FD Tons	-	-	-	5	16	16	13	-	223
Pressure treatment Input	Cubic Tons	-	-	-	8	11	11	5	-	150
	Cubic Tons	-	-	-	4	7	7	5	-	102
Sales volume	Export Sales% / Domestic Sales%									
Logs for plymilling	50 / 50 · Cubic Tons	-	-	12	35	35	35	35	-	537
Logs for sawmilling	65 / 50 · Cubic Tons	-	-	28	42	-	-	-	7	70
Rough sawn timber – air dried	- / 35 · Cubic Tons	-	-	-	7	28	28	28	-	406
Timber – kiln dried	100 / - · Cubic Tons	-	-	-	1.5	5	5	5	1.5	73
Mouldings	100 / - · Cubic Tons	-	-	-	1.2	7	7	7	1.2	101
Pressure treated timber	- / 100 · Cubic Tons	-	-	-	4	7	7	5	-	102
Sales value						$ Million				
Export		-	-	0.89	3.13	7.43	7.43	7.43	1.81	109.85
Domestic		-	-	1.73	4.52	5.16	5.16	5.16	0.71	79.20
Total		-	-	2.62	7.66	12.59	12.59	12.59	2.52	189.06
Less: Export sales commission		-	-	0.04	0.16	0.37	0.37	0.37	0.09	5.47
Less: Bad debts		-	-	0.07	0.19	0.31	0.31	0.31	0.02	4.62
Less: Transport costs		-	-	0.40	0.89	0.82	0.82	0.82	0.12	12.89
Net sales value ex mill		-	-	2.11	6.42	11.09	11.09	11.09	2.29	166.08
Costs										
Logging & transport to main landing		-	-	0.33	3.53	5.60	2.49[2]	1.70	-	57.42
Sawmilling		-	-	0.20	1.30	3.48	1.39	1.39	-	25.61
Kiln drying		-	-	-	0.35	0.90	0.21	0.21	-	4.34
Moulding		-	-	-	0.16	0.44	0.14	0.14	-	2.64
Pressure treatment		-	-	-	0.10	0.23	0.21	0.21	-	3.39
Head office and general management		-	-	0.25	0.20	0.20	0.20	0.20	0.20	3.65
Total costs – ex mill		-	-	0.78	5.64	10.85	4.64	4.64	3.85	97.05
Net cash flow to company before royalties and taxes		-	-	(0.78)	(5.64)	(8.74)	6.45[2]	7.24	2.29	69.03
Payment to state for royalties and taxes ($275/acre logged)		-	-	0.20	-	0.82	1.63	1.36	-	25.00
Company cash flow (to be financed)		-	-	(0.78)	(5.64)	(9.56)	(4.82)	5.88	2.29	
Less: Loan 50% (interest 7% paid to 1983)		-	-	.39	2.82	4.78	1.58	-	-	
MARA and SEDC Cash Flow		-	-	(.39)	(2.82)	(4.78)	(1.58)	5.88	2.29	

(1) May not add due to rounding

(2) Constant all years 1976-1988 accept removals of equipment $3.52m 1979 and 1984 $1.93m 1978 and $2.43m 1983.

PART II
BACKGROUND AND FOREST RESOURCE

3.1 Introduction

Alternative recommendations for the utilisation of timber resources and raising revenue from the forest resources in Johor Tenggara were submitted in the Draft Project Report January 1971. Fuller information amplifying these recommendations was also provided (Supporting Report IV).

The findings were discussed with the Review Group set up for the purpose. The most important were provisions for the logging and processing of timber from 92,000 acres; modifications to the present system of premia, royalties and export duties and studies of the utilisation of residual timber.

The Steering Committee, reflecting the views of the Review Group, advised (March 1971) the following major decisions:

(a) that the logging and processing of the timber from the whole of the enumerated area of 92,000 acres should be under the integrated control of one organisation;

(b) that, while accepting in principle that changes in the system of premia and royalties were desirable, a satisfactory formula had to be prepared;

(c) that a study of the utilisation of residual timber for Johor Tenggara would be of limited use but that the residual timber in Tanjong Penggerang should be disposed of by tender, and a later study of such timber in Johor Tengah might prove useful.

Following these decisions, this volume provides in Part 2 a brief account of the forestry resources of the Region as a whole and in Part 1 describes and evaluates the 92,000 acre Johor Tengah timber project. Additional material is provided in Appendices.

Particular attention has been paid to the form of organisation which will best ensure the rapid establishment of the timber complex which is a key factor in the overall development of Johor Tengah. Further consideration has been given to the adjustment of premia and royalties because these constitute a substantial source of potential revenue to the State and are a positive means of encouraging more intensive and extensive use of the available resource.

The processing facilities will not be operative until 1975. By that time research into additional

products from the complex and their marketing, now being carried out by the Forestry Research Institute, the Pahang Tenggara Project and the UNDP team will be much advanced. For this reason some flexibility has been assumed in the mix of products which the timber complex may produce in the longer term.

3.2 Forest Regeneration

It has been assumed that all land with average slopes of less than 20^0 will be developed for agriculture. The social rate of return from agricultural development, in particular from oil palms and rubber, is substantially greater than that obtainable from regenerated forest. This situation is likely to continue until the rotation cycle for forest is brought down to less than 20 years compared with the present 70. This in turn implies that considerable advances in the utilisation of smaller trees will have to be made and/or that very quick-growing species must be introduced. Research into the possibilities of quick-growing tropical pine and other trees is currently being carried out by the UNDP team (Appendix B). As yet the research is not sufficiently well-advanced to suggest that social returns will be similar to those possible from oil palms and rubber even though the price prospects for timber are so much better than those for these tree crops.

3.3 Forestry in West Malaysia

In recent years, output from logging operations in West Malaysia has grown fast but the processing of timber in West Malaysia has grown at a slower rate. In 1960, exports of timber and timber products totalled about 500,000 cubic tons but by 1969, the exports of timber and timber products totalled about 1.9 million cubic tons valued at about $250 million (Table 3.1). But whereas in 1960, only about 17 percent of the log outturn or production in West Malaysia was exported as logs, by 1969 approximately 25 percent of the log outturn was being exported in unprocessed form. The proportion of total sawmill output that was exported grew during the decade from about

TABLE 3.1

Imports And Exports Of "Primary Wood Products" - West Malaysia 1967 - 1969

MTC or SITC Commodity Codes[1]	Imports[1]				Exports[1]			
	1967		1969		1967		1969	
	Thousand tons	($mn)	Thousand tons	($mn)	Thousand tons	($mn)	Thousand tons	($mn)
241/100-200 Fuelwood/Charcoal	9	-	11	1	78	1	108	3
242/200-300 Sawlogs/Veneerlogs	-	-	-	-	816	59	1,041	86
242/400-900 Poles/Posts/-243/100 Railway Sleepers	3	-	5	-	15	1	55	6
243/211-315 Sawnlumber over 0.2 inches	3	1	3	1	409	70	612	123
251 Pulp and Waste Paper	26	4	16	3	-	-	-	-
631/100-219 Plywood/Veneer	2[2]	2	2[2]	2	25[2]	12	75[2]	34
631/400 Particle Board	-	-	1[4]	-	-	-	5[4]	-
641/100 Newsprint	15	7	22	11	-	-	-	-
641/200 Printing Paper	18	14	20	17	-	-	-	-
641/300 Kraft Paper (Board)	17	9	26	14	-	-	-	-
641/500 Wrapping Paper (Board)	14	9	13	8	-	-	-	-
641/601-603 Hardboard	2[3]	1	1[3]	1	-	-	-	-
641/604-605 Softboard	3[4]	1	3[4]	1	-	-	-	-
641/900 Paper/Paper Board	10	9	12	10	-	-	1	1
642 Boxes, Bags and Other Paper Articles	9[5]	14	9[5]	13	2[5]	3[6]	5[5]	4[6]
T O T A L	131	71	144	82	1,345	146	1,902	257
Average value ($ per ton)[7]	540		570		110		140	

(1) MTC - Malaysian Trade Classification   SITC - Standard International Trade Classification
Sources - West Malaysia - Annual Statistics of External Trade, 1967 and 1969. Import values are at cif prices and exports at fob prices.
(2) Converted from square feet/5 millimeter thick at 3,000 square feet = 1 ton of 50 cubic feet.
(3) Converted from square feet of varying thicknesses at an average of 5,000 square feet/ton.
(4) Converted from square feet of varying thicknesses at an average of 2,200 square feet/ton.
(5) Estimated
(6) Mostly re-exports to East Malaysia and Singapore
(7) Rounded to nearest $10 per ton.

25 percent in 1960 to over 40 percent in 1969 and the production of plywood and veneer grew from insignificant proportions in 1960 to more than 250 million square feet in 1969 (the input into plymills however still represented less than one-tenth of the log outturn in 1969). But at the end of the decade there were still no significant exports of mouldings and other components, chipboard or fibreboard, or even hardwood chips for pulping.

The present yield of logs from each acre of forest reserve exploited is about 12-15 FD tons.

It is suggested that a major cause of this low level of utilisation is the royalty and premium structure and recommendations for changes in the structure are made (Appendix F). Even if further processing in West Malaysia were limited to the sawing of logs presently exported, between 3,000 and 4,000 additional jobs would be created in West Malaysia on the basis of the 1969 output (Appendix H).

3.4 Forestry in Johor State

In 1969 Johor produced 434,000 FD tons (Glossary Appendix A) of logs, about half of which came from Forest Reserves and half from State land. Forty one sawmills and five plymills produced logs, sawn timber and plywood for local and export markets to a value of some $55 million. State royalties and premia amounted to $7.78 million. Some 5,000 people were employed in forestry, in felling and transporting logs, in sawmilling and ply manufacture (Table 3.2). In 1970 forty one agreement area holders worked a total Forest Reserve coupe of 13,000 acres. Forty four licence holders worked in State Land forest and four in alienated land. The largest individual coupe was 1,000 acres.

3.5 Forestry in Johor Tenggara

Forest, both primary and secondary, covers about 518,000 acres or 70 percent of the total project area.

The Johor Tengah Region contains a compact block of about 178,000 acres of undisturbed forest which are mainly in the centre and north but include two small areas of similar forest in the south east. This area lies within Kluang, Rengam, Ulu Sedili and Panti forest reserves. In the north west and south there are extensive areas of exploited forest, both in forest reserve and state land, including 10,000 acres of regenerated forest below twenty years of age in Kluang and Panti forest reserves and about 15,000 acres of treated forest not yet classed as regenerated mostly in

TABLE 3.2

Johor State Sawmill And Plymill Industry 1969

	Breakdown Saws					Re-Saws					Personnel Employed												
											Management				Skilled				Unskilled				Totals
Existing Sawmills (No.)	Circular 60" Diameter and Over	Band 48" and over; Automatic feed	Band 48" and over; without automatic feed	Horizontal band	Others	Band	Circular	Edgers	Number of Drying Kilns	Total H.P.	Malays	Chinese	Indian	Others	Malays	Chinese	Indian	Others	Malays	Chinese	Indian	Others	Malays / Chinese / Indian / Others
41	15	19	1	1	-	118	34	2	3	9730	Managers 2 / Clerks 11	38 / 207	- / -	- / -	100	742	2	2	458	389	33	-	569/1378/35/2
Existing Plymills (No.) 5	Rotary Lathes 7		Slicers 1							3290	Managers - / Tech'l Adv's - / Clerks 2	- / - / 25	- / - / 2	5 / 5 / -	64	122	7	2	550	400	94	6	616 547 103 8

Notes: (i) Source – From information supplied by State Forest Department for 1969 and from factory managers.
(ii) Only four sawmills worked more than one shift a day in 1969.
(iii) Total labour figures under "Plymills" exclude 5 expatriate managers and 5 expatriate technical advisors.
(iv) In 1969 four plymills only worked three shifts per day. One worked two shifts, one 1½ shifts and one 1 shift per day.

Kluang and Rengam forest reserves (Table 3.3).

The proposed extension to Panti forest reserve in the south east contains about 6,000 acres of forest which has been lightly logged in the past. This area could be usefully exploited again for conventional timber (Table 3.3).

In the Tanjong Penggerang Region there are extensive tracts of secondary forest, which are the result of past clearings for gambier (Uncaria gambier) and tapioca cultivation. The remaining areas consist mostly of exploited primary forest (Table 3.3).

In the Johor Tengah Region logging under twenty year agreements is proceeding at the rate of 1,650 acres per annum in Kluang and Rengam forest reserves. Two of these agreements expire in 1979 and one in 1980 and account of this constraint has been taken in preparing logging and agricultural development programmes.

There are also two areas of State land on either side of the S. Linggiu currently being logged under licence, and, in the Tanjong Penggerang Region two State land areas are being logged under licence. In both regions the licences are renewable half-yearly and should not affect the development programme but early action is necessary to ensure that all merchantable timber is extracted expeditiously so that these areas will be available for agricultural develop- ment when required.

TABLE 3.3   Project Forest Areas

1. Johor Tengah

(a) Inventory Area

	Acres
Hill forest above the 20° average slope line	51,000
Lowland Agreement areas, un- disturbed	6,000
Other lowland forest un- disturbed, including 21,000 acres of water catchments	92,000
	149,000

(b) Uninventoried Area

	Acres
Hill forest above the 20° average slope line	14,000
Lowland Agreement areas, un- disturbed	8,000
Other lowland forest, un- disturbed	7,000
Regenerated Forest	10,000

Treated forest not classed as Regenerated	15,000
Exploited, under exploit- ation, secondary and other disturbed forest including 6,000 acres in Panti Forest Reserve Extension	80,000
	134,000
Total Johor Tengah	283,000

2. Tanjong Penggerang

	Acres
Mangrove forest	18,000
Fresh water alluvial and peat swamp	60,000
Exploited, under exploit- ation, secondary and other disturbed forest	157,000
Total Tanjong Penggerang	235,000

4.1 Forest Area in Johor Tengah Region

The total forest land in Johor Tengah which is not alienated is about 283,000 acres (Table 4.1) of which some 168,000 acres have been included in development schemes.

The bulk of the commercially valuable forest is to be found in this part of the Project Area, and in sub-divided into two categories; lowland dipterocarp and hill dipterocarp depending upon form and productivity of species. The boundary between the two categories for the purpose of this study has been defined as the 500 foot contour. But it is recommended that for the time being, forest on the steeper terrain, i.e. forest above the accepted limit for agriculture (20° average slope), whether lowland or hill type, should be protected and remain unworked. No successful regeneration techniques have been evolved for these forests and exploitation might cause erosion, the silting of streams and impair the habitat of important fauna. When satisfactory management techniques have been evolved this steep land forest may make a useful contribution to the forest industry. It is about 65,000 acres in extent but not all will be worked as the steeper slopes (with average slopes greater than 25°) must be fully protected.

4.2 Forest Area in Tanjong Penggerang Region

The total area of forest land in Tanjong Penggerang which is not alienated is 235,000 acres (Table 4.2) of which 113,000 acres are to be developed for agriculture.

Little marketable timber remains and what is left can only be considered for chipping. Excluding timber in the fresh water alluvial and peat swamps, which would be difficult to extract, and the mangrove forests currently under Forest Department working plans for the production of firewood and charcoal, the remaining forest, which may be marketable, consists of unpopular trees of more than 4 feet GBH and trees of both popular and non-popular species between 2 and 4 feet GBH.

In the south central part of the peninsula, considerable areas of young secondary forest contain a high proportion (45-90 percent) of tiup-tiup (Adinandra dumosa). This type of forest is estimated to cover 57,000 acres.

Between S. Santi and the south coast, apart from the mangrove fringe along the river and the alluvial swamps on the coast, the forest has been cleared for either bauxite mining or rubber plantations. Along the east coast the majority of the strand is flanked by Barrintonia with occasional fringes of Casuarina. Coastal hill forests occur immediately behind the beach sands and swamps. Further inland, behind the more extensive peat and alluvial swamps, is the inland or lowland dipterocarp forest. The principal emergent species in these forests are red meranti, kempas and keruing.

TABLE 4.1 Forest Areas Johor Tengah Region
(Thousand acres)

	Agri- culture areas	Non agri- culture areas	Total
Forest above 20° slope	-	65	65
Undisturbed forest subject to agreement.	11	3[1]	14
Undisturbed forest not subject to agreement including 7,000 acres which is part of Kluang Forest Reserve	78	21[2]	99
Partially logged Forest (proposed extension to Panti Forest Reserve)	6		6
Regenerated, exploited, under exploitation secondary and other disturbed forest	73	26[1]	99
	168	115[1]	283

(1) Includes some river valleys subject to flooding and scattered areas which may eventually come under agricultural development.

(2) Lowland water catchment area.

TABLE 4.2   Forest Areas: Tanjong Penggernag Region
            (Thousand acres)

	Agri-cultural areas (2)	Non agri-cultural areas	Total
Mangrove forest	-	18,000	18,000
Freshwater alluvial and peat swamp	-	60,000	60,000
Exploited, under exploitation, secondary and other disturbed forests including some steep land	106,000	51,000 [1]	157,000
	106,000 [2]	129,000	235,000

[1] Includes some river valleys subject to flooding, scattered areas which may eventually come under agricultural development and possible future urban development areas.

[2] With residual timber

4.3   Forest Categories

For the purposes of the study the forest resource have been considered under five categories.

(1) Conventional timber in the lowland inventory area of Johor Tengah
(2) Conventional timber outside (1) and in Tanjong Penggerang
(3) Residual timber in the agricultural development area
(4) Hill forests
(5) Peat swamp and mangrove forests.

The inventory results for Johor Tengah and the limited sampling data for Tanjong Penggerang give estimates of the tonnages of large popular and residual timber as shown in Table 4.3. More than 2¼ million tons of acceptable timber and more than 7 million tons of residual timber are estimated to be contained in the areas to be logged in the two Regions.

4.3.1 Conventional timber in the inventory area

An inventory was carried out in a compact block of 149,000 acres of undisturbed forest in Johor Tengah. The procedures and criteria adopted and results obtained are fully described in Appendix Q. All trees of four feet girth and over in sampling strips were measured and recorded. In addition all stems down to 2 feet in girth were measured in a 10 percent subsample. Species were classified into 17 groups for recording stand and volume data.

In Tanjong Penggerang a very limited sampling was carried out because of the disturbed

nature of the forest. It was, however, thought desirable to obtain some information on the residual stand; sampling procedures and the classification of species groups used for these samples were similar to those used in Johor Tengah.

The volume per acre of commercial timber of 4 feet girth and over (Table 4.4) is estimated to be 1,909 cubic feet in the lowland areas to which heavy, medium and light hardwoods, contributed 280, 615 and 1,014 cubic feet respectively. In the hill areas the total volume per acre is 1,657 cubic feet of which 224 cubic feet are heavy hardwoods, 620 are medium and 813 cubic feet are light hardwoods.

4.3.2 Conventional timber in non-inventoried areas

It is not planned that any of these areas will supply the projected timber complex; some of them are already being worked by Agreement holders and it is proposed that the remainder should be put out to tender. The areas are detailed in Table 4.3 under Johor Tengah (ii), (iii) and (iv).

There are virtually no large popular logs in the Tanjong Penggerang Region.

4.3.3 Residual timber for Johor Tengah and Tanjong Penggerang

At present, after utilisable logs are extracted from logging concessions in West Malaysia there are usually two types of residual timber left. There are the large (of 4 feet girth and over) logs of presently unacceptable species on the one hand and the smaller stemmed trees on the other. This residual timber constitutes a very large tonnage of wood for which it has been concluded markets can probably be found. With this, in view, assessments of the residual timber in both Johor Tengah and Tanjong Penggerang have been made (Table 4.3) and the question of utilising such material has been examined in some detail in Appendix B.

In Johor Tengah, the inventory results indicate a net yield of about 34 tv tons per acre for all species of 4 feet girth and over of whibh about 23 tons per acre consist of currently utilisable timber. The balance of 11 tons per acre consists of residual timber. But for the purpose of assessing the volume of utilisable residual timber it is reasonable to use the gross volume before the deduction of defects. The 11 tons per acre is after the deduction of 29 percent for defects. When these are added back a gross volume of approximately 15 tons per acre of trees 4 feet girth and over is obtained.

For trees between 2 and 4 feet girth, in-

TABLE 4.3

Estimated Yield Of Timber From Development Areas In Project Regions
(in true volume tons)

Regions	Area in acres	Utilisable Volume (RME) 4' girth & over	Residual Timber (Gross) 4' girth & over	2' to 4' girth
Johor Tengah			(A)	(A)
(i) Inventory area (Timber Complex)	92,000	2,125,000	1,065,000	1,420,000
(ii) Agreement areas (6,000 acres within Inventory Area plus 8,000 acres outside Inventory Area)	14,000	(B) 323,000	210,000	280,000
(iii) Other lowland undisturbed forest including 500 acres of virgin Jungle Reserves	7,000	161,000	105,000	140,000
(iv) Panti Forest Reserve Extension (partially logged in the past)	6,000	(C) 60,000	90,000	120,000
(v) Regenerated forests in Kluang and Panti forest reserves, under 20 years old	10,000	–	–	(C) 100,000
(vi) Treated forests in Kluang, Rengam and Panti forest reserves (not regenerated)	15,000	–	–	(C) 150,000
(vii) Exploited primary forests State land and forest reserve	53,400	–	800,000	1,068,000
(viii) Secondary forests containing some tiup-tiup	5,000	–	–	(C) 50,000
Totals	202,400 (E)	2,669,000	2,270,000	3,328,000
Tanjong Penggerang				
(i) Exploited primary forest excluding peat and other swamp forest	48,000		733,500	978,000
(ii) Secondary forests containing tiup-tiup	57,000		–	570,000
Totals	105,900	–	733,500	1,548,000
Totals both regions	287,300	2,669,000	3,003,500	4,876,000

Note: A) Calculated for 71,000 acres only as 21,000 acres is within proposed water catchments in which no extraction of residual timber should be permitted.
B) This timber will be extracted by existing Agreement holders.
C) Estimated yield at 10 tons per acre.
D) Area of forest land in Johor Tengah to be developed to agriculture is 181,400 acres (202,400 acres less 21,000 acres of water catchment)
E) Area of developable land under forest in Tanjong Penggerang is 113,000 acres.

TABLE 4.4

FOREST INVENTORY – JOHOR TENGAH

Volume of Commercial Timber per acre for trees
of 4 feet girth and over, after allowance for defect

Species Groups	Species	(a) Lowland Volume in cubic feet		(b) Hill forest Volume in cubic feet	
		Mean	RME	Mean	RME
1.	Heavy Hardwoods	280.3	250.7	224.0	197.3
2.	Kempas	97.6	85.8	39.6	33.2
3.	Keruing	127.1	103.2	102.1	87.8
4.	Kapur and Keladan	48.5	34.1	210.9	146.0
5.	Other Medium Hardwoods	342.1	324.6	287.3	248.2
	Total Medium Hardwoods	615.3	574.9	619.9	535.6
6.	Meranti Melantai	55.7	47.5	18.4	13.5
7.	Meranti Rambai Daun	21.3	16.0	19.2	14.2
8.	Meranti Sarang Punai	33.3	27.2	16.5	11.9
9.	Meranti Tembaga	58.8	47.9	47.4	38.1
10.	Seraya	21.2	12.7	116.4	97.6
11.	Nemusu, Gerutu Gerutu and other Red Meranti	172.7	133.0	85.3	68.7
12.	White Meranti	11.9	9.0	7.5	4.3
13.	Mersawa	12.4	8.8	7.2	2.9
14.	Yellow Meranti	29.8	23.3	50.5	41.4
15.	Jelutong	8.9	6.4	5.0	2.4
16.	Mengkulang	49.5	41.9	24.9	19.1
17.	Other Light Hardwoods	538.7	486.7	414.7	385.1
	Total Light Hardwoods	1,014.2	918.6	813.0	734.8
	Grand Total	1,909.8		1,656.9	

Note: Reliable minimum estimates (RME) are not additive as the sampling error for combined groups is less than that for the separate components. RME totals, therefore, are used solely to indicate orders of magnitude.

ventory over a sub-sample of 67 acres in Johor Tengah Region gave a net volume (RME) of 15.4 tons per acre (Appendix C). By allowing for the same mean defect factor a gross volume of 20 tons true per acre is obtained. In total therefore it is estimated that the volume of residual timber in Johor Tengah Region is about 35 tons per acre.

The exploitation of residual timber can be best considered by differentiating three types of area;

(i) land which as far as large marketable logs are concerned has already been worked of is being worked under existing agreements;

(ii) land which, it is recommended, will be the subject of the usual type of logging agreements

and (iii) land which is recommended for exploitation by the complex located in the proposed New Town in Johor Tengah.

As far as (i) is concerned, the acreage involved in Johor Tengah is about 97,000 and the volume of logs of more than two feet GBH on this land probably exceeds 2.7 million tv tons. About one million tons of this consists of logs of more than 4 feet GBH; for these areas, harvesting prior to clearing may result in the best utilisation. This has been the practice recently followed by FLDA in, for example, the Ayer Tawar area in Tanjong Penggerang. But FLDA and other developing agencies should probably call for tenders not only for harvesting alone but also for combined harvesting and clearing. If the combined tenders result in the lowest total costs (or the highest revenue) then these should be accepted.

Furthermore the payment of a fixed sum per acre for royalties and premia would probably result in better utilisation. The Forest Department should therefore combine royalties and premia into lump sums: Companies from which tenders for harvesting are requested cojld include some of the Japanese companies interested in the shipping of wood chips. Alternatively FLDA or other developing agencies could arrange to purchase the residual timber and resell to the Japanese companies on contract.

Those areas which are yet to be logged, but not by the company which it is recommended should establish the new processing facilities in Johor Tengah, should be put out to tender by the State Forest Department with the individual or company submitting the highest tender being awarded the licence. Since these areas are to be cleared soon after logging,

there should be no restrictions placed on logging and the tender price should be the only sum payable to the Forest Department. The payment of a fixed sum would, it is considered, lead to greater utilisation. (Appendix F).

Similarly a lump sum should be payable by, and no restrictions imposed on the organisation exploiting the remaining 71,000 acres to be developed for agriculture.

In Tanjong Penggerang, an area of 46 acres of lowland disturbed forest (logged primary forest only) was sampled to indicate the potential for residual timber over 106,000 acres of the agricultural development land in Tanjong Penggerang. Results indicated a mean volume of approximately 42 tv tons per acre for all species of two feet girth and over (Appendix C).

Compared with the total RME figure of 35 tons gross volume per acre for Johor Tengah it would appear that an appreciable difference in tonnage may be expected from the two areas. However the figure of 42 tons per acre for Tanjong Penggerang is not a reliable minimum estimate and therefore the lower figure of 35 cubic tons true has been used to calculate the total potential outturn of residual timber from both areas. Gross volume has been used as it is thought that a high proportion of defective timber can be utilised in a chipping industry.

The total estimated yields of residual timber in the two Regions differ from those used earlier in this study (See Supporting Report IV of January 1971) because yields from silviculturally treated forest will be much lower than those from untreated forest. The revised total volume of residual timber in the Project Area is estimated at over 7 million tons which would probably give a bone dry weight of chips of over 5 million tons having an fob sales value of over $250 million.

In certain cases in Tanjong Penggerang, where the land has already been alienated to FLDA, supplementary agreements have been entered into whereby the licensee has paid a fee to FLDA for the right to extract the remaining timber. (Appendix D). In addition the licensee must obtain a permit from, and pay royalties to the Forestry Department. No information has been obtained as to the average amounts collected per acre by FLDA and the Forestry Department from the agreements entered into the date, but it seems that the amount collected is small. (Appendix D).

Furthermore the evidence indicates that very little of the smaller timber is at the mo-

ment being extracted, yet there seem to be very good prospects for its further utilisation in any of three ways. These are sawing into strips and scantlings, chipping for domestic use and chipping for export. The prospects for the first two are probably small, except that it might be feasible to saw the stands of tiup-tiup. (Appendix E).

By far the most promising use of residual timber is in the form of chips for export. The chipping of most of the hardwoods would appear to be profitable (Appendix E). There are several Japanese companies interested in shipping chips of mixed tropical hardwoods, and one of these companies in particular has expressed interest in handing the residual timber from the Project Area.

It was because of the uncertainties relating to hardwood chips, and in particular uncertainties as to the cost of extracting and chipping and the prices likely to be obtained, that the Draft Project report recommended that an immediate and special study be fone of the feasibility of chipping Malaysian hardwoods for export. This recommendation was accepted only in part by the Review Group (Appendix E). In the absence of sufficient information it is not possible as a result to make any firm recommendations on the utilisation of the residual timber.

In Tanjong Penggerang, however it is suggested that harvesting of residual timber and clearing, Table 4.5, could take place at the same time (Appendix E).

TABLE 4.5   Clearance Requirements For Agriculture
Tanjong Penggerang (1972-1980)

Clearance Requirements Clearing Year	Acres to be cleared (Nearest thousand acres)
1971	8
1972	13
1973	14
1974	16
1975	15
1976	16
1977	8
1978	11
1979	11
1980	1
Total	113

At present most of the clearing is done manually. This system is unlikely to change in the near future nor does it seem desirable that it should change (Appendix D). However there would probably be some advantages in FLDA, after forestry clearance has been obtained, inviting combined tenders for harvesting and clearing. The payment by the

licensee for the residual timber should then be in the form of a lump sum since this arrangement is likely to lead to a greater amount being extracted than under the present royalty system. Furthermore, if the Forest Department were prepared to levy a lump sum for the right to extract the residual timber, the utilisation is likely to be further increased to the benefit of all concerned (Appendix F).

A chipping plant is now under construction at the new industrial estate and port site near Johor Baharu. In addition the Federal and Johor State Governments should consider encouraging the establishment of a further wood chipping plant in Johor.

If action of this sort is to be taken, it must be taken quickly, to be of any benefit in Tanjong Penggernag, although any action taken is likely to be of benefit to other areas such as Johor Tengah and, further in the future, to Pahang Tenggara and other large land development schemes. Because of the uncertainties attached to the use of residual timber, no estimate of the royalties receivable on residual timber has been made, although the amonts involved could be considerable. If for example, the residual timber were chipped and exported and the same price were obtained as is presently obtained for rubber chips, the sales value of the residual timber in Tanjong Penggerang would be at least $60 million and could be as much as $100 million. Royalties could amount to $3 million or $4 million.

4.3.4 Hill forests

The extent of hill forest above the 20° slope line and of the less steep enclave within it, not to be cleared for agriculture, is approximately 65,000 acres, all of which is found in Johor Tengah. Inventory data for this area indicate that the mean net commercial timber volume for trees four feet girth and above of form classes A and B only, after deduction for defect, is 1,657 cubic feet per acre.

The exploitation of this forest by current methods runs the risk of producing excessive erosion mainly from forest road construction on the steeper slopes. Furthermore a method or methods for regenerating hill forest successfully have not yet been found, although research has been active at the Forest Research Institute on this point. To work this forest not would run the risk of creating conditions such that no regeneration would be economically possible even if a successful method is found. It has been

recommended (Pt. 1) that these 'hill' forests be retained as conservation areas and not subhected to productive forest development until more is known regarding silvicultural treatment and the possible adverse effects on erosion resulting from logging. Furthermore, proposals for agricultural development have been limited to lands with an average slope less than 20°. The lowland forest (i.e. below the 500 contour) on land with average slopes greater than 20° would become permenant productive forest, the hill forest (above 500 feet) would be protective forest. The hill forest may become productive should regeneration techniques improve but forest on land with average slopes greater than 25° must remain as permenant protective forest.

4.3.5 Peat swamp and mangrove forest

These are all to be found in Tanjong Penggerang, covering 36,000 and 18,000 acres respectively. The peat forests have all been logged over and contain little conventionally utilizable timber. Much timber remains which would be suitable for chipping but it would be difficult to extract in view of the swampy conditions. It needs to be ascertained whether or not this timber could be profitable exploited for this purpose.

For the future this land will not be needed for agriculture; about half is already within forest reserve and it is recommended that the remaining part should also be gazetted.

The mangrove forest is all of poor quality; the Forest Department working plan continuing its exploitation is under revision. No recommendations are made.

HILL FOREST CONSERVATION AND MANAGEMENT

5.1   Introduction

In Part 3 (Conservation) of this Supporting Volume measures are advocated to conserve physical resources in those land categories destined for clearance and agricultural development.

In response to the Review Group's views on resource conservation and the management of hill forests, the needs are now examined of those lands lying above the steepland boundary (lands generally steeper than 20°) and proposals are similarly made to protect the physical resources and timber supplies within these areas.

5.2   Tanjong Penggerang Region

Apart from the existing areas of mangrove which should continue to be protected and managed by the Forestry Department no areas of productive forest are planned. A few isolated hills where remnants of the flora with Bornean element are to be found (Part 3 - Chapter 7) and part of the upper catchment of the S. Lebam should, however, be protected. The former as Strict nature Reserves and the latter as protective forest for conservation of water supplies (SV 3). These together with forest reserves incorporating all freshwater and alluvial swamps are delineated in Figure 7.2. The boundaries to existing forest reserves will require adjustment and those for new reserves drawn for gazettement.

5.3   Johor Tengah Region

5.3.1 Conservation

The sources of water supply rising in Johor Tengah Region are important both to existing and future demands outside the project area and to future requirements for development within it. Uncontrolled activities in the lands lying above the steepland boundary could seriously impair these important water sources.

A total of 65,000 acres is to be found in Terrain Classes V and VI but no more than 6,300 acres fall within the latter category which stipulates permanent reservation without any development activity.

With this in mind the Draft Project Report (January 1971) stated that

"Most of the land with an average slope of more than 20° lies in Johor Tengah in a large block and will remain under forest. There are silvicultural problems to be overcome if timber from this steep, inaccessible forest is to be economically exploited on a sustained yield basis without impairing conservation; but for the time being it should remain un-touched" and "Other areas where conservation is recommended for water supply purposes are the Kahang and Linggui catchments which are now, or may in future become, important sources of supply. Unwise development of these areas could increase the costs of providing adequate water storage".

The Review Group set up to consider this aspect of the Draft Report commented as follows:-

"Specifically recognising the relatively small area of primary forest catchments which are likely to remain in Johor and hence the possibility of critical water supply problems the Review Group recommend the following:-

"(a) Delayed phasing of land development in areas with 15-20° slope, leaving such areas till the last. In the meantime the reality of water supply problems in Johor will become more apparent. For practical purposes the 15-20° slope may be translated as Terrain Class IV, that is land with 12-20° slope.

(b) That the Consultants incorporate within the Masterplan proposals for the establishment and maintenance of hydrological stations which will enable a study to be made of changes in hydrological regimes following conversion of forested catchments to developed catchments."

Account has been taken of the first requirement of the Review Group in the preparation of phased programmes for logging in so far as is consistent with the proposed rate of land clearance for agricultural development. But it has not been possible to delay logging in all areas in which the conditions apply.

The second requirement of the Review Group

has also been met. The hydrological network set up for project studies has been transferred to the Drainage and Irrigation Department (SV 3) and provision made for its continued operation and maintenance.

5.3.2 Management

It is recognised that the timber resources of part of the 59,000 acres of land lying in Terrain Class V will no doubt be utilised when satisfactory methods of extraction compatible with resource preservation have been devised. With this in view an assessment of potential productivity has been made (Table 5.1) based on data available. The assessment does not include steepland in Panti Forest Reserve for which there is no information.

TABLE 5.1 Productivity acreages in all hill forests (limited by the area covered by the productivity survey of the Forestry Department)

Slope Classi-fication	Product-ivity class	Acres			
		Highly Product-ive	Product-ive	Margin-al	Total
	Basal Area sq. ft.	Below 50	35-50	20-35	
C5 20°-25°		12,400	13,600	5,800	31800
C6 Above 25°		2,100	2,700	1,100	5900

It is thus clear that substantial timber supplies are to be found in these areas.

An indicative forest productivity map has been produced at a scale of 1:63,360 (Map Folder). It demarcates the boundaries of the land below 20°, land between 20° and 25° of slope, 500 and 1000 foot contours, areas of varying productivity according to the Forest Department's assessment (1966) and the location of the project forest enumeration rentis lines (1969/70). The last have been individually analysed to give mean stock net volume per sampling strip in cubic feet true per acre. It should be noted however, that this can give a linear impression only of productivity.

The present logging programme provides for annual coupes taken from approximately 6,000 acres on land of slopes up to 20°. A recommendation is contained in Part 3 Chapter 7 that on conservation grounds timber should ultimately be logged from steepland only up to the 1000 foot contour. If

these conditions are observed and an annual coupe taken equivalent to that proposed for the land of less than 20° slope, the life of the mill complex would be extended by a further 8 to 9 years. Assuming that the eastern slopes outside the Project Area are also protected and worked then the mill life would again be extended. Consideration might also be given to incorporating the forest reserve (H. Simpan Kapor) proposed in the State's Second Malaysia Plan (Figure 5.1) as well as existing reserves either side of the road between Kg. Kahang and Kg. Jamaluang into the overall management plan.

The comments of Review Group II in regard to the proposals in the Draft Project Report for management of forest above the steepland boundary were as follows:

"Forestry

In the management of these "hill forests" the Review Group recommends the following:-
(a) Demarcation of the boundary of potentially productive hill forests (above 20° slope) and the non productive forests, the latter serving strictly a protective function. This will assist in the development of forest management plans for the productive hill forests.
(b) Joint management of these forests by the Forest and Game Departments rather than by the Game Department alone. This will enable research on forestry development to be carried out while at the same time wild life and other conservation requirements to be satisfied.
(c) Proposals should be put forward by the Consultants for productive forestry management within the concept of multi-purpose use of hill forests."

Recommendation 4(a) has been taken into account and the boundary of the potentially productive hill forests (20° slope) and the non productive forests is shown on the Productivity Map.

Joint management of the forests as suggested in 4(b) is strongly supported. It is recommended that those authorities responsible for river maintenance (DID) and water supplies (JKR) should also participate with the Game and Forest Departments in the establishing and operating a multiple use policy for these forest areas.

FIGURE 5.1

FOREST RESERVES

(2nd Malaysia Plan)

LEGEND

FOREST RESERVE _ _ _ _ _ _

PROPOSED FOREST RESERVE _ _ _

COASTAL SWAMP FOREST RESERVE _ _ _

SINGAPORE
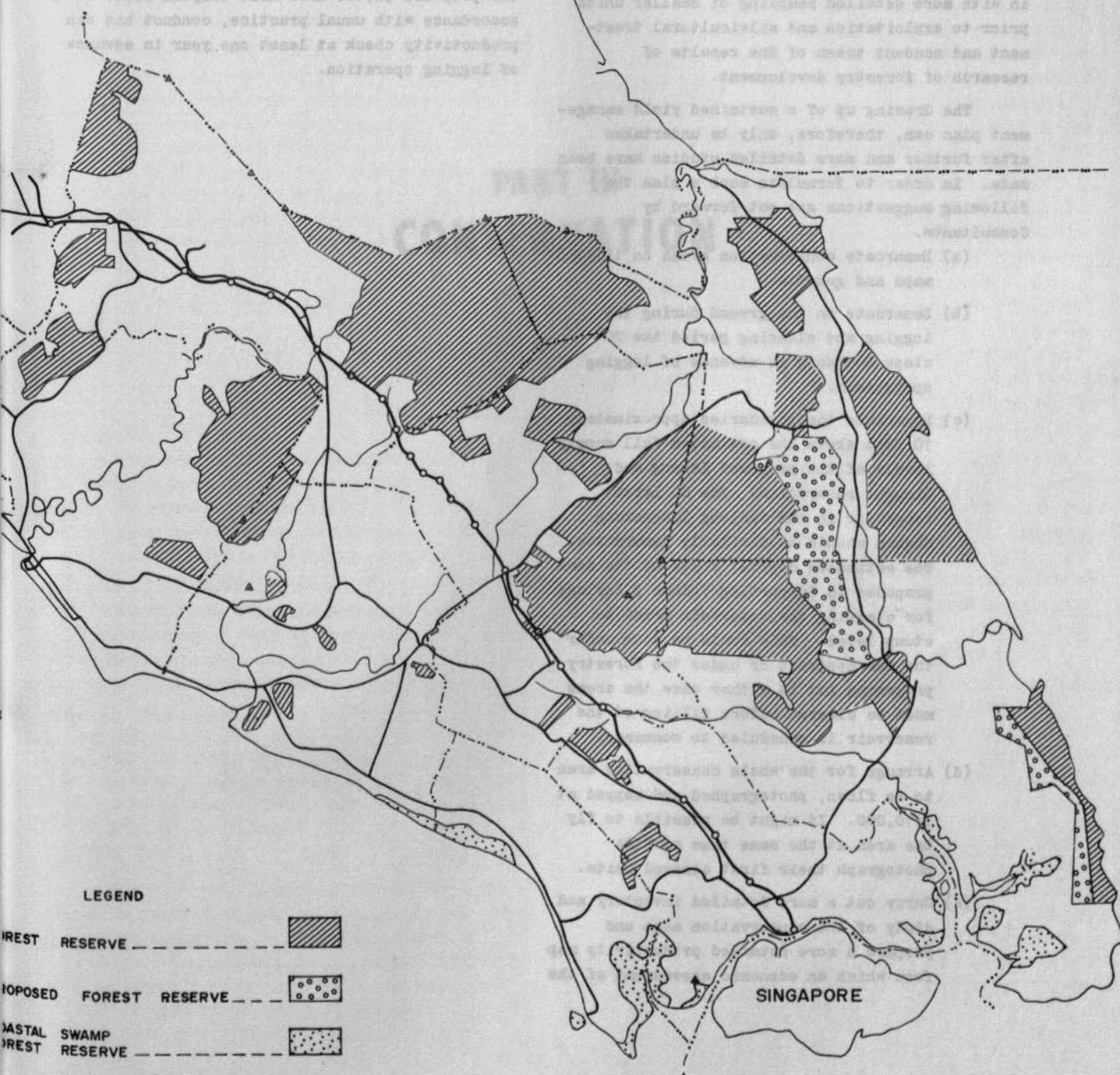
1:1013760

Scale: 16 Miles to an inch

Miles 16   8   0   16   32 Miles

In so far as the requirement in 4(c) above is concerned it must be pointed out that a productivity map on a scale which would be a realistic basis for detailed operational control as opposed to management planning can only result from a far more detailed survey than the specification as laid down in the Scope of Work. The scale of inventory used (Appendix C), which was agreed with the Forest Department at the commencement of the study, can only give the framework within which the second stage of forest survey could be planned. This must also be tied in with more detailed sampling of smaller units prior to exploitation and silvicultural treatment and account taken of the results of research of forestry development.

The drawing up of a sustained yield management plan can, therefore, only be undertaken after further and more detailed studies have been made. In order to formulate such a plan the following suggestions are put forward by Consultants.

(a) Demarcate conservation areas on 1:63360 maps and gazette.

(b) Demarcate on the ground during the logging and clearing period the 20° slope boundary in advance of logging operations.

(c) Demarcate the boundaries approximately 10 feet above the estimated full supply levels of the proposed Kahang and Linggui reservoirs. The S. Lebam reservoir in the Tanjong Penggerang Region should be similarly demarcated. The estimated capital costs of the dams proposed in Supporting Volume 3 include for clearing the reservoir areas to stump level. This could be done under the dam contract or under the forestry programme but in either case the areas must be cleared before filling of the reservoir is scheduled to commence.

(d) Arrange for the whole conservation area to be flown, photographed and mapped at 1:10,000. It might be possible to fly the area at the same time as FLDA photograph their first cleared units.

(e) Carry out a more detailed inventory and study of the conservation area and prepare a more detailed productivity map from which an economic assessment of the present growing stock can be made.

(f) Draw up the overall management plan taking into account the results of silvicultural research into problems of regeneration currently in progress, erosion problems, development of new logging techniques and the recommendations contained in the Draft Project Report and Part 3 of this volume concerning a National Park.

It is assumed that the forest manager of the proposed 92,000 acre mill complex will, in accordance with usual practice, conduct his own productivity check at least one year in advance of logging operation.

PART III
CONSERVATION

6.1 Introduction

A fundamental criterion by which to judge the efficacy of new land development is that in the process of that development the quality of the physical resources should have been maintained and whenever possible improved.

Changes in land use resulting from development activity produce changes in the landscape of different types, some of which constitute potential hazards to the environment. Some, again, are more readily recognised than others. Clearly it is important that these hazards should be widely recognised and that measures for their removal or amelioration should be put into effect.

Identification of these hazards has been a feature of the present regional studies and recommendations have been made in regard to them which are discussed throughout the Supporting Volumes. Their significance, in regard to conservation of physical resources, is considered important enough to bring them together.

Conservation of the environment within the region has been interpreted to include the removal or avoidance of pollution. Conservation needs have been examined in relation to the soil and water resources, biological communities, the forest resource and amenity values.

One very important criterion in regard to the protection of soil and water resources is the legally established slope cultivation limit. The steepland boundary has been defined (Leamy and Panton 1966) as "a line separating land with average slopes less than 20°, and topographically suitable for tree crop agriculture from land having average slopes exceeding 20° and better suited to permanent forest rather than extensive agricultural development". The 20° limit has been agreed and accepted in preparing the Master Plan.

Conservation of these resources may therefore be considered from two points of view, those measures applicable to land steeper than 20° and those on lesser slopes, the former consideration is primarily a matter of forest management and is dealt with in Chapter 5 of Part 2.

6.2 Catchment Conservation Studies

The removal of jungle cover on a large scale produces significant effects upon the rate of surface run off, plant water use and upon river behaviour. Hydrological studies within the Project Area (Supporting Volume 3) show that peak river discharges (during periods of flood) could possibly increase by 100 percent and that low river discharges (during periods of drought) could possibly decrease by 50-75 percent, when the jungle cover is removed and replaced by rubber/oil palm plantations and associated roads, settlements etc.

Further information from other sources has also been sought. Comparable circumstances exist in some high rainfall tea growing areas in Kenya in which hydrological studies were undertaken by the East Africa Agricultural and Forestry Research Organisation (Pereira). The results are relevant to the observations made in Johor Tenggara and support the conclusions for example that a change in land use will introduce a change in the hydrological regime which will be permanent.

Initial land clearance will substantially increase the rate of run off and there will be a sharp decrease in plant water use. As tree and cover crops replace the forest and gradually assume the hydrological influences of a forest the water regime would be progressively resolved. Inevitably the substatial aggregate area of roads, administrative buildings, residential, commercial and industrial areas would continue to yield a high rate of run off.

It is clear that the hydrological changes due to land development should be observed and studied. Such information would be valuable in planning and designing water resource developments including the protection of river banks and low lying areas against expected changes in flood levels.

As a result of the project studies recommendations have been made (and already put into effect) that the hydrological network should be maintained for future observation of rainfall and river flows. The range of catchment sizes which will be observed through the hydrological network will be suitable for recording progressive changes as the forest canopy is

replaced by a complex of development activities.

In order to maintain a comparison between the permanent forest cover and areas specifically planted to oil palms or rubber, pairs of smaller adjacent catchments should be selected, by preliminary airphoto interpretation, about one square mile in extent, in the major land use categories suitable for oil palms and rubber. Rainfall and stream flow should be recorded in these catchments. Site accessibility for regular reading and supervision is essential to ensure the validity and accuracy of the records obtained. The intention of MARDI to establish a research centre in the region suggests that this programme should be linked with their activities.

6.3 Water Conservation

Present demands upon the total water resources of the Johor Tenggara region are small and relatively little development has taken place in the region to disturb the water regime. In the past therefore, it has been found necessary to gazette only the catchment of the S. Semberong Kechil for protective purposes.

Development proposals for the region foreshadow changed patterns of land use which will lead to a rapidly increasing internal demand for water as well as an estimated increase from outside.

Full development within the region is expected to create a total demand for eleven million gallons per day (mgd) of which 6.5 mgd will be required in Johor Tengah and 4.5 mgd in Tanjong Penggerang. A further demand of up to 335 mgd from Johor Tengah is anticipated for supply to points outside the region.

To meet these estimated demands it has been found necessary to recommend the construction of three major water storage dams to maintain regular supplies. If economical quantities of good quality water are to be provided it is clear that their sources should be conserved, particularly in Johor Tengah.

Two of the recommended storage sites are in Johor Tengah; one on the S. Kahang and one on the S. Linggiu. The headwaters of both these rivers are located on the slopes of Gunong Blumut. These storages will be the major sources to meet the estimated rapid increase in demands for water for the population and industry of Kluang and Johor Baharu and possibly Singapore. It is considered that special priority should be given to the protection of these reservoir catchments. The area below the 20 degree slope limitation

(totalling about 21,000 acres) has been exclude from agricultural development although logging of marketable species has been accepted.

The application of the 20 degree slope limitation to cultivation (which has also been us to distinguish between upper and lower catchmen areas) in Johor Tengah restricts the use of 65,000 acres. Only 10 percent of this area how ever, has average slopes greater than 25 degree and therefore falls within the category of abso lute reservation. The conservation of these areas of higher and steeper land has been discussed elsewhere (Supporting Volume V Part II).

There are other catchments located on the slopes of Gunong Blumut and Gunong Panti which may affect water supplies in the future outside the project area. For example eventual development of a large area east of Johor Tengah is foreshadowed (EPU L.C.R. 1986). The opportunity is taken now to suggest that the 20 degree slope boundary drawn within the project area should be extended beyond it to reserve the forest lands on the eastern slopes of the above mountains. Adjustments would be necessary to include lower catchment areas in those cases where specific water storage or offtake programmes are contemplated.

In the Tanjong Penggerang area, conservation of water sources presents a less complex problem. It has been found necessary to recommend construction of a water storage on the S. Lebam to provide supplies for tourist and agricultural settlement development. The catchment concerned contains no undisturbed forest. It is proposed that no development activity, forest or agricultural, should take place in this catchment which would also provide an amenity asset for the proposed nearby coastal tourist resort.

6.4 Water Pollution

The possibilities for pollution of the river systems in Johor Tenggara following the implementation of development recommendations are substantial. They would include include potential hazards from trade wastes, sediments from the tin mining industry and domestic sewag

and refuse. It is not anticipated that present levels of application of known herbicides would constitute a hazard, but regular examination for the effects of persistent herbicides and pesticides should be carried out.

The widespread planting of oil palms and rubber carries with it a need for processing facilities. Eight palm oil factories and four rubber factories are proposed in the development of the regions. They are located on the following rivers: Pengeli (2 No.) Kahang, Belitong, Sembererong (3 No.), Jengeli (2 No.), Bahau, Sening and Lebam. The introduction of pineapple growing would create a similar need. The effluents of factories from all three processing activities are noxious and those from palm oil and rubber factories have high Biological Oxygen Demand values. Rubber factory effluent also carries acid and ammoniacal nitrogen concentrations. In the interests of maintaining good quality water supplies in the rivers, maintaining and developing the freshwater fish population and preserving the amenity value of the system as a whole, it is strongly recommended that treatment of these effluents at source should be vigorously enforced.

Pollution of rivers from tin extraction is extensive where mining is active. Measures are required to remove this hazard to river waters, in a region which will support a large and well distributed population in the years to come. It is also considered desirable that steps should be taken to restore the landscape amenity value of tin mining areas when operations are completed.

Enforcement of the limitation of development activity on slopes in excess of 20 degrees and use of sound soil conservation measures on less steep lands should minimise silt loads in the rivers. It should however, be noted that natural slippage on very steep yet fully protected slopes is not uncommon in West Malaysia in conditions of high rainfall intensity. Such slippage would lead to increased silt loads in nearby streams.

Legislation now in force provides for the control of water pollution from all sources. It is, however, considered that permissible concentrations of pollutant materials should be laid down and the methods of enforcement reviewed. In the case of mine effluents consideration should be given to reducing the present legal maximum substantially.

6.5 Soil Conservation

The measures advocated for the conservation of water sources will help to protect the soil resources. Nevertheless it has also been found necessary to make recommendations for further protection in areas of agricultural land on slopes of less than 20 degrees. These measures vary according to soil and slope conditions and the type of crop grown. They include the recognised systems applied to the protection of land supporting tree crops such as oil palms and rubber as well as forms of terracing and contour cultivation desirable for land planted to short term and pasture crops. (R.3).

6.6 Atmospheric Pollution

As planned development runs its course in Johor Tenggara the possibilities of atmospheric pollution will increase. Factory operations and the use of vehicles, particularly heavy diesel types, would be obvious contributors. The extent to which they are having an adverse effect on the urban environment in the future should be kept under review.

7.1 Introduction

The substitution of one type of vegetation cover for another, offers the possibility not only of losing usual, rare or even unique associations of botanical interest or importance but also of losing a wide range of fauna as the result in a change of their habitat.

This possibility was recognised by the inclusion of specific provisions in the Scope of Work for studies to establish the extent to which there may be a need to preserve biological communities of special interest within Johor Tenggara.

7.2 Existing Reserves

The greater part of the Johor Tengah region has been gazetted as Forest reserve and Forest cum Game reserve (Fig No.7.1). Three major Forest reserves, the Rengam reserve, the greater part of the Kluang and half of the Panti Forest reserves are located in the region. Part of the Kluang Forest reserve has also been gazetted as a Game reserve (which is part of the Endau-Kota Tinggi Wild Life Reserve (western portion). The eastern portion of the latter is located outside the project area within the Jamaluang and Tenggarah Forest reserves.

In the Tanjong Penggerang region the Pantai Forest reserve covering the coastal swamps between Tg2 Sedili Kechil and Penawar has been gazetted together with the coastal mangrove areas shown in Fig No. 7.2.

There are no wild life reserves on Tanjong Penggerang at this time. During the course of field studies however, sitings of wild life were recorded (Appendix L).

7.3 The Need for Further Reserves

7.3.1 Purposes

The fauna and flora of the region are rich and have produced a variety of complex types of vegetation and biological communities. As yet these have been imperfectly studied. Scientists owe a responsibility to their profession to preserve representative samples for study by future generations. Many plants useful in breeding better crops or as sources of new drugs have been and are being obtained from the very varied wild materials. Animals have been domesticated, used in medical research and for the biological

control of pests. So the applied sciences of agriculture and medicine must have constant recourse to the wild reserves of biological material, which can be maintained far more effectively and cheaply in nature than in any collections. Natural vegetation and the biological communities sheltered in it are baseline or controls for observations and experiments on land use, hydrology, forestry, game management, soil development and agriculture. Reserves of wildlife and natural vegetation are acknowledged as necessary by fundamental and applied scientists alike.

The wise utilisation of soil and water, which are among the bases of agriculture, inevitably incorporates measures for their conservation such as the protection of catchment areas, river banks, sea coasts and flood plains. The cover of natural vegetation is usually the cheapest and most effective protection. As urban, industrial and agricultural areas spread there is an overspill of waste products and residues, some demanding oxygen and biological activity for their decomposition and others being toxic in themselves. Pollution is a worldwide problem. Prevention is most desirable, but there will always be cases needing remedial action. It is not enough to arrest pollution, but healthy conditions must be restored. This is difficult unless there are biological reserves to recolonise the affected areas.

The preservation of representatives of biological communities, the conservation of natural resources and the resiliance to recover from environmental disturbance can be coordinated with each other and the recreational or spiritual needs of the people. When the wilderness predominated, mankind flocked to the cities for artificial entertainment but as the regimentation of agriculture and the mechanisation of life in the cities increase, an ever-increasing proportion of mankind will wish to enjoy natural surroundings for their recreation. Strictly controlled hunting and fishing can be made into remunerative uses of wild-lands, so too can resorts for those who want merely the pleasure of being there. The peoples of Malaysia have inherited a rich patrimony of wildlife, which if destroyed can never be replaced (whereas any work of art

can be restored). The enjoyment and preservation
of that wildlife and the natural, scenic land-
scapes can be a source of national pride innocent
of communal affinities.

7.3.2 Means

Examples of the different types of vegeta-
tion should be identified. A comprehensive bota-
nical survey is impossible with the limited man-
power available. Therefore other sources of in-
formation must be utilised as far as possible,
these include:-

(a) Published accounts of the vegetation
and flora,

(b) Herbarium collections and monographs,

(c) Foresters' enumerations of commercial
timber trees,

(d) Maps of the topography and geology,

(e) Aerial photographs.

Sources (a) and (b) are particularly helpful
to detect areas with floras rich in endemics,
peculiar to the locality or highly specialised.
Sources (c) to (e) indicate the more widespread
types. Ideally all unique areas with a strictly
local or special flora should be preserved and
adequate examples of the others. In each case
there should be a central Strict Nature Reserve,
or Virgin Jungle Reserve in the current termino-
logy of the Forest Department, which should be
left untouched, no trees felled or poisoned and
no timber extracted, cutting would be restricted
to that necessary for a access and collections
for scientific study. As far as possible this
central area should be regular and compact in
shape, of a minimum area of 250 acres or better
one square mile and surrounded by a boundary
belt of forest, which although worked would
afford protection against the effects of an
abrupt change in the environment. Sites subject
to flooding or changes in drainage due to adja-
cent activities should be avoided. It is unde-
sirable that any major throughfare should lie
through the strict reserve.

As far as possible sites should be selected
so that they do not conflict with other forms of
land development of higher priority, but that
the reserves chosen may be integrated with fores-
try, catchment protection and wilderness areas
for recreation. Certain types of lowland dipte-
rocarp forest occur on the better soils suitable
for agriculture. If practicable an example
should be reserved as an enclave protected by
other types of forest on poorer soils rather than
as an enclave isolated in agriculture.

Although there is little definitive evi-
dence, it is believed - or at least hoped -
that an adequate representative series of
Virgin Jungle or Strict Nature Reserves each
of the relatively small area mentioned will
preserve the majority of plant species and
invertebrates provided these reserves are well
sited and surrounded by forest. This surroun-
ding forest may be 'Protective' in the fores-
ter's sense, that is, it is not felled or
treated, but remains untouched to protect a
catchment for example and is for practical pur-
poses an extension of the strict reserve. The
surrounding forest may be 'Productive', that
is felled, treated and managed on a rotational
basis (for example 70 year cycles) in which the
natural regeneration is progressively upgraded
to bear a higher stocking of commercial timber.
Productive forest will preserve selected species,
but not the whole flora, hence the need for
Virgin Jungle Reserves. Productive forest is
important also for the conservation of animals,
especially the larger mammals.

If the habitat requirements, whether cha-
racterised by a specific type of vegetation or
a range of forest types, of particular animals
and the minimal areas to sustain breeding
populations were known, it would be possible
theoretically to define suitable areas to con-
serve all species of wild animals. This infor-
mation is lacking for most animals and the
corresponding information about the detailed
distribution of the vegetation types is also
lacking. There is a marked difference between
the lowland and montane faunas of both birds
and mammals, few species are common in both
zones. Some large mammals have fairly exten-
sive territories, e.g. 100 to 200 square miles
to support a herd of 8 to 10 elephants or 50
square miles (a 4 miles radius) per adult
tiger. Predators need a larger area per beast
than vegetarians. The stocking of herbivores,
carnivores and scavengers and the size of the
largest specied in each category is probably
higher on more fertile soils and in the biolo-
gically more productive communities they sup-
port. Therefore, if the best land is cleared
for agriculture, the remaining forest may not
be able to sustain so much wildlife as the ave-
rage stocking when the animals had access to
the more fertile areas.

These larger mammals which range over wide
areas presumably are not highly critical in
their habitat requirements. They live on several

different kinds of forest, both virgin and disturbed. The area of forest must be adequate in aggregate and the different portions should be contiguous in places. The animals must be free from molestation. The Virgin Jungle Reserves and Protective Forest are clearly satisfactory. However, the wildlife will have to depend on Productive Forest for much of its area and the probable effects of forestry practices on the fauna must be considered.

The bulk of the timber extracted at felling is obtained from emergent trees. Large non-commercial trees are poisoned. The canopy habitat is destroyed and its inhabitants such as gibbons, leaf-eating monkeys, many squirrels and birds are lost with it. The disturbing activities of the loggers, who usually include some hunters with fire-arms, and the subsequent poisoning operations drive away or take their toll of the ground living mammals such as deer. During the early stages of regrowth the quantity of browse should increase and with it the stocking of herbivores such as elephant and deer, also in turn the dependent predators such as tiger and panthers should increase. This is not always so in practice, perhaps because protection from molestation by hunters is not afforded in these areas to which access has been improved by the forestry operations. The imposition of a close season may be indicated. Pig, fruit-eating monkeys, civets and some rodents may become more common during these stages. Eventually as the rotation of forest regeneration approaches maturity the original balance in the fauna, including the reappearance of the canopy, may be restored.

If the whole contiguous forest area is logged within a short period of time, there will be nowhere for the canopy-dwellers to retreat to (overcrowded as they would be) and, more important, nowhere from which they may recolonise the canopy in the regenerated forest. Similar problems would arise if the deer were annihilated by excessive hunting during felling. Therefore if Productive Forest is to realise its potential for the conservation of wildlife, it should be contiguous with the strict reserves and protective forest. Moreover, the whole should not all be at one stage of the forestry cycle at one time, but there should be a mosaic of substantial areas at different stages. If sawmills and other timber dependent industries are to be supported indefinitely by local forest, the felling and extraction must be spread over a long period, so there is not necessarily any conflict between forestry and wildlife interests.

Protective forest will occupy the steeper and higher land. Productive Forest will occupy the areas of intermediate slope and fertility, unsuitable for agriculture, and perhaps freshwater swamp uneconomic to drain and most mangroves. These may not provide suitable examples for a few animals of very restricted habitat requirements, such as the rare Otter Civet which seems to need undisturbed forest in river valley bottoms. In drawing the boundaries of a Johor State National Park, which would consist mainly of protective forest and strict reserve, it may be possible to include portions which are uneconomic to develop owing to isolation from the main agriculture areas, although their soil is reasonably fertile. In addition to the conservation of biological communities and the preservation of catchment areas, the environment must be kept free of pollution. Control of aerial pollution will require special legislation and enforcement as State and Federal levels as industrialisation proceeds. The pollution of rivers and waters is already evident in parts of Johor, for example the Sungei Scudai estuary. The overburden of silt in rivers from mines and land clearing operations may have contributed already to flash floods. Existing legislation should be enforced, for example the retention of protective strips of unfelled forest on river banks and restricting on silt deposition in streams. Further legislation is desirable to make terracing compulsory in steep sloping plantations, to prevent discharge of insecticides and other poisons into waters and to ensure treatment of all factory effluents including those processing crops.

7.3.3 General Recommendations

The recommendations are concerned primarily with the selection of areas as Strict Nature Reserves, including Virgin Jungle Reserves, to preserve examples of the biological communities in the region, especially those which are unique or poorly represented elsewhere. The Strict Reserves must be surrounded by buffer zones. The Strict Reserves must be contiguous with other areas such as Protective and Productive Forest, where wildlife can survive and flourish. These areas, of which the Strict Nature Reserves are but part, must serve several purposes, such as catchment, soil and water conservation, preservation of the landscape, provision of recreation and tourist attraction. Therefore these recommendations take into account other aspects

FIGURE 1

FOREST INVENTORY AND
EXISTING EXPLOITATION
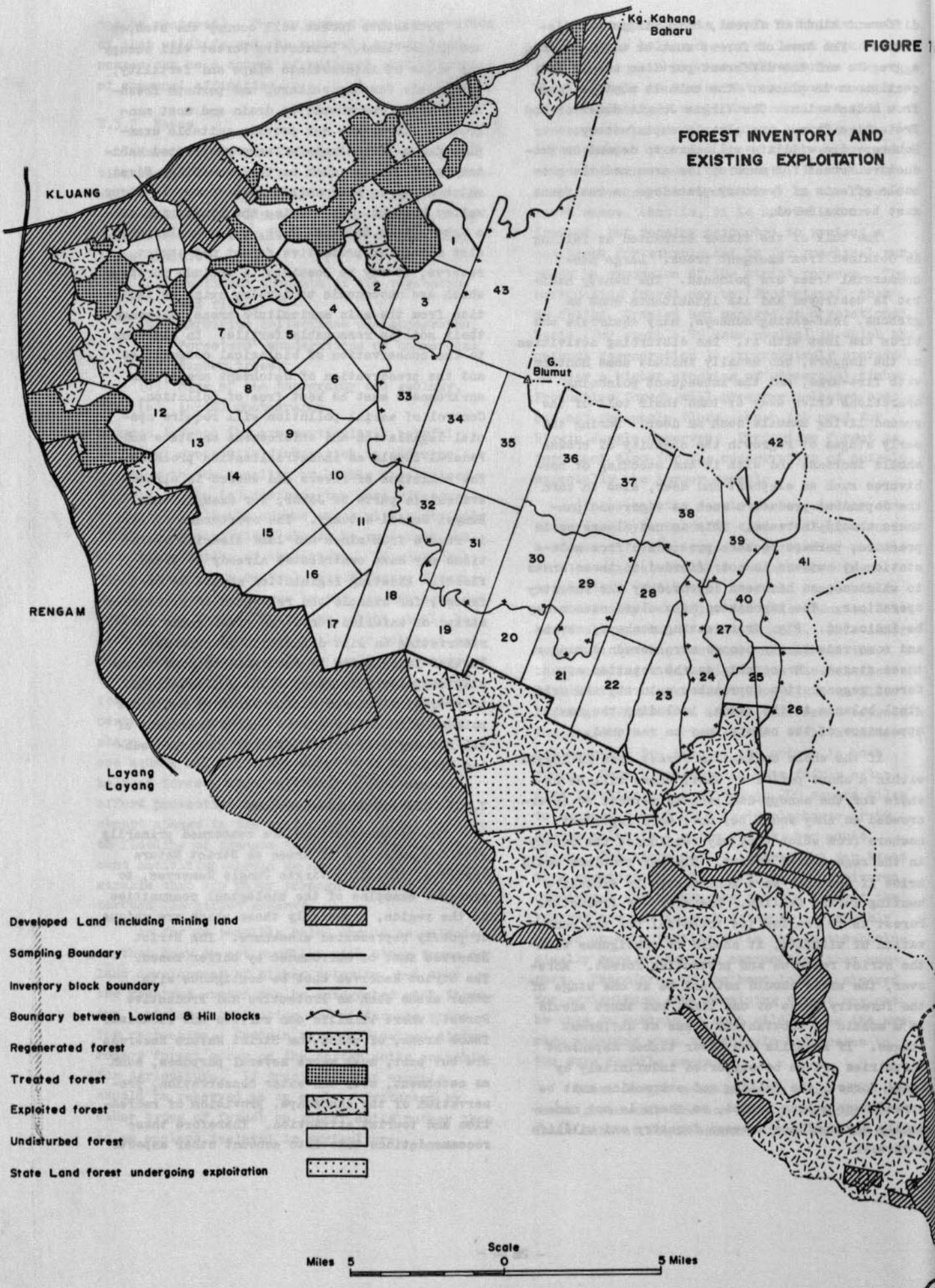
KLUANG

Kg. Kahang
Baharu

G.
Blumut

RENGAM

Layang
Layang

Developed Land including mining land

Sampling Boundary

Inventory block boundary

Boundary between Lowland & Hill blocks

Regenerated forest

Treated forest

Exploited forest

Undisturbed forest

State Land forest undergoing exploitation

Miles 5   Scale   5 Miles
              0
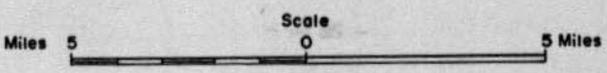
FIGURE 7.2

FORESTED AND OTHER LAND

KOTA
TINGGI

S. JOHOR

S. Lebam

S. Sanî
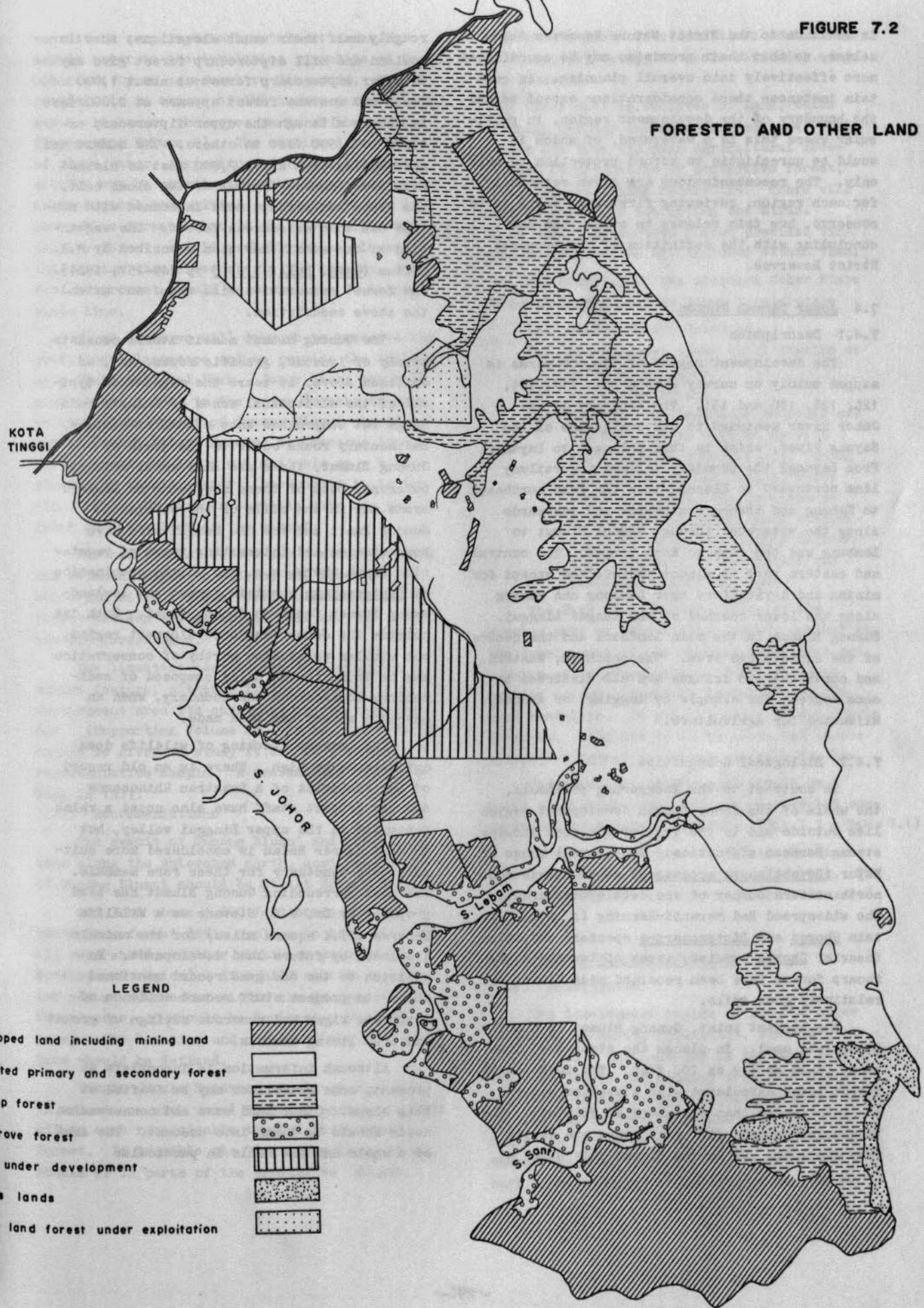
LEGEND

...veloped land including mining land

...ploited primary and secondary forest

...amp forest

...ngrove forest

...nd under development

...ass lands

...ate land forest under exploitation

Scale

Miles 5   0   5 Miles

in addition to the Strict Nature Reserves them-
selves, so that their provision may be coordinated
more effectively into overall planning. In cer-
tain instances these considerations extend beyond
the boundary of the development region, in parti-
cular where this is a watershed, of which it
would be unrealistic to afford protection to half
only. The recommendations are given separately
for each region, reviewing first what there is to
conserve, how this relates to other land uses,
concluding with the definition of the proposed
Strict Reserves.

7.4 Johor Tengah Region

7.4.1 Description

The development region of 370,000 acres is
mapped mainly on survey sheets Nos. 117, 124,
125, 126, 130 and 131. The boundary is the
Johor River westward to the confluence of the
Sayong River, which is then followed to Layang2.
From Layang2 the boundary follows the railway
line northward to Kluang, then the road northeast
to Kahang and thence southwards and eastwards
along the watershed through Gunong Blumut to
Lombong and the road to Kota Tinggi. The central
and eastern part is almost undisturbed except for
mining and agriculture near Lombong and mining
along the lower reached of the Sungei Linggui.
Gunong Blumut is the main landmark and the centre
of the undisturbed area. The southern, western
and north-eastern fringes are all disturbed to
some degree, for example by logging, or already
alienated for agriculture.

7.4.2 Biological Communities

In contrast to the Penggerang peninsula,
the whole of the Johor Tengah development region
lies outside and to the west of the area showing
strong Bornean affinities. The natural range of
Kapur (Dryobalanops aromatica) extends into the
north eastern corner of the development area.
The widespread Red Meranti-Keruing (rich in cer-
tain Shorea and Dipterocarpus species) and Balau
(heavier Shorea species) types of lowland dipte-
rocarp forest have been recorded near Kluang on
relatively good soils.

The highest point, Gunong Blumut is about
3,300 feet amsl. In places the steep-land line
seems to be as low as 200 feet. The zonation of
forest types associated with elevation occurs
at lower levels than elsewhere in Malaysia. The
boundaries between different zones are seldom
very distinct. On Gunong Blumut they occur at

roughly half their usual elevations, that is
lowland and hill dipterocarp forest give way
to upper dipterocarp forest at about 1,000
feet, and montane forest appears at 2,000 feet
in places although the upper dipterocarp ex-
tends to 2,500 feet in others. The summit and
surrounding area above 2,800 feet is clothed
with mossy forest typical of the cloud belt,
the flora has perhaps more in common with mon-
tane oak than ericaceous forest. The vegeta-
tion of the summit has been described by R.E.
Holtum (Card. Bull. S.S. 3 pp 245-257, 1924).
The forest enumeration will amend and extend
the above description.

The Gunong Blumut massif itself consists
mainly of igneous, granitic rocks, and, as
outlined above, it bears the vegetation typi-
cal of the altitudinal zones of Malay's Main
Range but compressed into a smaller compass.
Sedimentary rocks occur to the south of
Gunong Blumut, there are also small volcanic
outcrops, both of these are found in lowland
areas and in the hills of the watershed:
Gunong Panti and the Ulu Sedili area have
been studied and interesting types of vegeta-
tion found there, e.g. the unique combination
of Leptospernum mountain forest and lowland
swamp forest found on Gunong Panti. Both lie
outside the Johor Tengah development region,
but similar vegetation worthy of conservation
may be found in the hills composed of sedi-
mentary rocks along the boundary, when an
adequate survey has been made.

The present stocking of wildlife does
not seem to be high. There is an old record
of the footprint of a Sumatran Rhinoceros
and the project staff have also noted a rhino
footprint in the upper Linggui valley, but
an area nearer Endau is considered more suit-
able as a sanctuary for these rare mammals.
The area surrounding Gunong Blumut has been
proposed by Dr. W.E. Stevens as a Wildlife
Reserve (87.4 square miles) for the animals
displaced by future land development. In
addition to the one game record mentioned
above the project staff record evidence of
elephant, tiger and numerous sitings of ground
and tree living mammals.

Although information is incomplete at
present, some guidelines may be drafted at
this stage. Other land uses and conservation
needs should be taken into account. The area
as a whole and the hills in particular

constitute very important catchment areas to supply water to the developing townships of South Johor and by an agreement to Singapore. The rainfall is in excess of 100 inches per year and may be higher on the upper parts of the hills: (Supporting Volume 2). The continued provision of clean water, prevention of floods and soil erosion may be coordinated with the conservation of biological communities. The upper limit of productive forest, that is the lower limit of protective forest, should probably be set lower in this region than elsewhere in the country, and for the present should be around the 20 degree slope line.

These measures will do much to preserve the traditional landscape and to provide the nucleus of a State National Park. Johor lacks any hill station and access to the upper forests is restricted. The summit of Gunong Blumut should be made a Strict Nature Reserve to preserve its mossy forest and it is not suitable as a hill station or tourist resort, because it is in the cloud belt. However, a suitable site may be found on a shoulder of the massif.

Another tourist resort for boating, fishing and swimming might be made by the reservoirs above dam sites. There could be productive forest between the steepland line and the protective forest line.

The limestone near Gunong Sumalayang is a unique feature, although it lies outside the development area its quarrying may be recommended. (Supporting Volume 2). If so, opportunity should be given to study it and to preserve a representative sample. A preliminary study was made in 1971.

7.4.3 Recommendations

The summit of Gunong Blumut and other hilltops along the watershed north, east and south of Gunong Blumut should be Strict Nature Reserves.

All land above 1,000 feet contour should be protective forest (this applies to both sides of all watersheds, whether within or outside the development region). If a hill station or tourist resort is created within the protective forest zone, it should be declared a bird sanctuary. The location and extent of the hill station should be defined.

Virgin Jungle Reserves should be declared in accordance with usual Forest Department policy within each recognisable type of productive forest. If possible the Virgin Jungle Reserves should be in parts of the productive forest

adjacent to protective forest, so that strips of forest typifying the whole altitudal range are preserved.

There will be enclaves of land, which although perhaps suited to agriculture, will be cut off from the main agricultural development by productive or protective forest, rivers or artificial reservoirs. There will also be corridors connecting the hills. These may be productive forest provided Virgin Jungle Reserves are included within them.

The boundary of the proposed Johor State National Park should be drawn to include:-

(a) Strict Nature Reserves
(b) Recreational Areas (Hill Station or Artificial Lakes)
(c) Protective Forest
(d) Enclaves and Corridors to round off the area and to connect up with parts such as Gunong Panti, Gunong Sumalayang and Ulu Sedili, which although outside the development region, are of established biological importance, scenically interesting, worthy of conservation and inclusion within the Park.

The Park will be surrounded for the greater part by forest which could, subject to the development of new logging techniques and results of longterm silvicultural research, one day become productive between 500-1,000 feet elevation. It would include Virgin Jungle Reserves. Wildlife would be protected in the productive forest in accordance with the law.

The Park and its surrounds could be a model of multiple land use and coordinated conservation of natural resources (Fig.7.3 & Table 7.1).

Provision to study the unique Sumalayang limestone should be made before quarrying. The areas proposed for conservation are delineated in Fig.

7.5 Tanjong Penggerang Region

7.5.1 Description

The development region of 330,000 acres is mapped on survey sheets Nos. 126, 127, 131, 132 and 135. The boundary is the east bank of the Johor River and estuary from Kota Tinggi southward to the Straits of Singapore, it then follows the eastern coastline with the South China Sea to the road at the mouth of Sedili Besar River, and is completed by this road back to Kota Tinggi. The natural vegetation

TABLE 7.1

Multiple Land Use : Proposed National Park

SLOPE CLASSIFICATION	ELEVATION AND USE		
	0' - 500'	500' - 1000'	Above 1000'
0° - 20°	Lowland dipterocarp forest. Protected catchments to be logged out before water storage works completed. Artificial lakes can be used for recreational purposes.	Hill Dipterocarp forest. Restricted use - see below.	
20° - 25°	Restricted use but may be managed eventually as productive forest. Should contain Virgin Jungle Reserves which should be in parts of the productive forest adjacent to protective forest.		Permanently reserved as protective forest with Strict Nature Reserves on all hill tops along the watersheds. Recreational areas i.e. hill station or tourist resort including a bird sanctuary located just below Gunong Blumut.
Above 25°	Permanently reserved with Strict Nature Reserves as above.		
All Slopes	Water and Wildlife Conservation Areas		

FIGURE 7.3

PROPOSED NATIONAL PARK

Sg.Kahang

FOR
GME

Sg.Lenggor

G. Blumut
33/3

Sg.Linggiu

FOR

G. SUMALAYANG

ENDAU/KOTA TINGGI
WILD LIFE
RESERVE

D

FOR

G. PANTI
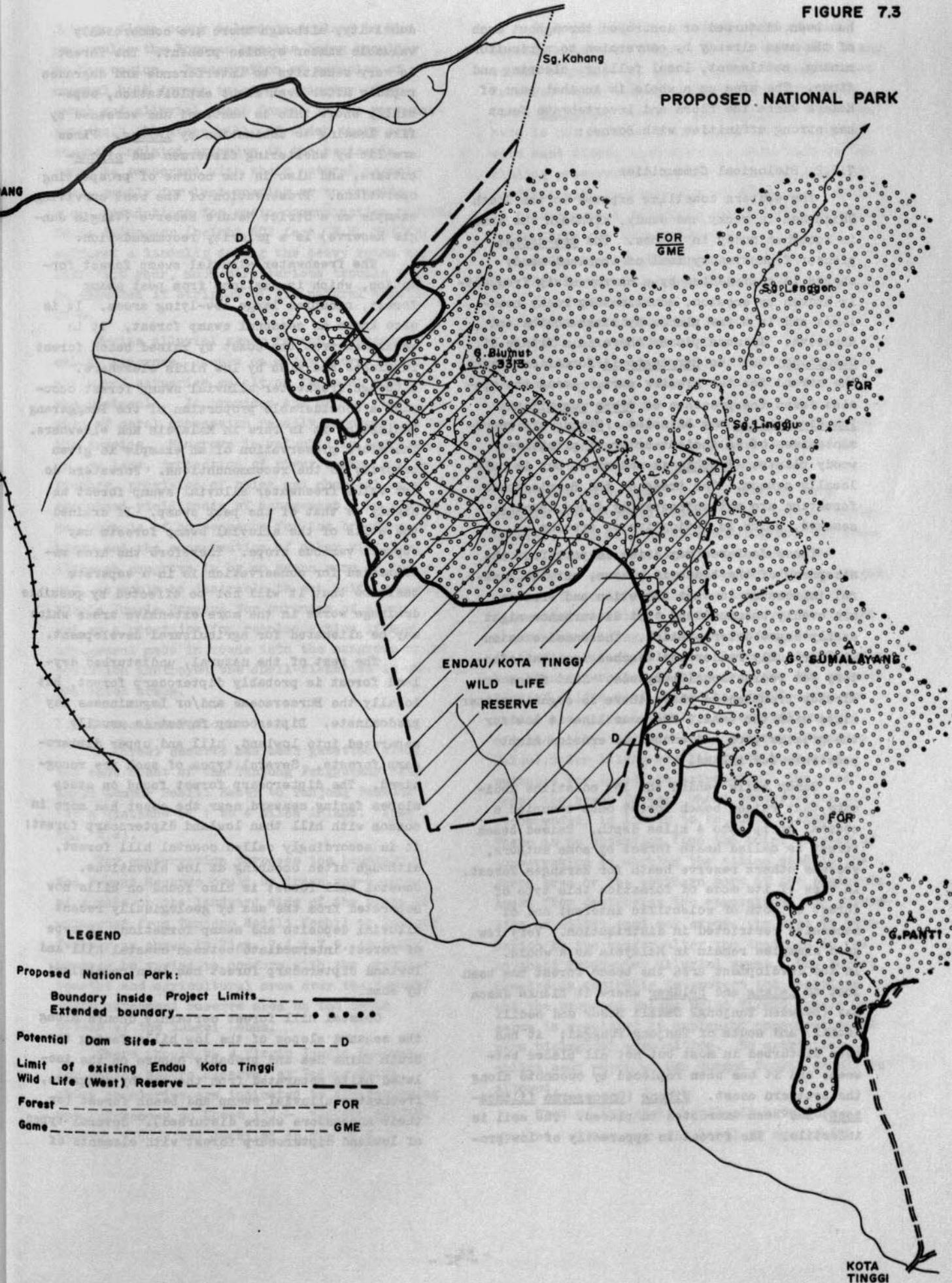
LEGEND

Proposed National Park:

   Boundary inside Project Limits _____
   Extended boundary _____ • • • • •

Potential Dam Sites _____ D

Limit of existing Endau Kota Tinggi
Wild Life (West) Reserve _____

Forest _____ FOR

Game _____ GME

KOTA
TINGGI

has been disturbed or destroyed throughout much of the area already by conversion to agriculture, mining, settlement, local felling, clearing and fires. The area as a whole is in that part of Malaya where the flora and invertebrate fauna has strong affinities with Borneo:

7.5.2 Biological Communities

The eastern coastline exposed to the South China Sea is rocky and sandy, although the sand is somewhat muddy in places. The pes-caprae pioneer formation typical of tropical sandy shores is represented by a narrow strip frequently broken by erosion, sometimes by rocky headlands and in a few places by river mouths and mangrove. In some places there is a fringe of Casuarina, but the Barringtonia formation flanks the strand for the greater part. Among the species found the presence of Cycas rumphii and Pemphis acidula may be noted. Cycads are representatives of an ancient order of primitive woody plants. Pemphis is not rare, but is only locally common. The trees of the Barringtonia formation are not infrequently found leaning seaward, which is indicative of erosion.

These features may arise in part from the steepness of the beach in places, but the general impression is that accretion and erosion are evenly balanced and that disturbance might easily cause deterioration. Increased erosion will probably render the beaches less satisfactory for recreational purposes. Sand flies are already troublesome where there is organic matter mixed with the sand. The coastline is low for the greater part and unchecked erosion might penetrate far inland.

Sandy soils behind the low coastline indicate that raised beach forest once occupied a coastal strip upto 4 miles depth. Raised beach forest is called heath forest by some authors, whereas others reserve heath for kerangas forest. In view of its mode of formation this type of forest is both of scientific interest and of necessity restricted in distribution. Very few good examples remain in Malaysia as a whole. In the development area the beach forest has been lost to lalang and belukar where it flanks Jason Bay (between Tanjong2 Sedili Besar and Sedili Kechil) and south of Tanjong Punggai; it has been disturbed in most but not all places between, and it has been replaced by coconuts along the southern coast. Nibong (Oncosperma filamentosa) has been extracted in places. The soil is infertile. The forest is apparently of low pro-

ductivity, although there are commercially valuable timber species present. The forest is very sensitive to interference and degrades rapidly after even light exploitation, especially where this is hastened and worsened by fire leading to domination by lalang. Fires are lit by sheltering fishermen and nibong-cutters, and also in the course of prospecting operations. Preservation of the best surviving example as a Strict Nature Reserve (Virgin Jungle Reserve) is a priority recommendation.

The freshwater alluvial swamp forest formation, which is distinct from peat swamp forest, occupies large low-lying areas. It is also known as seasonal swamp forest. It is separated from the coast by raised beach forest in places and also by low hills elsewhere. Although freshwater alluvial swamp forest occupies a considerable proportion of the Penggerang Peninsula, it is rare in Malaysia and elsewhere. Therefore preservation of an example is given priority in the recommendations. Foresters do not value freshwater alluvial swamp forest as highly as that of the peat swamp. If drained the soils of the alluvial swamp forests may support various crops. Therefore the area recommended for conservation is in a separate basin so that it will not be affected by possible drainage works in the more extensive areas which may be alienated for agricultural development.

The rest of the natural, undisturbed dryland forest is probably dipterocarp forest, but locally the Burseraceae and/or Leguminosae may predominate. Dipterocarp forest is usually separated into lowland, hill and upper dipterocarp forests. Several types of each are recognised. The dipterocarp forest found on steep slopes facing seaward near the coast has more in common with hill than lowland dipterocarp forest; it is accordingly called coastal hill forest, although often occuring at low elevations. Coastal hill forest is also found on hills now separated from the sea by geologically recent alluvial deposits and swamp formation. A type of forest intermediate between coastal hill and lowland dipterocarp forest has been recognised by some.

Coastal hill forest certainly occurs along the seaward slopes of the low hills facing the South China Sea and probably occurs on the isolated hills separated from the sea by mangrove, freshwater alluvial swamp and beach forest (or their successors where disturbed). Several types of lowland dipterocarp forest with elements of

Bornean flora occur inland on dryland in the peninsula, the Bornean species being peculiar to the region. Preservation of examples of coastal hill forest is given priority after beach and alluvial swamp forest in the recommendations. All steep hill, of which there are several isolated examples in the peninsula, could be preserved with their natural vegetation, partly for land-scaping or to provide sound foundations for radio-communication towers. Bukit Belungkor (height 602 feet, M.R. 387763) suffered a landslip during the heavy rains earlier this year, much more serious trouble might be expected if stripped of its natural vegetation.

Marine alluvial swamp forest, commonly called mangrove, occurs on muddy shores and in sheltered estuaries mainly on the west coast of the peninsula. It provides one of the few examples of seral succession readily demonstrable in the tropics. Mangrove is valuable in accretion of new land, protection of river banks, shellfishery, provision of poles and charcoal on a sustained yield basis of management. In places mangrove is of consequence for the breeding of birds and the conservation of other wildlife. Although mangrove is by no means rare in Malaysia, it would be desirable to set aside a small Virgin Jungle Reserve for purposes of study and as a provision for recolonisation if mismanagement made in roads into the mangrove or po pollution destroyed the shell-fisheries in unprotected areas.

7.5.3 Recommendations

A Forest Reserve has been gazetted along the east coast of the Tanjong Penggerang from Kuala Lumpur Sedili Besar to Tanjong Penawar for a distance of 1 to 4 miles inland. (See Fig. 7.2).

For conservation purposes the boundary of the Forest Reserve could be drawn one-quarter of a mile on the landward side of the crest or watershed from Tanjong Sedili Kechil to Tanjong Penawar as shown in Figs. 7.4 & 7.5. It could however be varied to conform with the proposed tourist and agricultural area over the forest/water catchment reserve area on the beach waters of the Sungei Lebam.

There should be a Virgin Jungle Reserve (or Strict Nature Reserve) at Padang Mulut, whose boundaries are indicated by the following map references on Sheet 132:- 5220600 558058, 540992, 575025 and detailed in Fig. 7.5.

That is from the northern half of the foreshore between Tanjong Kelesa and Telok Siang to the boundary (of the proposed revised Forest Reserve) beyond the watershed. The foreshore (part Casuarina and part Barringtonia formation) here is not pure sand and seems to be infested with sand flies, therefore a strict reserve including preservation of the foreshore will not conflict with recreational requirements. Within this proposed Virgin Jungle Reserve of 5,320 acres there are approximately:-

    540 acres of raised beach forest
    1880 acres of freshwater alluvial swamp
        forest
    2740 acres of coastal forest
    160 acres of disturbed forest

This is the only place where the three types of natural vegetation awarded priority for conservation occur together in a compact, (almost completely) undisturbed area with its own isolated drainage system. Absolute priority should be given to the conservation of this area.

There is no need for any road to pass through the proposed Padang Mulud Virgin Jungle Reserve. The main north-south highway can pass to the west and the link to the east coast could be in area of the headwaters of the Sungei Lebam. The only conflicting interest is the alienation to extract silica land in the raised beach area Tanjong Kelesa to Tanjong Balau (including Padang Mulud). Although 13,000 acres has been demarcated in this area for the extraction of silica sand, less than 2,000 acres are raised beached and likely to bear silica sand, of which only the southern 460 acres (Siang to Balau) under lalang are likely to bear sand suitable for immediate extraction. The sand under the beach forest, whose conservation is recommended, is likely to be humic stained. There is no objection from the point of view of conservation to working the silica sand in the Jason area or the southern part of the peninsula. Apart from destroying the vegetation, the extraction of silica sand may expose the area to inundation by the sea/or alter the drainage in the adjacent freshwater alluvial swamp. The Forest Reserve is desirable to protect the coastline and the proposed Padang Mulud Virgin Jungle Reserve is essential to implement conservation of rare biological communities. No extraction of silica sand north of the Sungei Tengah should be allowed.

Most of the rocky headlands have been spoiled, either near sea level or near their

FIGURE 7.4

PROPOSED
CONSERVATION AREAS

Sedili
Besar

Sedili
Kechil

Tg. Gemoh

Tg. Kelesa

Tg. Siang

Tg. Balau

Tg. Lompat

TOURIST
PROJECT

Tg. Per

Tg. Pu

KOTA
TINGGI

S. JOHOR

LEBAM
PROPOSED
WATER
CATCHMENT
RESERVE

S. Lebam

S. San?i

Penggerang

Tk. Ramunia
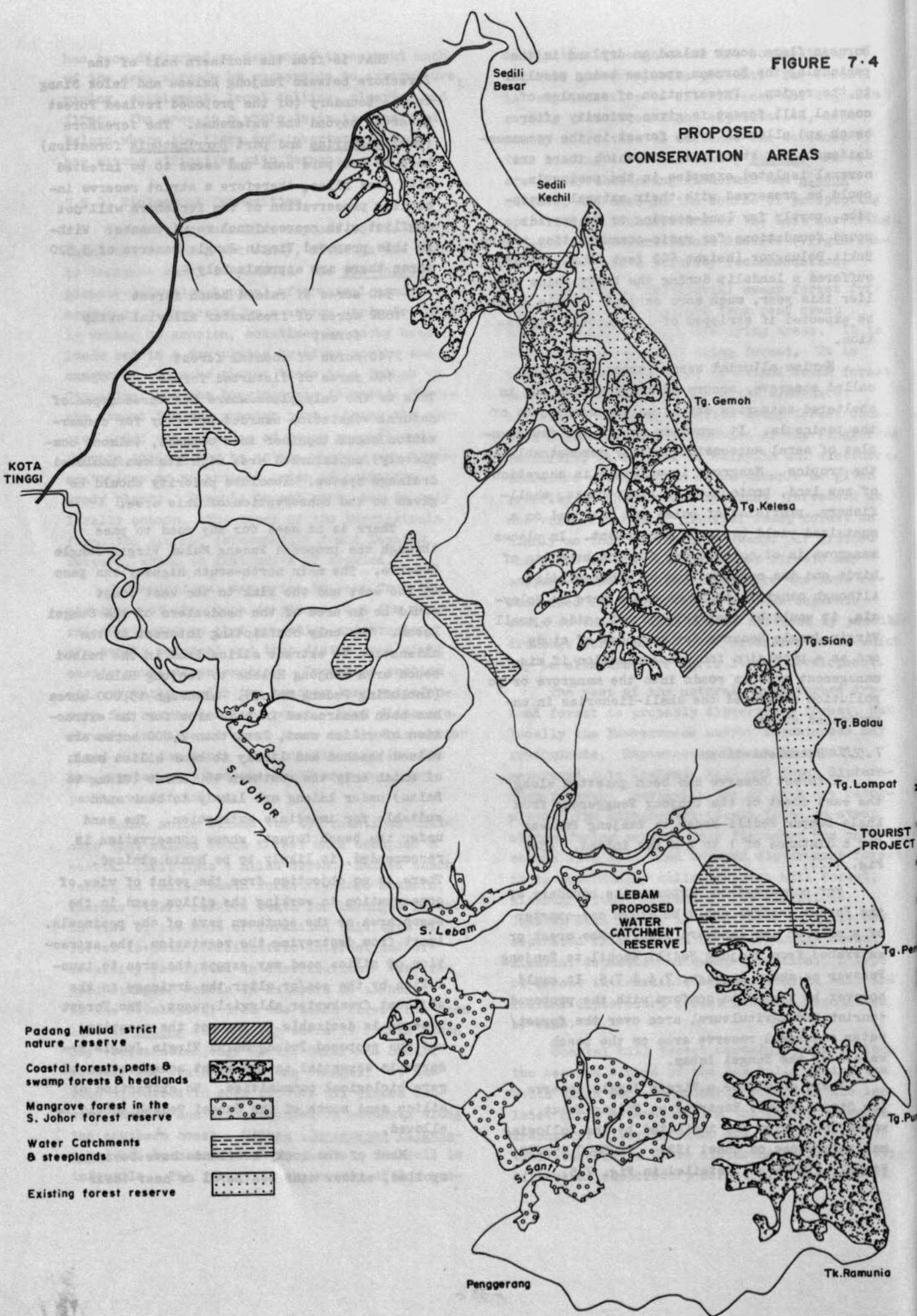
Padang Mulud strict
nature reserve

Coastal forests, peats &
swamp forests & headlands

Mangrove forest in the
S. Johor forest reserve

Water Catchments
& steeplands

Existing forest reserve

Scale
Miles 5   0   5 Miles
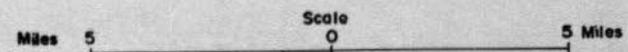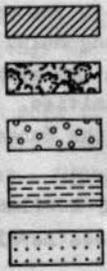
FIGURE 7.5

PADANG MULUD STRICT
NATURE RESERVE

SEDILI KECHIL

CHINA SEA

TG.GEMOH

TG.KELESA

PADANG
MULUD

TG.SIANG

TG.BALAU

TG.LOMPAT

TG.PENAWAR

S. Lebam

LEGEND

Mangrove

Fresh water swamp

Beach forest

forest

lalang secondary forest
and Resam
(Gleichenia linearis)

Lalang
(Imperata Cylindrica)

Note:

Map prepared from air
photo interpretation for
nature conservation
studies.

Miles 2½   Scale   2½ Miles
0
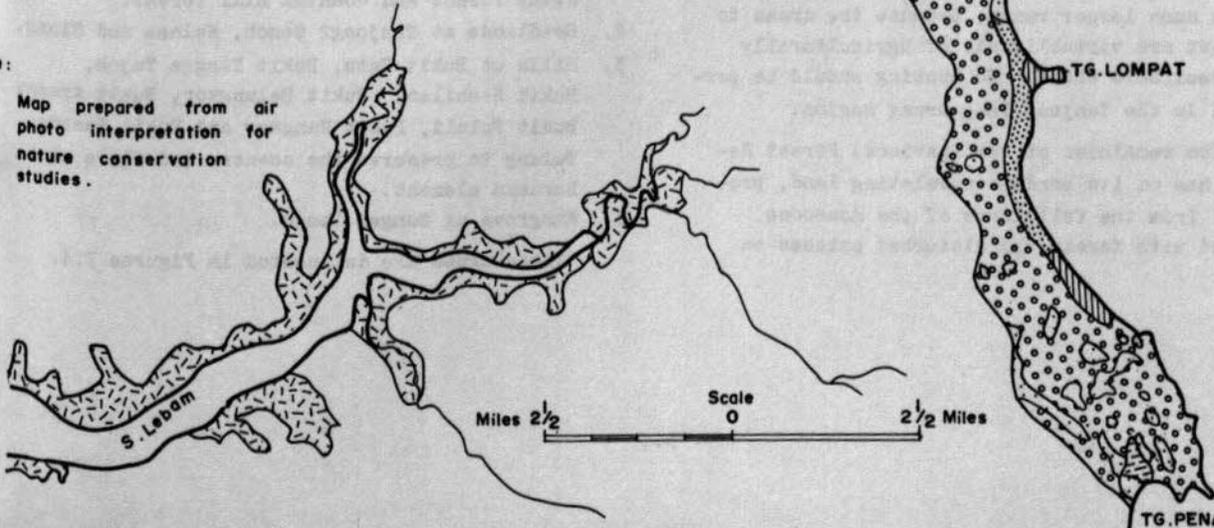
summits. Small Virgin Jungle Reserves are proposed to save what remains as follows:-

Tanjong Gemoh, M.R. 535137, 525137, 529112, 538112; 560 acres

Tanjong Kelesa, M.R. 554086, 548172, 561065; 410 acres

Tanjong Siang, M.R. 597000, 595992, 597990; 120 acres

Thus far within the total Forest Reserve proposed in Fig. 7.4, the proposed Virgin Jungle Reserves (Fig. 7.5) total only 6,410 acres. There are 460 acres lalang covered raised beach (Siang to Balau) where silica sand extraction or other development might be permitted. The coastal fringe south of Tanjong Balau will probably become a tourist resort. The remainder could be either Protective or Productive Forest. The soils are generally poor, the raised beach forest easily degraded, the coast is exposed to the northeast monsoon, Protective Forest or Productive Forest based on moderate working plans would seem to be indicated.

Elephant are known to frequent Padang Mulud and tiger have been report in the vicinity. The Forest Reserve as defined in Figure 7.4 is likely to support more than a small remnant of the existing wildlife in the Penggerang peninsula, virtually no large herbivores or big cats. The fate of the adjacent areas must be considered.

The large areas of freshwater alluvial swamp forest of the Sungei Sedili Besar, Sungei Bahan and Sungei Sedili Kechil basins match with the northern part of the Forest Reserve (as revised here). Agricultural usage depends on drainage. Productive forest plans are problematic. Protective forest means that there will be no economic use of substantial areas. Retention of these tracts of alluvial swamp as productive or protective forest is the most likely means of providing a connection between the proposed forest (and Nature) Reserve of the Penggerang peninsula with Ulu Sedili and other areas to the north. This might be used as a corridor by wildlife, apart from providing them with a much larger range, because the areas to the west are virtually all of agriculturally more desirable soils. No hunting should be permitted in the Tanjong Penggerang region.

The remainder of the (revised) Forest Reserve has on its borders undulating land, protected from the full force of the monsoons, clothed with forest and disturbed patches on relatively fair to good soils southward from the swamps. Much of this will probably be required for agriculture and in places open-cast mining for bauxite. As it is necessary to protect the headwaters of the Sungei Lebam as a catchment area, the area available to wildlife is further extended.

The isolated hills shown in Fig. whose retention under natural vegetation is recommended, are in approximately descending order of importance:-

(a) Bukit Satu, Bukit Tangga Tujoh (M.R. 388027) and Bukit Sembilan complex in the centre of the peninsula,

(b) Bukit Belungkor (M.R. 387763) and Bukit Arang (M.R. 422751) complex,

(c) Bukit Pelali (M.R. 547697) and Bukit Kangkar complex, and

(d) Bukit Tambun Tulang (M.R. 242148).

The hill area mentioned under (a) above contains a wide variety of vegetation including Virgin Forest on the central part of the ridge with elements of the Bornean flora. The area also contains a remarkably varied range of habitats within a comparatively small area. The presence of the following large animals are noted: elephant, tiger, deer, gibbons, monkeys. Insects are abundant, occupying each distinctive habitat.

The approximately one square mile area of reasonably undisturbed mangrove forest in the Sungei Johor Forest Reserve about the Sungei Temon (from just south of Kampong Panchor to just north of the Sungei Guntong) is recommended for retention as nature reserve and exemption from exploitation.

7.5.4 Conclusions

The following Strict Nature Reserves (Virgin Jungle Reserves or Scientific Reserves) are recommended.

1. At Padang Mulud to preserve good examples of strand flora and three rare biological communities, namely, beach forest, alluvial swamp forest and coastal hill forest.

2. Headlands at Tanjong2 Gemoh, Kelesa and Siang.

3. Hills at Bukit Satu, Bukit Tangga Tujoh, Bukit Sembilan; Bukit Belungkor, Bukit Arang; Bukit Pelali, Bukit Kangkar and Bukit Tambun Tulang to preserve the scenery and flora with Bornean element.

4. Mangrove at Sungei Temon.

These areas are delineated in Figures 7.4.

APPENDIX A

GLOSSARY OF TERMS USED IN THIS VOLUME

DBH - Diameter at breast height
GBH - Girth at breast height
fob - free on board
cif - cost, insurance, freight
RME - Reliable Minimum Estimate

The value referred to as the Reliable Minimum Estimate (RME) that is applied to stem numbers, basal area or volume is equal to the mean less 't' times the standard error of the mean, where 't' is a constant determined by the probability of the estimate (5 percent in this report) and the number of sample units on which the estimate is based. The variation that occurs around the mean values in the sample inventory could mean that the actual values were lower or higher than the sample mean values by amounts related to their standard errors. It is the lowest probable values (sometimes referred to as the 95 percent lower confidence limit) that are of interest in summarizing inventory data. Therefore RME is used when tabulating basal area and net volumes by species groups for the main- and sub-samples for both lowland and hill blocks in Tables C 14-17. For a further explanation of sampling error as applied to a forest inventory, see Loetsch and Haller, 1964.

Log Measurement

There are at least four different measures of logs used in Malaysia. They are as follows:

1. The true volume (tv) measure - this is calculated by multiplying the length by the average cross-sectional area, the latter being the average of the surface areas at the small and large ends of the log. One ton of true volume is equal to 50 cubic feet (cu.ft.)

2. The Malaysian Forest Department Measure (FD ton) - this is also referred to as the timber ton or Malay ton (see Appendix 1 of Charnell (1968)). Volume equals length multiplied by the cross-sectional area (excluding bark) at the small end only. The volume obtained will vary from the true volume, the extent of the variation depending on both length and taper. Within the range of log diameters and lengths commonly produced, the experience of the Malaysian Forest Department suggests that one Forest Department or timber is equal to about 1.14 true volume tons. Alternatively one FD tons is equivalent to about 57 cubic feet.

3. Hoppus or Chinese ton as measured in Johor and Singapore - this is referred to here as the Johor Hoppus. One Johor Hoppus ton is calculated by multiplying the length by the square of the quarter girth, where the girth is measured at the centre of the log. One Johor Hoppus ton is approximately equal to 1.28 tv tons.

4. The Selangor Hoppus - the Hoppus or Chinese ton as measured in Pahang and Selangor. Volume is calculated as length multiplied by the square of the quarter girth where the girth is measured at the small end. The Selangor Hoppus ton is therefore equal to about 1.28 FD tons.

Timber Measurement

It is quite common to refer to sawn timber in tons of 50 cubic feet or in Foot Board Measure (FBM). A board foot is commonly used in Canada, the United States, Australia and New Zealand and refers to the quantity of sawn timber or lumber, one inch thick, 12 inches wide and 12 inches long. Based on a 60 percent recovery or yield factor, one FD ton is equivalent to about 410 FBM of sawn timber, but for most conversion purposes, one FD ton is taken as equal to about 400 FBM.

Wood Chip Measurement

A term which is commonly used in the wood chip trade is the "bone dry unit". This is equivalent to 2,400 pounds of chips in a bone dry condition.

The Measures Used in this Report and Approximate Conversion Tables

In this volume, most of the inventory volumes are given in terms of true volume whereas in the calculations of costs, selling prices and royalties and premia, FD tons are used.

The conversions used are as follows:

One true volume (tv) ton equals 50 cubic feet.
One Forest Department (FD) ton equals 57 cubic feet.
One Johor Hoppus ton equals 63-64 cubic feet.
One Selangor Hoppus ton equals about 73 cubic feet.
One thousand FBM sawn (often written as 1 MBM) equals 2.5 FD tons, at a 60 percent recovery factor (see page 38 of Gardiner (1968)).
One ton of sawn timber of 50 cubic feet equals about 600 board feet.
For example to arrive at FD tons from tv tons, it is necessary to multiply the tv tons by 50 and divide by 57.

Virgin Jungle Reserves

Malayan Forest Records No. 23 define Jungle Reserves and their objects as follows:-

Introduction

These reserves are selected areas of natural vegetation; or areas carrying the least man-disturbed vegetation that are known of a particular type and that it is possible to preserve; or areas containing rare species or particular floristic individuals which it is desired to retain for posterity; or areas which it is desirable to preserve for wild life conservation. They can be parts of existing Forest Reserves or created especially under the Land Code. Such reserves are called Forest Nature Reserves in Uganda and Preservation Plots in India.

Objects

(i) The preservation of natural vegetation habitats for fundamental scientific study in its widest aspect.

(ii) The provision of accessible areas throughout the country in which botanical, phenological and ecological studies of natural forest can be carried out.

(iii) The retention of specimens of all types of natural vegetation to serve as controls for managed forest, i.e. the exploited and regenerated areas.

(iv) The provision of natural arboreta for the benefit of the staff and interested members of the general public by means of permanent Sample (Jungle) Plots in which trees are numbered and identified.

(v) The preservation of outstanding forest or individual trees as a national heritage, e.g. areas containing forest giants or rare species.

(vi) The provision of wild life sanctuaries within the large tracts of managed forest in order not only to preserve all species of wild life but to provide a sufficient and well-distributed number of undisturbed biological habitats. The presence of such habitats could be the only means of ensuring the

success of the surrounding managed forest, viz. being the home of certain essential predators or of agents of seed dispersal in naturally regenerated forest.

The Record also lays rules governing their layout and maintenance.

APPENDIX B

STUDIES ON FORESTRY AND TIMBER UTILISATION BEING CARRIED OUT IN WEST MALAYSIA

There are many serious gaps in Malaysia's knowledge of forestry and timber utilisation. The most serious are at the marketing end of the process, but some studies are underway that may fill some at least of these holes.

The major studies underway are as follows:

(1) A study of Forest Industries in West Malaysia - under UNDP - the field work is due to be completed in 1971 but the final report is not due to be produced until 1973;

(2) A UNDP study of the feasibility in West Malaysia of developing plantations of quick-growing exotic softwood species for pulpwood. This is also a 5-year programme and is due to be completed by 1972/73;

(3) Studies in connection with the Pahang Tenggara project due to be completed in 1971/72. These studies include an inventory of the forests and allied work in Pahang Tenggara, but also more work on plymilling, particle board and furniture products than was possible for this report;

(4) A special research project into hill forest regeneration at the Forest Research Institute, Kepong.

It is however probably fair to say that more emphasis needs to be put on the marketing problems constraining greater timber utilisation especially in such fields as the reconstituted wood industry (particle board, fibreboard, chips, etc. - See Appendix E of this volume), and knock-down furniture products.

APPENDIX C

1   JOHOR TENGAH REGION

1.1   Forest Description

The commercially valuable undisturbed forests are confined to this part of the project area, and consist of lowland and hill forests.

The lowland forest is representative of the Lowland Dipterocarp type commonly found in West Malaysia up to about 1000 feet above sea level. The principal emergent species are those of the family Dipterocarpaceae viz. red, yellow and white meranti, with red meranti predominating, keruing, merawan, balau, chengal, resak, kupur and seraya. Kapur is only found in two small areas in the north west and south east. Seraya, normally found on high ridges is infrequent, though it has been met with at elevations down to 200 feet on the lower slopes of Gunong Lambak in Rengam Forest Reserve. Other species in order of abundance are kedondong, kelat, kempas, nyatoh, medang, kembang semangkok, bintangor, mengkulang, rengas, keranji, durian and simpoh. Jelutong, an important commercial species, is uncommon; so is mersawa of the Dipterocarp group.

The Hill Dipterocarp type of forest extends beyond the general level of the lowland type to about 2500 feet above sea level. In the lower altitudinal ranges kapur, red and yellow meranti, keruing, kempas and mengkulang are well represented. On the ridge tops seraya and merpauh are conspicuous. Between 1500 and 2000 feet elevation, bintangor, kelat, merpauh and medang are commonly found mixed with some chengal, yellow meranti, seraya, kapur and nyatoh.

The red meranti and keruing forest is widely distributed throughout the area and is the largest commercially important type, the greatest acreage of which is to be found below 500 feet elevation. The average height of the dominant canopy is about 130 feet.

The kapur forest type consists of the tallest emergents with an average height of 150 feet. This species has a strong gregarious tendency and is not as wide spread as the red meranti keruing type though forming a very important component of the crop. The greatest concentration of the species is to be found just below the seraya ridge type and between the altitudinal range of 200 to 1500 feet.

On the high ridges seraya and merpauh are the dominant species. These two species grow in admixture with kapur up to an elevation of 2000 feet on the Gunong Blumut massif. Beyond the 2000 feet elevation within the inventory area there is little timber of commercial importance.

1.2   Scope of Inventory

The inventory covered a compact block of 149,000 acres of undisturbed forest within Rengam, Kluang and Ulu Sedili forest reserves, stratified into two categories - lowland and highland. The boundary between the two, for the purposes of this study, has been agreed with the Forestry Department to approximate to the 500 foot contour.

The sampling plan was prepared so as to exclude forest logged since the 1966 aerial photography of the area. A total of 43 sampling blocks were delineated on to 1:63,360 topographical sheet numbers 124 and 125, the size of each block averaging five square miles.

The lowland area comprised 27 blocks viz. 1 to 23, 25, 27, 28 and 40 with an acreage of 81,634 acres. The sixteen hill blocks are numbers 24, 26, 29, to 39, 41, 42 and 43, having an acreage of 67,639 acres. These inventory blocks are indicated in Figure 7.1 which shows the actual boundaries between lowland and hill blocks which does not always conform to the 500 dividing line.

Included in the inventory area were about 6000 acres of lowland forest under logging agreement. The larger expanses of fresh water swamp forest along stretches of the Kahang and the upper reaches of the S. Linggiu were excluded.

1.3   Sampling Procedure

The inventory procedure was planned and executed in close consultation with the West Malaysian Forestry Department and the Commonwealth Forestry Institute, Oxford. Inventory field staff were provided by the State Forest Officer, Johor.

Two sampling strips, each one chain in width and extending across main topographical features, were located at random within each block. Sampling consisted in measuring and recording all trees of four feet girth and over at breast height or above buttresses, in one foot girth classes from 4 feet to 13 feet, the last including all stems above this girth. In addition, all stems down to two feet in girth were measured in every tenth square chain (10 percent sub-sample) along each strip in order to provide some information on the stocking of trees between two and four feet in girth. In each sub-sample all trees were visually graded as follows:-

A: Straight and cyclindrical, suitable for use as peeler logs.
B: Suitable for use as sawlogs.
C: Badly shaped and unsuitable for use as peelers or sawlogs.
D: Visibly defective.

All data was recorded in field sheets, each for ten chains of strip. Note was taken of defective trees encountered during the inventory - these were omitted in the final analysis.

The area of the main sample was 1050 acres or 1.3 percent in the lowland blocks and 666 acres or 1.0 percent in the hill blocks.

1.4   Species Groups

Seventeen species groups were used for recording stand table and volume data and were selected in consultation with the Forestry Department. A detailed list of species recorded in the inventory, with their botanical identities, is given in Table C.13.

1.5   Defect Study

This was undertaken in conjunction with the forest inventory in Johor Tengah and was confined to logging areas in forest reserves bordering the inventory area.

Work in the field was carried out by a team from the Mensuration Branch of the Forest Research Institute, Kepong, and involved the measurement of 487 felled trees in Lowland Dipterocarp forest for assessment of defective timber volume due to rot, hollowness, brittle heart (in the case of meranti only) large knots and breakage below the first branch. Measurements were made in compartments 16 and 25 Rengam Reserve, 75 and 78B Kluang Reserve, 13 Lenggor Reserve and 54 Panti Reserve. All data was processed under the direct supervision of the Forest Statistician.

Table C.1 gives the defective volume percent stratified by the 17 species groups. In the calculations of volume these figures were applied individually to the gross volume of

Kg. Kahang
Baharu

FOREST INVENTORY AND
EXISTING EXPLOITATION

KLUANG

1

2

43

3

4

7

5

33

G.
Blumut

8

34

42

12

35

13

36

14

37

10

38

39

41

32

11

15

31

30

40

16

28

27

18

29

25

17

19

20

24

26

RENGAM

21

22

23

Layang
Layang

Developed Land including mining land

Sampling Boundary

Inventory block boundary

Boundary between Lowland & Hill blocks

Regenerated forest

Treated forest

Exploited forest

Undisturbed forest

State Land forest undergoing exploitation

Scale

Miles 5   0   5 Miles
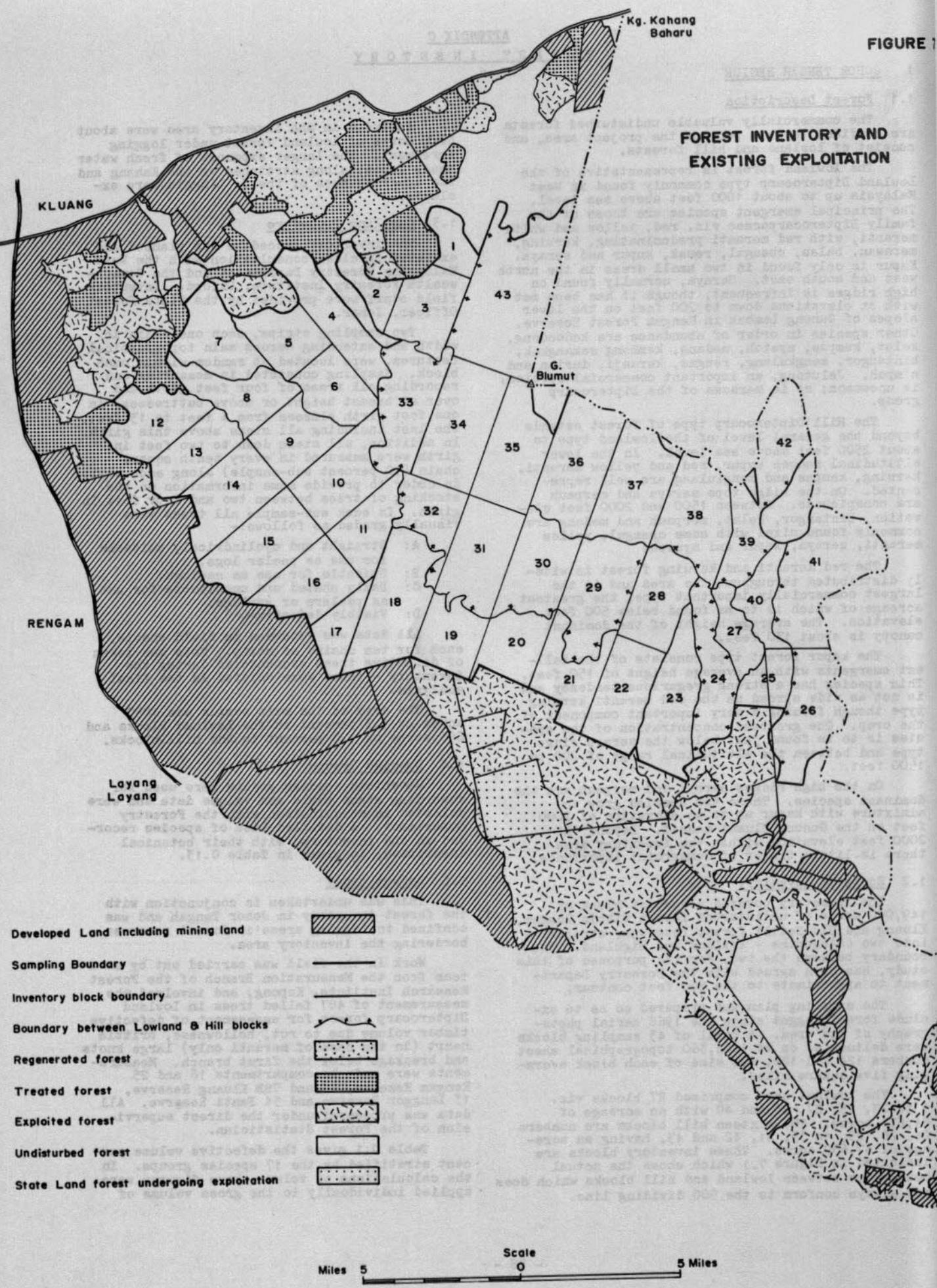
each species group to obtain the merchantable or net volume.

In the case of seraya, mersawa and jelutong, a total of only 17 trees were measured because of the scarcity of these three species. Not much reliance can therefore be placed on the percentage defect for each of these.

TABLE C.1.

Defective volume percent stratified by 17 species groups

Species Groups	No. of trees	Volume in cubic feet true			Percentage defect
		Commercial Timber Volume	Defective Timber Volume	Merchantable Timber Volume	
1. Heavy Hardwoods	54	12,943.67	2,759.08	10,184.59	21.31
2. Kempas	36	8,913.60	3,569.20	5,344.39	40.04
3. Keruing	40	10,328.09	2,492.95	7,835.13	24.13
4. Kapur & Keladan	45	12,891.26	2,227.61	10,663.65	17.28
5. Other Medium Hardwoods	24	4,482.24	1,013.15	3,469.09	22.60
6. Meranti Melantai	43	8,263.14	2,906.31	5,356.82	35.17
7. Meranti Rambai Dau	10	1,370.06	404.34	965.71	29.51
8. Meranti Sarang Punai	17	2,780.57	849.04	1,931.53	30.53
9. Meranti Tembaga	23	4,618.24	922.10	3,696.14	19.96
10. Seraya	6	1,768.86	306.52	1,462.34	17.32
11. Nemesu, Gerutu2 & other R. Meranti	55	13,503.45	4,866.78	8,636.67	36.04
12. White Meranti	12	2,644.54	1,411.14	1,233.40	53.36
13. Mersawa	8	4,956.75	2,284.29	2,672.46	46.08
14. Yellow Meranti	12	3,545.28	1,525.70	2,019.57	43.03
15. Jelutong	3	294.89	114.54	180.34	38.84
16. Mengkulang	21	4,030.40	1,112.07	2,918.32	27.59
17. Other Light Hardwoods	78	12,746.54	3,487.58	9,258.95	27.36

Defective volume percent by the three main classes

	Volume in cubic feet true			Percentage defect
	CTV	DTV	MTV	
Heavy Hardwoods	12,943.67	2,759.08	10,184.59	21.31
Medium Hardwoods	36,615.20	9,302.92	27,312.28	25.40
Light Hardwoods	60,522.78	20,190.47	40,332.31	33.36
Overall	110,081.65	32,252.47	77,829.18	29.29

1.6 Data Processing

All field data was submitted to the Commonwealth Forestry Institute for preparation of stand tables and volumes by computer. This data included the field sheets of the inventory and also the clear bole height measurements of the different species groups. The latter were obtained by Haga hypsometer at random intervals on certain strips, and measured separately in lowland and hill blocks.

Timber volumes were computed from single entry volume tables prepared at the Commonwealth Forestry Institute from the clear bole height data and based on the Forest Department dual entry volume tables (Malayan Forest Record No. 24). Three such tables were prepared viz. one for lowland, one for highland and one for the combined area. Volumes for lowland and hill blocks are based upon the combined data.

The sampling errors, as expected, did not exceed the 20 percent error limit for the volume of the major species groupings.

Details of Reliable Minimum Estimates and error percent of stand, basal area and net volume by species groups for the main and sub-sample areas in both lowland and hill blocks are tabulated in Tables C 14 to 17.

Volumes for stems in girth class 2-3 feet are nominal volumes estimated at 10 cubic feet per tree for the different species groups. Volumes for stems in girth class 3-4 feet were obtained by extrapolation from the tables in Malayan Forest Record No. 24.

1.7 Stand Tables in Lowland and Hill blocks

The total stand for trees of four feet girth and over in lowland and hill blocks is about the same, viz. twenty trees per acre.

Tables C.2 and C.3 give the mean number of stems in lowland and highland respectively in three grouped girth classes of four to under seven, seven to under ten and ten feet and over.

These figures are for units of 100 acres in order to provide a more realistic presentation of the data, particularly in the case of species groups of infrequent occurrence.

For the lowland blocks the percentage proportions of Heavy Hardwoods, Medium Hardwoods and Light Hardwoods are eleven, thirty six and fifty three respectively. In the case of the hill blocks these are twelve, forty and forty-eight percent respectively.

The popular species groups of keruing and all red meranti together make up 17 percent of the total stand in the lowland blocks and 14 percent in the hill blocks for trees of four feet girth and over.

Tables C.4 and C.5 give the mean number of trees of two feet girth and above for a sub-sample area of 105 acres in lowland blocks and 67 acres in hill blocks, also for units of 100 acres. These indicate a total stand of 73 trees per acre for lowland and 78 trees per acre for hill blocks.

1.8 Timber Volume Estimates in Lowland and Hill blocks

Estimates of timber volume per acre for trees of 4 feet in girth and over are shown in Table C.6. These are net volumes, that is, volumes after deduction for defect. Mean and Reliable Minimum Estimates (RME) at 95 percent lower confidence limits are given for both localities.

The mean net volume for the lowland blocks amounts to 1910 cubic feet true per acre. For the hill blocks the figure is lower at 1657 cubic feet per acre.

In the lowland blocks this volume is made up of 15 percent of Heavy Hardwoods, 32 percent of Medium Hardwoods and 53 percent of Light Hardwoods. The figures for the hill blocks are 13, 37 and 50 percent respectively.

The mean net volume of the currently popular species of keruing and red meranti, taken together, amounts to 490 cubic feet per acre in the lowland blocks or about 26 percent of the total. In the hill blocks the figure is 405 cubic feet or 24 percent of the total.

Kapur, another species of commercial importance, is capable of a mean yield of 211 cubic feet per acre in the hill blocks but only about 49 cubic feet per acre in the lowland. This particular species makes up the greater proportion of highly productive forest areas.

RME volumes for the various species groups are not additive because of variations in the sampling errors for the different groups. However, in the preparations of the report on timber utilisation the mean error percent for the main divisions of Heavy, Medium and Light Hardwoods was applied to the volume of each species group in order to obtain a total reliable minimum estimate. The resultant RME net volume for all species for the lowland blocks is 1710 cubic feet or 34.2 cubic tons per acre. In the hill blocks the RME figure is 1514 cubic feet or 30.3 cubic tons per acre.

1.9 Form Class Distribution in Lowland and Hill blocks

As mentioned in para. 1.3 of this report all trees in the ten percent sub-sample were graded into four classes to provide some indication of the quality of logs that might be expected from the lowland and hill blocks. As will be seen from Tables C.7 and C.8 79 percent of the trees recorded in the lowland blocks are in form classes A and B, i.e. suitable for production of peeler and sawlogs. In the hill blocks the proportion suitable for such purposes is higher at 88 percent. Not all the timber in form classes A and B would be considered for peeling since most of the Heavy and Medium Hardwoods and some of the Light Hardwoods are not at present utilised for peeling.

1.10 Percentage Composition of Species Within Groups

This information for trees of 4 feet girth and over is given in Table C18 for both Lowland and Hill blocks and is based on the number of trees of the different species specifically identified during the inventory.

It is designed to provide some idea of the composition of those groups containing more than one species.

1.11 Productivity Map

A map of the inventory area on a scale of 1:63,360 has been prepared to indicate the mean net volume for each sampling strip within each of the 43 blocks. This is shown diagramatically and indicates productivity for all species of a girth of four feet and over by net volume in cubic feet per acre in five broad classes viz. below 1000, 1000 to 1500, 1500 to 2000, 2000 to 2500 and 2500 and over. Productivity in this case means productivity based on present growing stock.

Table C.22 gives details of mean productivity in cubic feet per acre for the different species groups in each block. It is considered

TABLE C.2.

JOHOR TENGAH

FOREST INVENTORY - ALL LOWLAND BLOCKS

Stand Table per 100 acres of trees of 4 feet girth and over

(Area of sample = 1050 acres. Sample percent 1.3)

Species Groups	Grouped girth classes in feet				
	4 — <7	7 — <10	10 and over	Total 7 and over	Total 4 and over
1. Heavy Hardwoods	160.2	46.5	17.3	63.8	224.0
2. Kempas	48.1	24.4	4.5	28.9	77.0
3. Keruing	42.9	21.5	9.5	31.0	73.9
4. Kapur and Keladan	13.2	9.7	4.1	13.8	27.0
5. Other Medium Hardwoods	492.2	32.0	1.8	33.8	526.0
Total Medium Hardwoods	596.4	87.6	19.9	107.5	703.9
6. Meranti Melantai	35.3	14.3	2.7	17.0	52.3
7. Meranti Rambai Daun	11.2	4.2	1.0	5.2	16.4
8. Meranti Sarang Punai	25.0	5.4	0.3	5.7	30.7
9. Meranti Tembaga	27.4	10.1	1.0	11.1	38.5
10. Seraya	2.1	1.6	3.0	4.6	6.7
11. Nemesu, Gerutu2 and other Red Meranti	68.5	28.5	14.9	43.4	111.9
12. White Meranti	10.6	3.7	0.5	4.2	14.8
13. Mersawa	3.4	3.4	1.4	4.8	8.2
14. Yellow Meranti	11.4	5.7	3.1	8.8	20.2
15. Jelutong	3.1	1.7	0.9	2.6	5.7
16. Mengkulang	27.9	10.6	1.0	11.6	39.5
17. Other Light Hardwoods	628.6	49.3	5.5	54.8	683.4
Total Light Hardwoods	854.5	138.5	35.3	173.8	1,028.3
Grand Total	1,611.1	272.6	72.5	345.1	1,956.2

Note: Lowland blocks are Nos. 1-23, 25, 27, 28 and 40.

Total area is 81,634 acres for 27 blocks.

TABLE C.3.

JOHOR TENGAH

FOREST INVENTORY – ALL HILL BLOCKS

Stand Table per 100 acres of trees of 4 feet girth and over

(Area of sample = 666 acres. Sample percent 1.0)

Species Groups	Grouped girth classes in feet				
	4 – <7	7 – <10	10 and over	Total 7 and over	Total 4 and over
1. Heavy Hardwoods	204.7	34.0	11.5	45.5	250.2
2. Kempas	35.3	11.2	0.1	11.3	46.6
3. Keruing	46.1	22.5	7.5	30.0	76.1
4. Kapur and Keladan	76.6	45.1	18.9	64.0	140.6
5. Other Medium Hardwoods	519.7	27.2	1.1	28.3	548.0
Total Medium Hardwoods	677.7	106.0	27.6	133.6	811.3
6. Meranti Melantai	16.0	5.1	0.5	5.6	21.6
7. Meranti Rambai Daun	15.8	3.7	0.3	4.0	19.8
8. Meranti Sarang Punai	16.0	3.2	–	3.2	19.2
9. Meranti Tembaga	16.5	9.4	2.7	12.1	28.6
10. Seraya	30.7	18.3	12.1	30.4	61.1
11. Nemusu, Gerutu2 and Other Red Meranti	37.3	18.8	8.1	26.9	64.2
12. White Meranti	7.4	2.4	0.5	2.9	10.3
13. Mersawa	2.7	1.6	1.1	2.7	5.4
14. Yellow Meranti	33.8	8.7	4.6	13.3	47.1
15. Jelutong	3.5	0.9	0.3	1.2	4.7
16. Mengkulang	22.7	4.3	1.1	5.4	28.1
17. Other Light Hardwoods	594.0	54.9	2.3	57.2	651.2
Total Light Hardwoods	796.4	131.3	33.6	164.9	961.3
Podocarpus spp.	0.3	–	–	–	0.3
Grand Total	1,679.1	271.3	72.7	344.0	2,023.1

Note: Hill blocks are Nos. 24, 26, 29-39, 41, 42 and 43.
Total area is 67,639 acres for 16 blocks.

TABLE C.4.

JOHOR TENGAH

FOREST INVENTORY - ALL LOWLAND BLOCKS

Stand Table per 100 acres of trees of 2 feet girth
and over

(Area of sub. sample = 105 acres. Sample percent 0.1)

Species Groups	Grouped girth classes in feet					
	2 – <4	4 – <7	7 – <10	10 and over	Total 7 and over	Total 2 and over
1. Heavy Hardwoods	208.6	178.1	55.3	18.8	74.1	534.9
2. Kempas	30.3	42.6	26.9	2.6	29.5	131.9
3. Keruing	46.5	50.4	17.8	16.6	34.4	165.7
4. Kapur and Keladan	17.0	7.3	12.1	1.5	13.6	51.5
5. Other Medium Hardwoods	1,751.0	561.7	33.0	3.1	36.1	2,384.9
Total Medium Hardwoods	1,844.8	662.0	89.8	23.8	113.6	2,734.0
6. Meranti Melantai	30.2	28.5	14.9	–	14.9	88.5
7. Meranti Rambai Daun	10.6	12.9	4.2	1.1	5.3	34.1
8. Meranti Sarang Punai	31.0	21.2	2.8	–	2.8	57.8
9. Meranti Tembaga	18.0	29.5	5.0	3.3	8.3	64.1
10. Seraya	1.9	–	2.0	3.8	5.8	13.5
11. Nemesu, Gerutu2 and Other Red Meranti	95.9	86.2	25.3	18.0	43.3	268.7
12. White Meranti	6.6	10.9	3.1	–	3.1	23.7
13. Mersawa	2.4	4.7	3.8	–	3.8	14.7
14. Yellow Meranti	13.0	11.3	2.9	–	2.9	30.1
15. Jelutong	3.2	6.6	1.0	1.3	2.3	14.4
16. Mengkulang	45.4	25.9	8.9	–	8.9	89.1
17. Other Light Hardwoods	2,527.6	670.9	57.7	2.9	60.6	3,319.7
Total Light Hardwoods	2,785.8	908.6	131.6	30.4	162.0	4,018.4
Grand Total	4,839.2	1,748.7	276.7	73.0	349.7	7,287.3

TABLE C.5.

JOHOR TENGAH

FOREST INVENTORY - ALL HILL BLOCKS

Stand Table per 100 acres of trees of 2 feet girth and over

(Area of sub-sample = 67 acres. Sample percent 0.1)

Species Groups	Grouped girth classes in feet					
	2 - <4	4 - <7	7 - <10	10 and overr	Total 7 and over	Total 2 and over
1. Heavy Hardwoods	502.5	244.8	37.3	14.5	51.8	799.1
2. Kempas	29.6	25.8	7.8	-	7.8	63.2
3. Keruing	37.0	40.7	29.4	9.3	38.7	116.4
4. Kapur and Keladan	88.8	81.3	36.8	26.0	62.8	232.9
5. Other Medium Hardwoods	2,173.9	607.3	21.2	1.3	22.5	2,803.7
Total Medium Hardwoods	2,329.3	755.1	95.2	36.6	131.8	3,216.2
6. Meranti Melantai	32.4	10.0	4.6	1.1	5.7	48.1
7. Meranti Rambai Daun	21.0	23.0	2.4	-	2.4	46.4
8. Meranti Sarang Punai	26.5	24.3	5.8	-	5.8	56.6
9. Meranti Tembaga	15.1	10.2	7.2	3.6	10.8	36.1
10. Seraya	13.1	22.1	23.5	11.8	35.3	70.5
11. Nemesu, Gerutu2 and Other Red Meranti	63.7	43.6	16.5	8.8	25.3	132.6
12. White Meranti	12.2	6.4	2.3	1.1	3.4	22.0
13. Mersawa	2.3	-	2.3	-	2.3	4.6
14. Yellow Meranti	55.7	46.7	6.5	2.3	8.8	111.2
15. Jelutong	9.8	5.4	1.1	-	1.1	16.3
16. Mengkulang	39.9	37.8	4.8	4.8	9.6	87.3
17. Other Light Hardwoods	2,491.2	586.9	69.7	1.1	70.8	3,148.9
Total Light Hardwoods	2,782.9	816.4	146.7	34.6	181.3	3,780.6
Podocarpus	2.2	1.1	-	-	-	3.3
Grand Total	5,616.9	1,817.4	279.2	85.7	364.9	7,799.2

TABLE C.6.

FOREST INVENTORY - JOHOR TENGAH

Volume of Timber per acre for trees of 4 feet girth
and over, after allowance for defect

Species Groups	Species	(a) Lowland Volume in cubic feet true		(b) Hill forest Volume in cubic feet true	
		MEAN	RME	MEAN	RME
1.	Heavy Hardwoods	280.3	250.7	224.0	197.3
2.	Kempas	97.6	85.8	39.6	33.2
3.	Keruing	127.1	103.2	102.1	87.8
4.	Kapur and Keladan	48.5	34.1	210.9	146.0
5.	Other Medium Hardwoods	342.1	324.6	267.3	248.2
	Total Medium Hardwoods	615.3	574.9	619.9	535.6
6.	Meranti Melantai	55.7	47.5	18.4	13.5
7.	Meranti Rambai Daun	21.3	16.0	19.2	14.2
8.	Meranti Sarang Punai	33.3	27.2	16.5	11.9
9.	Meranti Tembaga	58.8	47.9	47.4	38.1
10.	Seraya	21.2	12.7	116.4	97.6
11.	Nemesu, Gerutu Gerutu and other Red Meranti	172.7	133.0	85.3	68.7
12.	White Meranti	11.9	9.0	7.5	4.3
13.	Mersawa	12.4	8.8	7.2	2.9
14.	Yellow Meranti	29.8	23.3	50.5	41.4
15.	Jelutong	8.9	6.4	5.0	2.4
16.	Mengkulang	49.5	41.9	24.9	19.1
17.	Other Light Hardwoods	538.7	486.7	414.7	385.1
	Total Light Hardwoods	1,014.2	918.6	813.0	734.8
	Grand Total	1,909.8		1,656.9	

Note: Reliable Minimum Estimate (RME) at 95 percent lower confidence limits are not additive as the sampling error for combined groups is less than that for the separate components.

TABLE C.7.

TREE FORM CLASS DISTRIBUTION – JOHOR TENGAH LOWLAND BLOCKS

Number of trees by grouped girth classes. (Sub-sample area = 105 acres)

Species Groups	A 4-<7 ft.	A 7-<10 ft.	A 10 ft. and over	B 4-<7 ft.	B 7-<10 ft.	B 10 ft. and over	C 4-<7 ft.	C 7-<10 ft.	C 10 ft. and over	D 4-<7 ft.	D 7-<10 ft.	D 10 ft. and over
1. Heavy Hardwoods	62	21	8	88	27	7	24	4	1	10	–	1
2. Kempas	27	18	2	18	10	1	–	2	–	1	–	2
3. Keruing	29	9	13	19	8	2	2	–	–	–	2	2
4. Kapur and Keladan	4	8	1	2	4	–	1	1	–	–	–	–
5. Other Medium Hardwoods	116	9	–	313	23	–	119	3	–	66	1	–
Total Medium Hardwoods	176	44	16	352	45	3	122	6	–	67	3	–
6. Meranti Melantai	14	9	–	15	6	–	1	–	–	–	–	–
7. Meranti Rambai Daun	8	1	–	8	5	2	–	–	–	1	–	–
8. Meranti Sarang Punai	9	3	–	13	–	–	1	–	–	1	–	–
9. Meranti Tembaga	23	4	3	4	1	1	1	–	–	2	–	–
10. Seraya	–	2	2	–	–	–	–	–	–	–	–	–
11. Nemesu, Gerutu2 and Other Red Meranti	44	17	9	35	7	10	5	1	–	3	2	–
12. White Meranti	6	2	–	4	2	–	–	–	–	2	–	–
13. Mersawa	4	3	–	1	1	–	–	–	–	–	–	–
14. Yellow Meranti	5	3	–	6	–	–	–	–	–	2	–	–
15. Jelutong	4	1	1	2	–	1	–	–	–	–	–	–
16. Mengkulang	11	1	–	13	8	–	3	1	–	–	–	–
17. Other Light Hardwoods	180	16	3	352	34	–	121	9	–	60	3	–
Total Light Hardwoods	308	62	18	453	64	16	132	11	–	71	5	–
Podocarpus	–	–	–	–	–	–	–	–	–	–	–	–
Grand Total	546	127	42	893	136	26	278	21	1	148	8	–
Sub-totals	1770						462					
Percentage to total	79.3 percent						20.7 percent					

A: Suitable for peeler logs.
B: Suitable for sawlogs.

C: Unsuitable for sawlogs or peelers.
D: Defective.

TABLE C.8.

TREE FORM CLASS DISTRIBUTION – JOHOR TENGAH HILL BLOCKS
Number of trees by grouped girth classes. (Sub-sample area = 67 acres)

Species Groups	A 4–<7 ft.	A 7–<10 ft.	A 10 ft. and over	B 4–<7 ft.	B 7–<10 ft.	B 10 ft. and over	C 4–<7 ft.	C 7–<10 ft.	C 10 ft. and over	D 4–<7 ft.	D 7–<10 ft.	D 10 ft. and over
1. Heavy Hardwoods	88	18	5	58	7	3	8	1	–	3	1	–
2. Kempas	11	5	–	3	1	–	2	–	–	–	–	–
3. Keruing	20	14	6	5	3	1	2	–	–	–	2	–
4. Kapur and Keladan	38	20	11	13	3	3	–	1	–	2	2	3
5. Other Medium Hardwoods	131	8	–	170	5	–	45	–	–	37	1	–
Total Medium Hardwoods	200	47	17	191	12	5	49	2	–	39	5	3
6. Meranti Melantai	5	4	–	2	–	–	–	–	–	–	–	1
7. Meranti Rambai Daun	9	4	–	3	–	–	–	–	–	–	1	–
8. Meranti Sarang Punai	14	5	–	3	–	–	–	–	–	–	–	–
9. Meranti Tembaga	3	–	1	3	1	–	–	–	–	–	–	1
10. Seraya	10	10	5	6	2	–	2	–	–	–	–	–
11. Nemesu, Gerutu2 and Other Red Meranti	22	12	–	6	1	–	1	–	–	–	–	2
12. White Meranti	1	2	–	3	–	–	–	–	–	–	–	–
13. Mersawa	–	–	–	–	–	–	–	–	–	–	–	–
14. Yellow Meranti	17	2	2	6	2	–	–	–	–	–	–	–
15. Jelutong	–	–	–	2	–	–	–	–	–	–	–	–
16. Mengkulang	15	3	–	7	1	–	3	–	–	2	1	–
17. Other Light Hardwoods	182	22	1	164	25	–	28	1	–	19	–	–
Total Light Hardwoods	279	69	14	205	32	7	34	1	–	21	2	4
Podocarpus	–	–	–	1	–	–	–	–	–	–	–	–
Grand Total	567	134	36	455	51	15	91	4	–	63	8	7

Sub-totals: 1258 (A, B) | 174 (C, D)

Percentage to total: 87.8 percent | 12.2 percent

A: Suitable for peeler logs
B: Suitable for sawlogs.
C: Unsuitable for sawlogs or peelers.
D: Defective.

that this and the map provide useful information on the basis of the inventory as carried out. A productivity map on a scale which would be a realistic basis for detailed operational control, as opposed to management planning, can only be produced from a far more detailed survey than the specification as laid down in the scope of work.

The major forest types within the inventoried area are shown on the same map and agree broadly with those in the forest type maps of Kota Tinggi and Kluang districts produced by the Forestry Department, (Forest Resources Reconnaissance Survey Report No. 8 for Kota Tinggi District and in a report, as yet unpublished, for Kluang District).

A copy of the productivity map as compiled from these two reconnaissance surveys has been re-produced on a scale of 1:63,360 and is included in the map folder.

2   TANJONG PENGGERANG REGION

2.1   Forest Description

The forest comprises four distinct types, viz. the mangrove swamps which are confined to the tidal limits of the streams of the Johor river basin in the west and south west, fresh water alluvial and peat swamps in the east and north east, logged primary forest of the lowland Dipterocarp type and secondary forest.

The bulk of the mangrove forests are constituted forest reserves. The stands are made up principally of bakau (Rhizophora spp.) with heights varying between 20 and 50 feet. These forests are currently under exploitation for production of poles and fuel.

The fresh water alluvial and peat swamp forests have been partially logged in the past, and contain a mixture of dominant emergent red meranti (including meranti bakau) and kempas. Other common species are nyatoh, bintangor, kedondong, pelawan, kelat, rengas and penarahan. Some of these swamps are inundated for most of the year whilst in others inundation only occurs during the north east monsoon.

In the logged primary forest little timber of commercial importance remains and this is currently being extracted.

The secondary forest contains a high proportion (40-90 percent) of tiup-tiup (Adinandra dumosa). The stand height varies between 15 and 90 feet with some stems up to 100 feet in the older regrowth. In the younger stands resam fern (Gleichenia linearis) is the typical ground cover. The greatest concentration of this type is in the central and south central area, where it occurs in an irregular pattern of areas separated from each other by strips of older disturbed forest.

2.2   Scope of Sampling

After consultations with the Forest Department it was agreed that in view of the very disturbed nature of the forests in this region, no inventory was necessary. However, it was suggested that some of the alluvial swamp forest might be sampled. Subsequent to this it was decided that a part of the disturbed dry land forest should also be sampled in order to obtain some information on the residual stand.

In pursuance of these objectives enumeration was carried out along eight strips totalling 18 miles of soil survey rentises in the north, central and south central areas. These gave a sample area of 46 acres for logged primary (disturbed) forest, 75 acres for secondary (tiup-tiup) forest and 24 acres for fresh water peat swamp.

Sampling procedure and species groups were similar to that used in the Johor Tengah inventory except that trees down to 2 feet in girth were measured in the main sample and down to 1 foot in girth in the sub-sample.

2.3   Stand Tables

Table C.9. gives the mean stand and basal area per acre for stems down to two feet in girth for disturbed (logged primary) forest, whilst tables C.10 and C.11 give the same information for tiup-tiup (secondary) forests and for peat swamp forest.

In the disturbed forest the total stand at 63 trees per acre is almost identical with that in the peat swamp at 67 trees per acre, as compared with an average of 75 trees per acre in the Johor Tengah sub-samples for lowland and hill blocks.

In the secondary forest the stand is much lower at 39 trees per acre.

Stand tables and basal area for trees down to one foot in girth over the smaller sub-sample area are given in more detail by species in Tables C. 19, 20 and 21.

2.4   Volume Estimates

Estimates of volume are given in Table C.12. This gives the estimated gross volume of the 17 species groups for disturbed, peat swamp and secondary forest for trees of two feet girth and over. In the case of stems in girth class 2-3 feet nominal volume of 10 cubic feet per tree has been used for each species group as in the case of Johor Tengah.

For disturbed and peat swamp forest the volume for trees of two feet girth and over is about 42 cubic tons per acre.

In the case of secondary forest the total volume is approximately 16 cubic tons per acre. However, from observations made in the field it is estimated that about 40 percent of this type of forest contains very young stands of tiup-tiup with few trees over two feet in girth. The strips selected for sampling were located, for the most part, in the older regrowth. Therefore it would be more realistic to apply an overall volume of around 10 tons per acre for trees of two feet girth and over, for this type of forest.

In the calculation of volumes for the three types of forest, it was considered appropriate to use the same single entry volume tables as those used for the Johor Tengah inventory.

2.5   Volume Tables for Tiup-Tiup

In September 1970 a team from the Mensuration Branch of the Forest Research Institute, assisted by project staff, carried out measurements in eight small plots, each of one square chain, in two different areas of tiup-tiup forest in Tanjong Penggerang. In two of these plots the trees were felled and measured. A dual entry volume table was subsequently prepared to give under bark volume of all utilisable stemwood and branchwood exclusive of stump, down to three inches diameter overbark. The measured overbark yield of stacked timber down to this size from the two felled plots with a percentage stocking of tiup-tiup of 42 and 93 percent was 500 and 550 cubic feet stacked per square chain, respectively. The mean diameter of tiup-tiup in the first plot was 9.3 inches and for the second 6.8 inches. Because of the wide variation in size classes over the whole area and because of the small size of the sample not much reliance should be placed on these yield figures.

TABLE C.9.

TANJONG PENGGERANG

Stand Table for Disturbed forest other than
tiup–tiup and peat swamp forests

(Area of sample 46.2 acres)

| Species Groups | Girth over bark in feet | | | | | | Total |
	2 to <3	3 to <4	4 to <5	5 to <6	6 to <7	7 and over	
1. Heavy Hardwoods	67	40	27	7	3	–	144
2. Kempas	12	8	1	1	4	1	27
3. Keruing	9	6	1	1	1	1	19
4. Kapur and Keladan	–	–	–	–	–	–	–
5. Other Medium Hardwoods	515	298	129	61	25	16	1,044
Total Medium Hardwoods	536	312	131	63	30	18	1,090
6. Meranti Melantai	18	16	3	2	1	2	42
7. Meranti Rambai Daun	2	2	1	–	–	1	6
8. Meranti Sarang Punai	10	7	3	5	4	3	32
9. Meranti Tembaga	4	7	7	4	4	–	26
10. Seraya	–	–	–	–	–	–	–
11. Nemesu, Gerutu2 and Other Red Meranti	19	17	12	9	5	5	67
12. White Meranti	–	1	1	–	1	–	3
13. Mersawa	1	–	1	1	1	–	4
14. Yellow Meranti	1	6	2	–	–	–	9
15. Jelutong	6	1	1	–	–	1	9
16. Mengkulang	11	8	8	1	3	2	33
17. Other Light Hardwoods	682	431	182	94	39	14	1,442
Total Light Hardwoods	754	496	221	116	58	28	1,673
Total Stems	1,357	848	379	186	91	46	2,907
Total basal area in square feet	678.5	822.6	610.2	448.3	305.8	246.3	3,111.7
Stems per acre	29.4	18.4	8.2	4.0	2.0	1.0	62.9
Basal area per acre	14.7	17.8	13.2	9.7	6.6	5.3	67.3

TABLE C.10.

TANJONG PENGGERANG

Stand Table for tiup-tiup (Adinandra dumosa) forest

(Area of sample 75.1 acres)

Species Groups	Girth over bark in feet						Total
	2 - <3	3 - <4	4 - <5	5 - <6	6 - <7	7 and over	
1. Heavy Hardwoods	191	31	5	3	–	–	230
2. Kempas	8	1	2	2	–	–	13
3. Keruing	3	1	1	–	–	–	5
4. Kapur and Keladan	–	–	–	–	–	–	–
5. Other Medium Hardwoods	199	102	37	12	4	1	355
Total Medium Hardwoods	210	104	40	14	4	1	373
6. Meranti Melantai	8	3	5	2	–	–	18
7. Meranti Rambai Daun	–	–	–	–	–	–	–
8. Meranti Sarang Punai	2	3	1	1	2	1	10
9. Meranti Tembaga	7	–	1	1	–	–	9
10. Seraya	–	–	–	–	–	–	–
11. Nemesu, Gerutu2 and Other Red Meranti	9	4	4	–	–	–	17
12. White Meranti	–	–	–	–	–	–	–
13. Mersawa	–	–	–	–	1	1	2
14. Yellow Meranti	–	–	1	–	–	–	1
15. Jelutong	6	1	–	–	–	–	7
16. Mengkulang	2	2	1	2	–	–	7
17. Other Light Hardwoods	1,575	478	130	49	12	10	2,254
Total Light Hardwoods	1,609	491	143	55	15	12	2,325
Total stems	2,010	626	188	72	19	13	2,928
Total basal area in square feet	1,005.0	607.2	302.7	173.5	63.8	65.1	2,217.3
Stems per acre	26.8	8.3	2.5	1.0	0.3	0.2	39.0
Basal area per acre	13.4	8.1	4.0	2.3	0.8	0.9	29.5

TABLE C.11.

TANJONG PENGGERANG

Stand Table for Peat swamp forest (partially disturbed)

(Area of sample 23.7 acres)

Species Groups	Girth over bark in feet						Total
	$\frac{2}{<3}$	$\frac{3}{<4}$	$\frac{4}{<5}$	$\frac{5}{<6}$	$\frac{6}{<7}$	7 and over	
1. Heavy Hardwoods	39	21	11	3	1	-	75
2. Kempas	7	14	3	12	13	4	53
3. Keruing	-	-	-	-	-	-	-
4. Kapur and Keladan	-	-	-	-	-	-	-
5. Other Medium Hardwoods	178	107	36	13	1	1	336
Total Medium Hardwoods	185	121	39	25	14	5	389
6. Meranti Melantai	-	-	-	-	-	-	-
7. Meranti Rambai Daun	-	-	-	-	-	-	-
8. Meranti Sarang Punai	1	-	1	-	1	-	3
9. Meranti Tembaga	1	-	2	-	-	-	3
10. Seraya	-	-	-	-	-	-	-
11. Nemesu, Gerutu2 and Other Red Meranti	2	2	-	2	-	2	8
12. White Meranti	-	-	-	-	-	-	-
13. Mersawa	1	-	-	-	-	-	1
14. Yellow Meranti	-	-	-	-	-	-	-
15. Jelutong	-	1	-	-	-	-	1
16. Mengkulang	2	-	-	1	-	1	4
17. Other Light Hardwoods	560	332	133	44	20	8	1,097
Total Light Hardwoods	567	335	136	47	21	11	1,117
Total stems	791	477	186	75	36	16	1,581
Total basal area in square feet	395.5	462.7	299.5	180.8	121.0	81.0	1,540.5
Stems per acre	33.4	20.1	7.8	3.2	1.5	0.7	66.7
Basal area per acre	16.7	19.5	12.6	7.6	5.1	3.4	64.9

TABLE C.12.

TANJONG PENGGERANG

Gross volume of timber per acre in cubic feet true for trees of 2 feet girth and over
by grouped girth classes,,with no deduction for defect

Species Groups	Disturbed forest			Peat Swamp			Secondary forest		
	2' – <4'	4' and over	Total	2' – <4'	4' and over	Total	2' – <4'	4' and over	Total
1. Heavy Hardwoods	44.8	63.3	108.1	47.5	49.5	97.0	39.9	8.4	48.3
2. Kempas	9.7	24.0	33.7	27.2	212.7	239.9	1.6	5.7	7.3
3. Keruing	6.5	12.7	19.2	–	–	–	0.9	1.1	2.0
4. Kapur and Keladan	–	–	–	–	–	–	–	–	–
5. Other Medium Hardwoods	279.2	222.0	501.2	192.5	80.1	272.6	61.8	27.4	89.2
Total Medium Hardwoods	295.4	258.7	554.1	219.7	292.8	512.5	64.3	34.2	98.5
6. Meranti Melantai	25.7	25.4	51.1	–	–	–	3.6	8.6	12.2
7. Meranti Rambai Daun	1.3	9.3	10.6	–	–	–	–	–	–
8. Meranti Sarang Punai	9.6	50.1	59.7	0.4	10.5	10.9	2.2	10.1	12.3
9. Meranti Tembaga	9.5	40.4	49.9	0.4	7.5	7.9	0.9	2.9	3.8
10. Seraya	–	–	–	–	–	–	–	–	–
11. Nemesu, Gerutu2 and Other Red Meranti	21.4	130.2	151.6	4.8	47.5	52.3	3.7	7.1	10.8
12. White Meranti	0.4	5.3	5.7	–	–	–	–	–	–
13. Mersawa	0.2	9.2	9.4	0.4	–	0.4	–	5.6	5.6
14. Yellow Meranti	5.3	3.4	8.7	–	–	–	–	1.1	1.1
15. Jelutong	1.9	6.5	8.4	1.1	–	1.1	1.1	–	1.1
16. Mengkulang	7.6	34.2	41.8	0.8	13.8	14.6	1.1	3.9	5.0
17. Other Light Hardwoods	390.2	692.4	1,082.6	600.5	778.8	1,379.3	375.2	243.7	618.9
Total Light Hardwoods	473.1	1,006.4	1,479.5	608.4	858.1	1,466.5	387.8	283.0	670.8
Grand Total	813.3	1,328.4	2,141.7	875.6	1200.4	2,076.0	492.0	325.6	817.6

TABLE C.13.

FOREST INVENTORY - SPECIES GROUPS

Group No.	Code No.	Vernacular Name	Botanical Name	Group No.	Code No.	Vernacular Name	Botanical Name
		Heavy Hardwoods				**Light Hardwoods**	
1.	1	Balau	Shorea spp.	6.	50	Meranti Melantai	Shorea macroptera
	2	Chengal	Balanocarpus heimii	7.	51	Meranti Rambai Daun	Shorea acuminata
	5	Keranji	Dialium spp.	8.	52	Meranti Sarang Punai	Shorea parvifolia
	6	Membatu	Shorea Guiso	9.	53	Meranti Tembaga	Shorea leprosula
	7	Merbau	Intsia palembanica	10.	54	Seraya	Shorea curtisii
	8	Resak	Vatica spp.	11.	55	Other Red Meranti	Shorea spp.
	9	Bitis	Madhuca utilis		56	Gerutu Gerutu	Parashorea lucida
	11	Kayu Arang	Diospyros spp.		57	Nemesu	Shorea pauciflora
	12	Mertas	Ctenolophon parvifolius	12.	58	White Meranti	Shorea spp.
				13.	59	Mersawa	Anisoptera spp.
		Medium Hardwoods		14.	60	Yellow Meranti	Shorea spp.
				15.	61	Jelutong	Dyera costulata
2.	21	Kempas	Koompassia malaccensis	16.	62	Mengkulang	Heritiera spp.
3.	22	Keruing	Dipterocarpus spp.	17.	63	Other Merawan	Hopea spp.
4.	23	Kapur	Dryobalanops aromatica		64	Ara Berteh	Parartocarpus spp.
	24	Keladan	Dryobalanops oblongifolia		65	Bintangor	Calophylum spp.
5.	25	Bangkong	Artocarpus spp.		66	Durian	Durio spp.
	26	Bekak	Amoora spp.		67	Geronggang	Cratoxylon arborescens
	27	Kasai	Pometia spp.		68	Kedondong	Canarium, Dacryodes and Santiria spp.
	28	Keledang	Artocarpus lanceifolius				
	29	Merbatu	Parinari spp.		69	Kembang Semangkok	Scaphium spp.
	30	Merawan Batu)	Hopea spp.		70	Kungkur	Pithecellobium splendens
	31	Merawan Siput Jantan)			71	Machang	Mangifera spp.
	32	Kelat	Eugenia spp.		72	Mata Ulat	Lophopetalum spp.
	33	Samak Pulut	Gordonia concentricicatrix		73	Medang	LAURACEAE
	34	Simpoh	Dillenia spp.		74	Melunak	Pentace spp.
	35	Tualang	Koompassia excelsa		75	Merpauh	Swintonia spp.
	37	Rengas	Gluta and Melanorrhoea spp.		76	Nyatoh	SAPOTACEAE
	38	Minyak Berok	Xanthophyllum spp.		77	Pelong	Pentaspadon spp.
	40	Kulim	Scorodocarpus borneensis		78	Pulai	Alstonia spp.
	41	Perah	Elateriospermum tapos		79	Ramin	Gonystylus spp.
	42	Berangan	Castanopsis spp.		80	Sepetir	Sindora spp.
	43	Mempening	Lithocarpus and Qercus spp.		81	Terentang	Campnosperma spp.
	44	Petaling	Ochanostachys amentacea		83	Penarahan	MYRISTICACEAE
	45	Temponek	Artocarpus rigidus		84	Mempisang	ANNONACEAE
					85	Sesendok	Endospermum malaccense
					86	Membuloh	Pellacalyx spp.
					87	Terap	Artocarpus spp.

Note: Code numbers 11-12 in the Heavy Hardwood group, 40-45 in the Medium Hardwood group and 83-87 in the Light Hardwood group were only used in the 10th chain sub-sample in the 16 hill blocks.

TABLE C.14.

JOHOR TENGAH

FOREST INVENTORY — ALL LOWLAND BLOCKS

Number of trees of 4 feet girth and over, basal area and net volume
per 100 acres after deduction for defect, at 95 percent lower confidence limits

Species Groups	No. of trees			Basal area/Square feet			Net volume/cubic feet		
	Mean	LCL 95 percent	Error percent	Mean	LCL 95 percent	Error percent	Mean	LCL 95 percent	Error percent
1. Heavy Hardwoods	223.9	203.3	9.2	816.3	730.2	10.5	28034.2	25066.1	10.6
2. Kempas	77.1	69.2	10.3	298.7	262.4	12.1	9755.8	8584.7	12.0
3. Keruing	73.7	61.8	16.1	328.9	266.8	18.9	12708.1	10321.6	18.8
4. Kapur and Keladan	27.1	20.4	24.7	130.9	92.2	29.6	4854.8	3410.8	29.7
5. Other Medium Hardwoods	526.0	497.1	5.5	1201.7	1140.0	5.1	34213.3	32459.5	5.1
Total Medium Hardwoods	703.9	669.5	4.9	1960.2	1842.8	6.0	61532.0	57485.3	6.6
6. Meranti Melantai	52.3	45.0	14.0	188.2	160.2	14.9	5567.1	4748.2	14.7
7. Meranti Rambai Daun	16.5	12.6	24.0	59.9	44.6	25.5	2134.9	1600.8	25.0
8. Meranti Sarang Punai	30.8	26.0	15.4	90.6	74.2	18.2	3326.2	2721.2	18.2
9. Meranti Tembaga	38.6	32.0	17.1	132.5	108.0	18.5	5875.6	4788.3	18.5
10. Seraya	6.6	4.2	36.5	50.0	30.0	40.0	2121.3	1268.3	40.2
11. Nemesu, Gerutu2 and Other Red Meranti	111.9	94.7	15.3	487.0	373.9	23.2	17274.7	13300.9	23.0
12. White Meranti	14.7	11.3	23.5	51.0	38.6	24.3	1187.9	897.6	24.4
13. Mersawa	8.3	6.2	24.7	42.8	30.2	29.5	1242.9	881.8	29.1
14. Yellow Meranti	20.2	16.8	17.0	92.7	72.0	22.3	2977.2	2332.2	21.7
15. Jelutong	5.8	4.1	28.5	28.6	20.3	28.9	892.7	636.3	28.7
16. Mengkulang	39.4	34.4	12.8	136.7	116.3	14.9	4953.9	4193.5	15.4
17. Other Light Hardwoods	683.4	634.4	7.2	1623.5	1469.7	9.5	53868.5	48673.0	9.6
Total Light Hardwoods	1028.5	962.8	6.4	2983.5	2706.5	9.3	101422.9	91856.1	9.4
Grand Total	1956.3			5760.0			190989.1		

Note: 1. Reliable Minimum Estimates (LCL 95 percent) are not additive as the sampling error for combined groups is less than that for the separate components.

2. Total area of 27 lowland blocks = 81,634 acres
   Total area of samples = 1,050 acres
   Sample percent = 1.3

TABLE C.15.

JOHOR TENGAH

FOREST INVENTORY — ALL HILL BLOCKS

Number of trees of 4 feet girth and over, basal area and net volume
per 100 acres after deduction for defect, at 95 percent lower confidence limits

Species Groups	No. of trees			Basal area/Square feet			Net volume/cubic feet		
	Mean	LCL 95 per-cent	Error percent	Mean	LCL 95 per-cent	Error percent	Mean	LCL 95 per-cent	Error percent
1. Heavy Hardwoods	250.5	231.7	7.5	760.2	674.0	11.3	22391.5	19739.0	11.8
2. Kempas	46.7	38.0	18.6	149.4	125.1	16.3	3964.8	3323.5	16.2
3. Keruing	75.9	67.9	10.5	309.9	266.7	13.9	10209.7	8778.1	14.0
4. Kapur and Keladan	140.6	98.2	30.1	634.0	440.4	30.5	21093.6	14603.4	30.8
5. Other Medium Hardwoods	547.9	512.9	6.4	1178.6	1096.4	7.0	26737.4	24822.4	7.2
Total Medium Hardwoods	811.1	754.9	6.9	2271.9	2054.6	9.6	62005.5	55556.9	10.4
6. Meranti Melantai	21.6	17.0	21.2	73.1	54.1	26.0	1833.5	1345.4	26.6
7. Meranti Rambai Daun	19.8	15.0	24.1	61.4	45.1	26.5	1926.4	1419.3	26.3
8. Meranti Sarang Punai	19.2	14.2	26.4	52.8	38.4	27.3	1643.6	1191.1	27.5
9. Meranti Tembaga	28.5	24.0	15.6	119.9	96.9	19.2	4736.6	3805.3	19.7
10. Seraya	61.0	50.7	16.9	317.3	266.2	16.1	11643.4	9757.2	16.2
11. Nemesu, Gerutu2 and Other Red Meranti	64.2	55.6	13.5	275.6	222.1	19.4	8534.4	6864.8	19.6
12. White Meranti	10.5	6.8	35.1	37.0	22.2	40.0	747.6	431.5	42.3
13. Mersawa	5.4	2.5	53.5	27.6	10.9	60.6	720.8	287.4	60.1
14. Yellow Meranti	47.1	36.5	22.5	177.3	145.2	18.1	5055.9	4142.2	18.1
15. Jelutong	4.9	2.8	43.2	18.3	9.3	49.5	492.7	241.6	51.0
16. Mengkulang	28.1	22.9	18.4	83.4	65.3	21.7	2488.1	1905.3	23.4
17. Other Light Hardwoods	651.3	607.4	6.7	1536.6	1427.4	7.1	41469.7	38511.3	7.1
Total Light Hardwoods	961.6	919.3	4.4	2780.3	2680.2	3.6	81292.7	78366.2	3.6
Grand Total	2023.2			5812.4			165689.7		

Note: 1. Reliable Minimum Estimates (LCL 95 percent) are not additive as the sampling
error for combined groups is less than that for the separate components.

2. Total area of 16 hill blocks   =   67,639 acres
Total area of samples   =   666 acres
Sample percent   =   1.0

TABLE C.16

JOHOR TENGAH

FOREST INVENTORY — ALL LOWLAND BLOCKS

Number of trees of 2 feet to < 4 feet in girth, basal area and net volume
per 100 acres after deduction for defect, at 95 percent lower confidence limits

Species Groups	No. of trees			Basal area/Square feet			Net volume/cubic feet		
	Mean	LCL 95 per-cent	Error percent	Mean	LCL 95 per-cent	Error percent	Mean	LCL 95 per-cent	Error perce
1. Heavy Hardwoods	208.6	165.3	20.7	155.6	124.1	20.2	4797.9	3819.5	20.
2. Kempas	30.3	20.3	33.1	20.8	13.3	36.2	675.9	391.1	42.
3. Keruing	46.5	28.3	39.1	31.5	17.9	43.3	904.9	470.7	48.
4. Kapur and Keladan	17.0	10.3	39.4	12.8	7.8	39.2	406.2	240.5	40.
5. Other Medium Hardwoods	1751.0	1581.1	9.7	1193.2	1081.0	9.4	28305.8	25656.2	9.
Total Medium Hardwoods	1844.8	1674.2	9.2	1258.3	1144.1	9.1	30292.8	27521.0	9.
6. Meranti Melantai	30.2	17.0	43.6	20.2	11.4	43.6	879.0	450.0	48.
7. Meranti Rambai Daun	10.6	2.5	76.7	7.3	0.8	88.5	147.8	16.4	88.
8. Meranti Sarang Punai	30.9	16.9	45.5	21.3	12.3	42.1	791.3	467.1	41.
9. Meranti Tembaga	18.0	9.7	46.3	14.1	6.6	52.7	682.7	267.0	60.
10. Seraya	1.9	-0.8	139.9	0.9	-0.4	139.9	18.9	-7.5	139.
11. Nemesu, Gerutu2 and Other Red Meranti	96.0	73.9	23.0	62.7	47.5	24.3	2119.5	1506.9	28.
12. White Meranti	6.6	2.5	62.3	4.6	1.4	70.1	89.9	27.3	69.
13. Mersawa	2.4	-0.9	137.8	1.8	-0.9	148.2	100.5	-75.9	175.
14. Yellow Meranti	13.1	6.1	53.3	9.7	4.0	59.2	323.5	108.5	66.
15. Jelutong	3.2	0.4	86.9	2.3	0.7	71.1	54.8	18.1	67.
16. Mengkulang	45.4	34.8	23.5	30.2	23.9	20.8	770.4	597.8	22.
17. Other Light Hardwoods	2527.6	2281.1	9.8	1719.2	1561.2	9.2	40752.6	37075.7	9.
Total Light Hardwoods	2785.9	2524.0	9.4	1894.3	1730.0	8.7	46730.9	42912.3	8.
Grand Total	4839.3	4525.8	6.5	3308.2	3108.8	6.0	81821.6	77029.9	5.

Note: 1. Reliable Minimum Estimates (LCL 95 percent) are not additive as the sampling
error for combined groups is less than that for the separate components.

2. Total area of 27 lowland blocks   =   81,634 acres
   Total area of sub-samples   =   105 acres
   Sample percent   =   0.1

3. Volumes are nominal volumes.

TABLE C.17
JOHOR TENGAH

FOREST INVENTORY - ALL HILL BLOCKS

Number of trees of 2 feet to 4 feet girth, basal area and net volume
per 100 acres after deduction for defect, at 95 percent lower confidence limits

Species Groups	No. of trees			Basal area/square feet			Net volume/cubic feet		
	Mean	LCL 95 percent	Error percent	Mean	LCL 95 percent	Error percent	Mean	LCL 95 percent	Error percent
1. Heavy Hardwoods	502.5	424.1	15.6	342.7	302.5	11.7	9878.0	8614.2	12.8
2. Kempas	29.6	14.0	52.6	21.7	9.5	56.1	749.5	289.7	61.3
3. Keruing	37.0	19.6	47.0	26.9	15.0	44.1	813.9	447.2	45.0
4. Kapur and Keladan	88.8	56.6	36.3	58.7	38.9	33.8	1679.4	1114.2	33.7
5. Other Medium Hardwoods	2173.9	2041.8	6.1	1452.8	1372.3	5.5	34181.8	32068.1	6.2
Total Medium Hardwoods	2329.3	2184.1	6.2	1560.1	1466.7	6.0	37424.6	34892.9	6.8
6. Meranti Melantai	32.3	13.5	58.3	20.5	9.3	54.4	808.4	341.0	57.8
7. Meranti Rambai Daun	21.1	10.8	48.8	16.8	8.3	50.6	343.2	169.1	50.7
8. Meranti Sarang Punai	26.5	6.0	77.3	18.6	3.3	82.1	711.5	59.5	91.6
9. Meranti Tembaga	15.0	2.1	86.1	10.6	0.8	92.9	455.2	- 21.4	104.7
10. Seraya	13.1	2.0	84.4	9.5	1.7	82.4	267.2	45.5	83.0
11. Nemesu, Gerutu2 and Other Red Meranti	63.7	33.5	47.3	41.6	22.2	46.7	1407.2	717.6	49.0
12. White Meranti	12.3	6.4	47.9	7.9	4.4	44.4	156.2	86.8	44.4
13. Mersawa	2.4	- 0.8	132.0	1.2	- 0.4	132.0	23.5	- 7.5	132.0
14. Yellow Meranti	55.7	21.8	60.9	38.4	13.6	64.6	1205.8	373.2	69.1
15. Jelutong	9.8	- 3.0	130.2	6.3	- 2.7	142.5	146.7	- 71.1	148.4
16. Mengkulang	39.9	21.4	46.3	28.0	14.6	48.0	741.3	354.0	52.2
17. Other Light Hardwoods	2491.2	2352.5	5.6	1653.1	1532.4	7.3	38780.8	35575.4	8.3
Total Light Hardwoods	2783.0	2635.8	5.3	1852.5	1730.2	6.6	45047.0	41760.3	7.3
Podocarpus	2.3	1.8	21.2	1.7	0.9	45.3	34.4	18.2	47.1
Grand Total	5617.1	5453.3	2.9	3757.0	3643.8	3.0	92384.0	88549.6	4.2

Note: 1. Reliable Minimum Estimates (LCL 95 percent) are not additive as the
sampling error for combined groups is less than that for the separate
components.

2. Total area for 16 hill blocks = 67,639 acres
Total area of sub-samples = 67 acres
Sample percent = 0.1

3. Volumes are nominal volumes.

TABLE C.18

PERCENTAGE SPECIES PROPORTIONS WITHIN GROUPS - LOWLAND AND HILL BLOCKS
BY GROUPED GIRTH CLASSES

Species Group	Species	Lowland blocks (main sample 1050 acres) Percentage to totals				Hill blocks (main sample 666 acres) Percentage to totals			
		4 feet to <7 feet	7 feet to <10 feet	10 feet and over	Total	4 feet to <7 feet	7 feet to <10 feet	10 feet and over	Total
	HEAVY HARDWOODS								
1.	Balau	22	42	42	28	11	22	18	13
	Chengal	7	23	48	14	4	24	70	10
	Keranji	20	6	–	16	12	3	–	10
	Membatu	3	5	2	3	1	2	–	1
	Merbau	1	3	1	2	1	2	–	1
	Resak	20	4	–	15	44	28	6	40
	Other Heavy Hardwoods	27	17	7	22	27	19	5	25
		100	100	100	100	100	100	100	100
	MEDIUM HARDWOODS								
4.	Kapur	46	62	90	58	94	95	97	95
	Keladan	54	38	10	42	6	5	3	5
		100	100	100	100	100	100	100	100
5.	Kasai	1	1	–	1	1	–	–	1
	Keledang	1	2	6	1	1	8	11	1
	Merbatu	1	3	6	1	1	1	–	1
	Merawan Batu	1	4	–	1	1	2	–	1
	Kelat	25	24	17	25	29	24	11	29
	Samak Pulut	1	3	–	1	1	3	–	1
	Simpoh	4	3	–	4	2	5	–	2
	Rengas	6	11	17	6	14	14	11	14
	Minyak Berok	4	5	–	4	3	1	–	3
	Other Medium Hardwoods	56	44	37	56	47	41	67	47
		100	100	100	100	100	100	100	100
	LIGHT HARDWOODS								
11.	Nemesu	21	50	65	34	24	57	60	39
	Gerutu Gerutu	6	4	1	5	14	8	2	11
	Other Red Meranti	73	46	34	61	62	35	38	50
		100	100	100	100	100	100	100	100
17.	Other Merawan	5	4	7	5	6	4	10	6
	Ara Berteh	–	1	–	–	–	–	–	–
	Bintangor	6	8	19	6	12	9	5	11
	Durian	3	14	13	4	2	9	5	2
	Geronggang	1	2	4	1	–	–	–	–
	Kedondong	21	15	9	21	17	10	5	16
	Kembang Semangkok	7	9	–	7	6	8	5	6
	Machang	1	3	6	1	3	3	–	1
	Mata Ulat	2	3	2	2	1	1	5	2
	Medang	8	5	2	8	3	4	5	6
	Melunak	1	1	6	1	1	2	–	1
	Merpauh	–	–	–	1	10	15	–	10
	Nyatoh	10	15	4	10	13	11	5	12
	Pelong	–	1	–	–	–	–	–	–
	Ramin	–	–	2	–	1	–	–	1
	Sepetir	1	5	17	2	1	5	35	1
	Terentang	1	1	–	1	1	–	–	–
	Other Light Hardwoods	32	13	9	30	21	18	20	25
		100	100	100	100	100	100	100	100

TABLE C.19

TANJONG PENGGERANG

Sub-Sample Stand Table for Disturbed Forest

(Area of sub-samples = 3.9 acres)

Species	Girth over bark in feet								Total
	1 -<2	2 -<3	3 -<4	4 -<5	5 -<6	6 -<7	7 -<8	8 -<9	
HEAVY HARDWOODS									
Keranji	1	-	-	1	-	-	-		2
Kayu Arang	3	2	-	1	1	-	-	-	7
Membatu	1	2	-	-	-	-	-		3
Mempoyan	3	1	1	1	-	-	-		6
Resak	3	2	-	-	-	-	-		5
Total Hardwoods	11	7	1	3	1	-	-		23
Basal Area/square feet	2.0	3.5	1.0	4.8	2.4	-	-		13.7
MEDIUM HARDWOODS									
Chempedak Ayer	1	5	2	2	-	-	1	-	11
Berangan	-	-	-	-	3	-	-		3
Kandis	2	-	2	-	1	-	-		5
Kasai	-	-	1	-	-	-	-		1
Kempas	1	-	-	-	-	-	-		1
Keruing	2	-	1	-	-	-	-		3
Kelat	27	28	14	6	1	-	1	1	78
Kulim	-	1	1	-	-	-	-		2
Minyak Berok	2	1	-	1	1	-	-		5
Mempening	2	1	3	2	1	-	1	-	10
Otak Udang	3	1	1	-	-	-	-		5
Perah	-	1	-	1	1	-	-		3
Petaling	-	2	2	1	-	-	-		5
Rengas	2	6	3	-	-	-	-		11
Simpoh	7	1	2	1	-	-	-		11
Tampoi	3	3	1	-	-	-	-		7
Other Medium Hardwoods	23	15	6	-	1	1	-		46
Total Medium Hardwoods	75	65	39	14	9	1	3	1	207
Basal Area/square feet	13.4	32.3	38.0	22.6	21.6	3.4	13.4	5.7	150.4

Species	Girth over bark in feet								Total
	1 <2	2 <3	3 <4	4 <5	5 <6	6 <7	7 <8	8 <9	

LIGHT HARDWOODS

Species	1 <2	2 <3	3 <4	4 <5	5 <6	6 <7	7 <8	8 <9	Total
Ara Berteh	1	1	-	-	-	-	-	-	2
Bengang	-	1	-	-	-	1	-	-	2
Bintangor	17	7	2	-	1	-	-	-	27
Durian	3	-	1	-	-	-	-	-	4
Geronggang	1	-	1	-	-	-	-	-	2
Jelutong	1	-	-	-	-	-	-	-	1
Kembang Semangkok	2	2	1	-	-	-	-	-	5
Kedondong	18	9	4	4	1	-	-	-	36
Keredas	1	-	-	-	-	-	-	-	1
Mata Ulat	1	1	2	-	-	-	-	-	4
Medang	5	4	4	-	1	1	-	-	15
Mengkulang	2	1	-	2	-	-	-	-	5
Meranti Melantai	2	2	2	2	-	-	-	-	8
Meranti Sarang Punai	3	2	-	-	1	1	-	-	7
Meranti Tembaga	-	-	2	1	-	-	-	-	3
Nemesu and Other Red Meranti	2	4	4	-	-	-	-	-	10
Yellow Meranti	1	-	-	1	-	-	-	-	2
Melunak	-	-	1	-	-	-	-	-	1
Mempat	1	-	2	-	-	-	-	-	3
Macaranga spp.	4	2	-	-	-	-	-	-	6
Membuloh	7	8	-	1	-	-	-	-	16
Mempisang	8	3	6	2	-	-	-	-	19
Mendong	1	-	-	-	-	-	-	-	1
Merawan	1	2	1	-	1	-	-	-	5
Nyatoh	10	3	11	1	3	1	2	-	31
Putat	1	2	1	-	-	-	-	-	4
Penarahan	9	5	3	1	1	-	-	-	19
Ramin	-	-	-	1	-	-	-	-	1
Sesendok	3	2	3	2	-	1	-	-	11
Sial Menahun	4	3	2	-	-	-	-	-	9
Terentang	-	-	2	2	1	-	-	-	5
Terap	2	1	1	-	-	1	1	-	6
Other Light Hardwoods	14	8	2	-	-	-	-	1	25
Total Light Hardwoods	125	73	58	20	10	6	3	1	296
Basal Area/square feet	22.4	36.3	56.5	32.2	24.1	20.1	13.4	5.7	210.7
Total Stems	211	145	98	37	20	7	6	2	526
Total Basal Area	37.8	72.1	95.5	59.6	48.1	23.5	26.8	11.4	374.8
Stems per acre	54.1	37.2	25.1	9.5	5.1	1.8	1.5	0.5	134.9
Basal Area per acre	9.7	18.5	24.5	15.3	12.3	6.0	6.9	3.0	96.1

TABLE C.20

TANJONG PENGGERANG

Sub Sample Stand Table for tiup-tiup (Adinandra dumosa) forest

(Area of sub-samples 8.2 acres)

Species	Girth over bark in feet							Total
	1 <2	2 <3	3 <4	4 <5	5 <6	6 <7	7 <8	
HEAVY HARDWOODS								
Keranji	2	-	-	-	-	-	-	2
Kayu Arang	2	-	-	-	-	-	-	2
Membatu	1	-	-	-	-	-	1	2
Mempoyan	43	25	4	-	-	-	-	72
Resak	2	-	2	-	-	-	-	4
Riang Riang	68	18	-	-	-	-	-	86
Other Heavy Hardwoods	1	-	1	-	-	-	-	2
Total Heavy Hardwoods	119	43	7	-	-	-	1	170
Basal Area/square feet	21.3	21.4	6.8	-	-	-	4.5	54.0
MEDIUM HARDWOODS								
Chempedak Ayer	-	2	1	1	-	-	-	4
Berangan	2	1	1	-	-	-	-	4
Kempas	-	-	2	2	-	-	-	4
Kandis	-	2	-	-	-	-	-	2
Kasai	2	1	1	-	-	-	-	4
Kelat	62	19	9	-	1	-	1	92
Kulim	2	1	1	1	-	-	-	5
Keledang	1	1	-	1	-	-	-	3
Minyak Berok	1	-	1	-	-	-	-	2
Mempening	1	1	-	3	1	-	-	6
Otak Udang	16	6	-	-	-	-	-	22
Petaling	4	1	1	-	-	-	-	6
Rengas	1	2	-	1	-	-	-	4
Simpoh	11	-	2	-	1	-	-	14
Tampoi	6	1	1	2	-	-	-	10
Other Medium Hardwoods	26	12	1	1	-	-	-	40
Total Medium Hardwoods	135	50	21	12	3	-	1	222
Basal Area/square feet	24.2	24.9	20.5	19.3	7.2	-	4.5	100.6

Species	|			Girth over bark in feet				Total
	1 <2	2 <3	3 <4	4 <5	5 <6	6 <7	7 <8	

LIGHT HARDWOODS

Species	1 <2	2 <3	3 <4	4 <5	5 <6	6 <7	7 <8	Total
Bintangor	43	12	4	2	-	-	-	61
Durian	1	-	1	-	-	-	-	2
Geronggang	7	6	12	3	1	-	-	29
Jangkand	29	9	3	1	-	-	-	42
Jelutong	3	-	-	-	4	-	-	4
Kembang Semangkok	6	1	-	2	1	-	-	10
Kedondong	13	7	1	3	3	-	-	27
Keredas	1	2	-	-	-	-	-	3
Mata Ulat	2	-	-	-	-	-	-	2
Medang	9	9	3	1	-	-	-	22
Mengkulang	1	-	-	1	1	-	-	3
Meranti Melantai	3	5	4	1	-	-	-	13
Meranti Sarang Punai	7	2	-	2	1	-	-	12
Meranti Tembaga	2	2	-	-	2	-	-	6
Nemesu and Other Red Meranti	3	2	2	2	-	-	-	9
Melunak	-	-	1	-	-	-	-	1
Mempat	16	9	2	-	-	-	-	27
Macaranga spp.	3	2	-	-	-	-	-	5
Membuloh	27	8	2	-	-	-	-	37
Mempisang	7	6	1	-	-	-	-	14
Mendong	12	3	-	-	-	-	-	15
Nyatoh	4	4	2	-	-	-	-	10
Putat	2	-	-	-	-	-	-	2
Penarahan	13	4	2	-	-	-	-	19
Sesendok	3	6	6	-	2	-	-	17
Sepetir	-	-	1	-	-	-	-	1
Sial Menahun	11	1	-	-	1	-	-	13
Terentang	7	1	4	3	1	1	-	17
Terap	4	3	-	1	-	-	-	8
Tiup-tiup	282	176	47	6	2	-	-	513
Other Light Hardwoods	19	10	1	2	1	-	-	33
Total Light Hardwoods	540	290	99	30	17	1	-	977
Basal Area/square feet	96.6	144.2	96.5	48.3	40.9	3.4	-	429.9
Total Stems	794	383	127	42	20	1	2	1369
Total Basal Area	142.1	190.5	123.8	67.6	48.1	3.4	9.0	584.5
Stems per acre	96.8	46.7	15.5	5.1	2.4	0.1	0.2	167.0
Basal Area per acre	17.3	23.2	15.1	8.2	5.9	0.4	1.1	71.2

TABLE C.21

TANJONG PENGGERANG

Sub-Sample Stand Table for Exploited Peat Swamp Forest

(Area of sub-samples = 2.4 acres)

Species	Girth over bark in feet							
	1 − <2	2 − <3	3 − <4	4 − <5	5 − <6	6 − <7	7 − <8	Total
HEAVY HARDWOODS								
Keranji	−	1	−	−	1	−	−	2
Kayu Arang	8	−	3	−	−	−	−	11
Mertas	−	3	−	−	1	−	−	4
Pelawan	20	−	2	−	−	−	−	22
Total Heavy Hardwoods	28	4	5	−	2	−	−	39
Basal Area/square feet	5.0	2.0	4.9	−	4.8	−	−	16.7
MEDIUM HARDWOODS								
Kempas	−	1	2	−	−	2	1	6
Kandis	2	1	−	−	−	−	−	3
Kasai	2	−	−	−	−	−	−	2
Kelat	37	11	6	−	−	−	−	54
Kulim	1	1	−	−	−	−	−	2
Merawan Batu	−	1	−	1	−	−	−	2
Otak Udang	3	1	−	−	−	−	−	4
Petaling	1	−	−	−	−	−	−	1
Rengas	12	6	3	−	−	−	−	21
Tampoi	1	1	−	−	−	−	−	2
Temponek	−	−	−	1	−	−	−	1
Other Medium Hardwoods	5	1	4	1	−	−	−	11
Total Medium Hardwoods	64	24	14	2	2	2	1	109
Basal Area/square feet	11.5	11.9	13.6	3.2	4.8	6.7	4.5	56.2

Species	Girth over bark in feet							Total
	1 – <2	2 – <3	3 – <4	4 – <5	5 – <6	6 – <7	7 – <8	

LIGHT HARDWOODS

Species	<2	<3	<4	<5	<6	<7	<8	Total
Bintangor	65	18	12	3	1	–	–	99
Durian	1	–	1	–	–	–	–	2
Geronggang	6	1	–	1	1	1	–	10
Kembang Semangkok	1	–	–	–	–	–	–	1
Kedondong	8	4	3	–	–	–	–	15
Mata Ulat	2	–	2	–	–	–	–	4
Medang	8	3	–	–	–	1	–	12
Malabera	1	–	–	1	–	–	–	2
Meranti Tembaga	1	–	–	–	–	–	–	1
Other Red Meranti	3	–	–	–	1	–	–	4
Membuloh	3	1	–	–	–	–	–	4
Mempisang	5	5	–	1	–	–	–	11
Nyatoh	16	13	7	12	2	–	–	50
Penarahan	14	2	2	–	–	–	–	18
Ramin	–	2	1	1	–	–	1	5
Sepetir	–	–	–	–	1	–	–	1
Terentang	19	5	2	–	–	–	–	26
Other Light Hardwoods	12	2	1	1	1	–	–	17
Total Light Hardwoods	165	56	31	20	7	2	1	282
Basal Area/square feet	29.5	27.8	30.9	32.2	16.9	6.7	4.5	148.5
Total Stems	257	84	50	22	11	4	2	430
Total Basal Area	46.0	41.7	49.4	35.4	26.5	13.4	9.0	221.4
Stems per acre	107.1	35.0	20.8	9.2	4.6	1.7	0.8	179.1
Basal Area per acre	19.2	17.4	20.3	14.8	11.1	5.7	3.6	92.1

TABLE C.22

Variation in productivity by species groups for Lowland blocks
in Johor Tengah inventory area

(Mean net volume in cubic feet true per acre)

					S P E C I E S		G R O U P S						
Block no.	1 Heavy Hard-woods	2 Kempas	3 Keruing	4 Kapur and Kela-dan	5 Other Medium Hard-woods	6-11 All Red Meran-ti	12 White Meranti	13 Mer-sawa	14 Yellow Meranti	15 Jelutong	16 Meng-kulang	17 Other Light Hard-woods	Total Volume per acre
1.	136.2	181.3	120.5	582.1	455.8	144.7	1.9	7.5	7.8	8.9	24.5	350.7	2021.9
2.	229.8	90.7	165.5	-	311.7	324.5	10.9	-	100.8	69.2	57.4	502.3	1862.8
3.	280.8	119.0	57.3	210.8	523.8	134.7	35.0	-	12.1	-	118.2	336.0	1827.7
4.	232.5	82.1	145.1	6.2	478.4	329.4	17.2	11.5	30.9	7.8	48.9	454.0	1844.0
5.	342.1	68.4	117.6	5.0	288.0	278.1	10.1	26.2	36.9	11.3	46.1	694.6	1924.4
6.	168.6	84.4	113.1	19.5	324.0	343.0	11.6	15.4	24.9	-	7.9	535.2	1647.6
7.	106.9	94.4	94.8	49.8	324.1	287.4	17.7	10.5	17.5	1.9	28.1	511.6	1544.7
8.	234.5	47.7	97.2	-	299.2	331.7	-	-	36.6	-	80.7	399.0	1526.6
9.	388.8	108.2	161.6	12.8	340.4	301.4	7.7	12.7	40.1	10.2	85.4	442.0	1911.2
10.	407.9	65.4	168.9	10.4	324.5	431.6	15.7	7.3	10.4	12.0	43.7	490.1	1987.9
11.	160.0	64.8	169.9	11.4	168.8	398.8	13.5	4.3	41.7	15.5	17.8	560.2	1626.7
12.	467.8	162.1	163.9	17.6	342.4	440.7	5.2	3.3	43.1	16.9	76.2	494.4	2233.6
13.	175.7	105.0	173.0	-	271.9	417.9	16.4	19.3	71.9	15.2	35.5	646.1	1947.9
14.	423.8	152.0	232.0	-	469.2	826.4	25.0	20.3	16.8	4.8	109.8	765.6	3045.7
15.	314.3	133.4	256.7	-	396.2	581.6	13.8	11.4	33.6	6.5	41.4	521.3	2310.2
16.	324.9	61.1	120.2	14.1	186.8	270.2	5.6	6.6	48.4	10.7	50.6	511.6	1610.8
17.	271.9	61.2	98.8	-	296.8	330.7	11.3	15.7	71.2	1.6	58.4	360.1	1577.7
18.	227.5	81.9	83.5	19.8	247.1	403.4	9.0	24.7	31.7	6.4	16.4	397.4	1548.8
19.	241.3	103.0	147.6	-	346.3	277.4	11.8	16.2	12.8	9.6	56.8	421.4	1644.2
20.	281.6	110.1	73.1	-	356.7	329.9	-	4.2	33.9	20.7	56.5	685.8	1952.5
21.	318.6	96.8	119.6	-	242.8	195.7	5.5	5.8	30.8	13.4	109.0	635.1	1773.1
22.	313.6	102.2	50.2	25.4	351.4	301.9	19.5	31.3	24.8	5.5	31.8	679.9	1937.5
23.	237.5	109.1	45.8	230.5	421.1	130.5	8.9	4.4	6.1	2.1	9.6	1176.7	2382.3
25.	38.6	35.0	16.2	86.3	416.5	48.0	3.8	-	-	-	-	532.8	1177.2
27.	83.6	100.2	17.3	53.8	236.4	279.6	3.9	8.4	-	10.5	4.8	416.6	1215.1
28.	242.0	113.3	39.1	74.1	346.4	271.4	10.1	15.7	21.2	-	51.3	590.5	1775.1
40.	92.1	38.6	55.8	31.2	253.3	290.9	5.2	-	4.5	12.9	15.7	468.2	1268.4

Note: The arithmetic means of the species in this table do not agree with the means of the
species in Appendix C.14 because of the different acreages in each sampling block;
neither do the block means have any statistical significance but were produced as an
approximate guide to possible productivity.

TABLE C.22 (CONTINUED)

Variation in productivity by species groups for Hill blocks in Johor Tengah inventory area

(Mean net volume in cubic feet per acre)

						S P E C I E S G R O U P S								
	1	2	3	4	5	6-11	12	13	14	15	16	17	Total
Block No.	Heavy Hard-woods	Kempas	Keruing	Kapur and Kela-dan	Other Medium Hard-woods	All Red Meranti	White Meranti	Mer-sawa	Yellow Meranti	Jelutong	Meng-kulang	Other Light Hard-woods	Volume per acre
24.	230.0	19.6	22.3	838.0	244.8	145.1	-	6.9	-	1.9	18.9	575.7	2103.2
26.	277.6	15.1	77.6	247.8	391.1	167.1	5.1	3.7	56.6	6.0	46.7	512.3	1806.7
29.	277.3	57.9	124.4	38.5	381.4	436.1	7.0	14.8	22.3	8.7	41.6	418.2	1828.2
30.	182.3	45.7	73.8	503.9	275.3	191.8	15.7	-	17.2	9.6	53.2	392.5	1761.0
31.	192.9	32.4	107.2	372.1	259.0	502.4	7.1	17.4	51.5	5.5	31.1	415.1	1993.7
32.	353.2	30.0	246.2	6.0	369.1	510.4	66.5	19.6	120.2	-	48.5	454.3	2224.0
33.	217.8	10.2	253.0	116.2	292.5	562.3	-	19.6	148.0	-	29.7	678.1	2327.4
34.	345.0	45.2	226.4	238.6	321.4	571.1	27.5	7.3	95.9	2.3	28.5	582.3	2491.5
35.	241.8	17.2	91.6	291.9	321.9	478.7	3.1	14.1	110.2	10.8	31.1	661.3	2273.7
36.	213.6	68.6	118.4	159.5	320.9	370.1	4.2	2.7	34.6	15.3	42.8	508.2	1858.9
37.	297.1	71.0	99.0	65.9	185.0	214.4	4.1	5.3	9.2	5.5	13.0	241.5	1211.0
38.	183.0	109.1	90.6	127.4	459.8	420.5	15.7	7.1	28.6	11.2	14.7	579.9	2047.6
39.	183.5	87.6	156.8	131.1	364.5	512.3	-	45.5	25.2	2.6	21.4	711.5	2242.0
41.	323.2	55.4	44.2	250.7	257.4	226.4	1.0	2.0	28.3	6.7	11.6	308.9	1515.8
42.	223.4	66.1	254.4	-	317.0	346.1	9.7	10.4	10.8	-	12.4	446.4	1696.7
43.	233.4	27.3	53.3	267.9	429.6	163.9	3.9	-	96.3	-	21.5	576.1	1873.2

Note: The arithmetic means of the species in this table do not agree with the means of the species in Appendix C.15 because of the different acreages in each sampling block; neither do the block means have any statistical significance but were produced as an approximate guide to possible productivity.

APPENDIX D

1. PRESENT PROCEDURE AND PHASING

The present procedure and phasing of clearing land for FLDA schemes is briefly as follows:

(i) approval from the State Forest Department;

(ii) if planting of the scheme is to begin in October 1972, the latest date for calling clearance tenders will be July or August of 1971;

(iii) if on the other hand, there is a gap of six months or more before this latest date for calling clearance tenders, and if applications are received by FLDA for exploiting any remaining timber, FLDA may enter into agreements with licensees for the right to extract timber. The licensees then have to obtain a Form 2 permit from the State Forest Department. If this is obtained, the licensees pay a certain sum for the right of access and the tender price to FLDA as well as a royalty which is payable to the State Forest Department. Royalties are payable to the State according to the schedule of royalties shown in Appendix E. Agreements have recently been signed between FLDA and three licensees relating to four schemes in the Ayer Tawar area.

The fee for the right of access in all three cases is $2 per FD ton (FLDA is informed of the tonnage extracted by the Forest Department) and the tender price varies between $5 and $8 per FD ton. The amounts so far extracted seem to be small although little information is available. For the Ayer Tawar III scheme, as in the Tanjong Penggerang Region, for example the income received by FLDA during 1970 was less than $7,000. This seems to apply to about 2-3,000 acres worked with the timber yield probably being less than one ton per acre. Appendix E discusses the potential for exploiting residual timber in more detail.

(iv) after calling for tenders in July or August of the year prior to planting, felling usually begins in October and continues through the monsoon to December;

(v) the primary burn is usually in February and pruning and reburning is done during the next 6 to 7 months, so that by October the land is ready for planting.

This description of clearance phasing applies to the most common method so far adopted, namely manual clearing. For a more detailed description of this method see Chapter 1 of Bevan, Fleming and Gray (1966).

FLDA follows a policy of accepting the lowest tender submitted and this has recently resulted in some mechanical clearing being done in the Ayer Tawar area. The stages of the mechanical process are:

- Bulldozers clear and fell trees up to 4'6" girth;

- Trees over this size are felled conventionally;

- The timber is left to dry for about 3 months;

- Bulldozers stack the timber in windrows which are then burnt and reburnt.

In the comparison of mechanical and manual clearing which follows, information has been derived from the Ayer Tawar operations and a report by Tractors Malaysia entitled 'Mechanical Land Clearing Proposal' and dated June 1969.

2. A COST COMPARISON OF THE ALTERNATIVES

To date only in a few cases have tenders specifying mechanical methods given lower costs than tenders specifying manual methods. Costs of land clearing differ significantly between areas of West Malaysia; prices are for example higher in Pahang than in Johor State. Costs of clearing are also of course affected by the type of terrain and stand of forest. Mechanical methods would be slower on wet ground or on steep slopes; more hand felling needs to be done in virgin jungle.

Using manual development costs contained in FLDA's 'Estimate of Development Costs – Oil Palm', the Tractors Malaysia (1969) report gives mechanical clearing costs of about 43 percent above the manual costs but total development costs are, according to the report, only about 5½ percent higher, since with mechanical clearing the costs of operations subsequent to clearing such as establishing harvesting paths, lining and planting are lower. The cost comparison is given on page 11 of that report as:

Operation	Cost ($ per acre cleared):	
	Mechanical	Manual
Felling	–	80
Burning	–	7
Pruning, reburning	–	75
Destumping	–	10
Total clearing price	246	172
Est. harvesting paths		14
Removing timber from planting points		10
Est. basic agricultural roads	7	30
Lining	5	8
Planting	20	30
Total development cost	278	264

3. OTHER CONSIDERATIONS

These financial costs are however not the only factors to be considered. Some additional factors such as employment and soil effects tend to favour manual clearing whereas others such as speed of clearance and financing have been put forward in support of mechanical clearing. Each of these are considered briefly below:

(i) Employment effects

In West Malaysian conditions of un- and under-employment, a project employing more labour, particularly un-skilled labour, will be preferable to one employing considerably less labour, other things being equal. As has already been pointed out, it is not certain whether other things are equal, but it is clear that manual clearing is very much more labour intensive than mechanical clearing. More than 80 percent of the cost of manual clearing consists of wage payments to unskilled labour, whereas less than 10 percent of the cost of mechanical land clearing consists of wages to labourers.

Manual clearing requires, according to page 3 of Bevan, Fleming and Gray 1966 – something like 16 man days per acre cleared. According to experience on Ayer Tawar III, the requirement was about 18 man days per acre. For mechanical clearing, on the other hand, the labour requirement is only about one and a half man days per acre. Put another way, for every 10,000 acres cleared over a period of say a year, manual land clearing creates about 600 jobs for that year, whereas mechanical clearing creates only about 50 jobs over the same period.

(ii) Soil Effects

Mechanical clearing may adversely affect the physical structure of the soil by sealing or compacting the surface and encouraging erosion. The precise effects are not known, but experience at Sungei Tekam in the Jengka area suggests that there may be difficulty in establishing grass or cover on mechanically cleared slopes. (See page 8 of Tractors Malaysia 1969). Whether this is likely to seriously affect the growth of tree crops such as rubber and oil palm is not yet known.

(iii) Speed of Clearing

The development cost advantages of mechanical clearing have already been discussed although it was shown that mechanical costs are still likely to be somewhat higher than manual costs. In addition, some FLDA officials have stated that mechanical land clearing is preferable, because it is faster. Other FLDA officials have denied this saying that since planting begins in October, mechanical felling cannot speed up clearance unless clearing and burning can be completed prior to the previous October. For a comparison of the phasing of the two methods see Figure D.1. There seems to be no reason why the number of people employed on manual clearing should not be expanded to meet a specified target.

(iv) Financing by an Overseas Agency

It may be easier to get overseas aid for a mechanical land clearing programme than for a manual land clearing programme, since mechanical programme will be more foreign equipment intensive. If Malaysia wants to meet a specified target of overseas financing but cannot produce a long enough 'shopping list' then it might be sensible to obtain foreign financing for the mechanical land clearing programme and expand employment by other locally-financed development.

To annually clear an FLDA scheme of 5,000 acres, approximately 9 D8Hs and 3 D6Cs would be required - see page 3 of Tractors Malaysia 1969. For an annual programme of 50,000 acres, the capital requirement would be about 90 D8Hs and 30 D6Cs. With a depreciation period of about 5 years, the annual capital cost would be about $4

million calculated as follows:

Type	Capital Cost ($ Thousand)	Life (years)	Annual Capital cost(1) ($ Thousand)	Number needed for 50,000 acres p.a. programme	Annual capital cost (mn.)
D8H	239	5	38	90	3.4
D6C	140	5	22	30	0.7
					4.1

(1) Assuming a trade-in-value of 20 percent and a depreciation period of 5 years.

This financing argument is not however applicable at present since World Bank loans are already provided for FLDA's programme, whether or not mechanical land clearing methods are used.

4. PROBLEMS AND ALTERNATIVES

At present most of the clearing for FLDA is done manually, since the tenders usually give lower costs for manual methods. Only for the fairly flat secondary jungle in the Ayer Tawar area have mechanical methods been used.

Manual methods are not only cheaper but other considerations also tend to favour the use of this method; and if, in the future, mechanical methods become financially cheaper because of rising wage rates, it might nevertheless be advisable for the Government to take action to encourage the use of manual methods to increase employment. But at the moment such encouragement seems unnecessary.

Sufficient labour for manual land clearing may be available using the present contractors. If not, then it may be possible to meet the land development target by expanding the FLDA youth Brigades (Supporting Volume 4 Chapter 3) into what have been termed Settlers Development Corps. Otherwise mechanical methods may have to be used. This report makes no particular recommendations on the method that should be used, but whichever method is used, FLDA should make their land clearing requirements known at least 2-3 years in advance so that contractors can make the necessary preparations.

FIGURE D.1   PHASING OF LAND CLEARING

YEAR MONTH	JUL.	AUG.1	SEPT.	OCT.	DEC.	JAN.	FEB.	MAR.	APR.2	MAY	JUN.	JUL.	AUG.	SEPT	OCT.	NOV.	DEC.	3JAN.
1. MANUAL METHOD																		
CLEARING TENDERS																		
FELLING																		
PRIMARY BURN																		
PRUNING, REBURNING																		
PLANTING																		
2. MECHANICAL METHOD																		
CLEARING TENDERS																		
FELLING																		
STACKING																		
BURNING																		
PLANTING																		

APPENDIX E

RESIDUAL TIMBER AND RECONSTITUTED WOOD INDUSTRIES - PROBLEMS AND POTENTIAL

1. INTRODUCTION

The Draft Project Report (January 1971) stated that there is a considerable tonnage of what was described as 'residual' timber in both the South East Johor regions. It was thought that in Tanjong Penggerang this might be exploited in conjunction with land clearing and thereby reduce clearing costs, whereas in Johor Tengah the exploitation of residual timber could either be combined with conventional logging or with clearing. However the report also stated that little was known about the extent to which this timber could be processed and sold, and a 'chipping' study and blackboard trials were recommended as matters of urgency.

Alternative measures were however agreed by the Review Group set up by the Government to consider them. The minutes of the meeting of Review Group stated that — "Taking into consideration the limited market for the 'residual timber', the Review Group considered that a study of this would be of limited value. Instead it was argued that the 'residual timber' from the Penggerang area would be tendered for by any interested group on the basis of royalties to be paid. The total value could be assessed based on an inventory. For the Johor Tengah area because of later phasing in development, a study of the utilisation potential of the residual timber may however be of value".

The latter study has not yet been initiated and because of the lack of information, especially on marketing potential, this report is only able to make some limited and tentative recommendations.

2. RESIDUAL TIMBER IN JOHOR TENGGARA

The definition of residual timber will depend on current logging and timber processing practices. What is residual timber and whether and how it is used depends on how intensively the acceptable species are used, which species are acceptable and therefore on how much timber of various sizes and species remains after the extraction of the acceptable species. Table E.1 summarises the residual timber estimated to be in the South East Johor regions. The exploitation of the timber can best be examined by splitting it into five groups.

In Johor Tengah about two-thirds of the area which is under forest but which is to be cleared for agriculture contains acceptable species above four feet GBH. The remaining third of Johor Tengah is more or less in the same state as the whole of the forest area in Tanjong Penggerang — that is it contains no acceptable species above four feet GBH.

In those areas where no conventionally marketable timber exists but which are to be cleared for agricultural development — about 62,000 acres in Johor Tengah and 106,000 acres in Tanjong Penggerang — the total volume of timber of two feet and over is about 3.7 mn tv tons. The density per acre varies from about 10 to over 30 tons tv per acre. In those areas of Johor Tengah which contain large timber of acceptable species the residual timber amounts to about 3.4 million tons tv. Total residual timber in the whole of the project area therefore amounts to about 7 million tons tv.

TABLE E.1   "Residual" Timber in the South East Johor Regions (1)

Region and Type of Forest	Area (Thousand of Acres)	Value of Residual Timber (Gross - Million t.v. Tons)	
		Trees of 4 ft. GBH but not Currently Acceptable	Trees of Between 2 and 4 ft. GBH
JOHOR TENGAH			
With Large Acceptable Timber			
1. 'Integrated Complex' Forest	71 (2)	1.07	1.42
2. Other Areas to be Logged	27	0.40	1.06
3. Areas with no Large Acceptable Timber	62	0.49	0.85
Total Johor Tengah	160	1.96	3.33
TANJONG PENGGERANG			
4. Exploited Primary Forest Excluding Peat and Other Swamp Forest	49	0.74	0.98
5. Secondary Forest Containing Tiup-Tiup	57	-	0.57
Total Tanjong Penggerang	106	0.74	1.55

(1) Source - Extracted from Table 4.3 in Chapter 4.

(2) Excludes 21,000 Acres of Water Catchment Area in which it is assumed no Extraction of Residual Timber should be permitted.

3. PRESENT AND POSSIBLE USES OF RESIDUAL TIMBER.

If a use could be found for the residual timber, even if only at the same export sales price as rubberwood chips of about $38 per ton, the sales value would be more then $250 million. This is more than the total estimated sales value of timber from the 92,000 acre complex area in Johor Tengah.

However, a use must be found for this timber. There are three broad prospective uses for forest waste

(i) sawing into strips and scantlings;

(ii) chipping for domestic use;

(iii) chipping for export.

It would be profitable to saw small trees in conventional mill machinery but an alternative possibility would be sawing small trees into sawable cants, and chipping the offcuts, either simultaneously in a chipper canter or with edgers, gangsaws, and separate chipping of waste . The timber could be exported sawn or form the basis for blockboard

production at plymills. These are perhaps the most
promising uses for the stands of Tiup-tiup in Tan-
jong Penggerang and for small trees of utilisable
species in Johor Tengah. Further work needs to be
done investigating the profitability of such opera-
tions but important though such developments would
be in encouraging utilisation in diversified fields,
it is believed that the market potential would be
much smaller than for the use of the timber as wood
chips.

The timber could be chipped for use domesti-
cally as board or for pulp and paper.

The production of particle or chipboard in
West Malaysia is negligible. There is one small
plant in Johor but its annual production capacity
is less than 1,000 cubic tons on a one shift basis.
The particle board and plywood industries are often
integrated because the former can be made from the
waste of the plywood mill and both serve the same
consuming sectors (construction and furniture).
But the imports of particle board into West Malaysia
are negligible, probably for the same reason, namely
that particle board serves the same market as the
domestically-produced plywood. The domestic market
also seems limited because thin particle board is
more expensive per cubic foot than plywood and
thicker board (of 18 mm. thickness) is more expen-
sive than blockboard of the same thickness.

The potential market for hard or soft fibre-
board also seems somewhat limited — imports into
West Malaysia in 1969 were running at less than
5,000 tons per annum or about 13 mn. square feet,
although work by Peel (1960) suggested that a
fibreboard plant, producing mainly hardboard and
based on rubberwood and meranti waste, might be
feasible.

Blockboard consisting of kiln dried strips of
timber about one and a half inches by three fifths
inch laid side by side and faced with 2 mm veneer,
is being made at several plymills in West Malaysia
using rubberwood and cores of peeler logs. It
currently sells at about 40 cents per square foot
(18 mm. thick) which is much cheaper than particle
board of similar thickness at 55 cents per square
foot. The market is said to be very good and
expanding but since its production is allied to
plymills and it is not envisaged that the complex
in Johor Tengah will include plymilling facilities,
no production facilities have been recommended as
part of the complex. Supporting Report IV of the
Draft Project Report did recommend;

"That trial work should begin on producing
blockboard using small trees below 4 feet
girth of different, and mixed, species.
Trial work should also begin on sawing small
dimension sawn timber using small gangsaws
and edgers. It is not considered appropriate
to install chipboard capacity until further
technical and market research has been under-
taken. This trial work could be the first
tasks of a small experimental unit, esta-
blished with public funds and attached to a
new timber complex in the Johor Tengah New
Town. It does not matter where the work is
carried out, but it is vital that it should
be carried out with as much emphasis on
problems of marketing and commercial scale
production as on technical sawing properties".

Wood chips can also provide the raw material
for pulp and paper or viscose rayon. Domestic
consumption of paper and paper products in Malaysia,
though rising rapidly, is small. Therefore the
domestic demand for chips to be used for paper
pulp would be small even if a domestic paper plant
using hardwood were constructed.

The biggest scope for the utilisation of
residual timber lies in exporting it in chip form
for pulping overseas. At present Daishowa (M)
Wood Products Sdn. Berhad is chipping and exporting

up to 500,000 tons of rubberwood per annum with
very much smaller amounts of mangrove wood and
sawmill waste. It appears that the rubberwood is
being used for corrugated paper production[1] and
that the hardwoods are being converted into dis-
solving pulp for rayon production. There seem to
be two problems associated with the use of hard-
woods for paper pulp. One is that some of the
hardwoods are too hard for chipping (examples are
chengal, keranji, kempas and derom); the other
problem is the variation of fibre length between
species.

There have been many reports in 'World Wood'
(March 1971) of agreements to supply wood chips
from New Guinea and Tasmania to Japanese companies
such as Chuetsu, Honshu, Jujo, Sanyo, Mitsubishi,
Daishowa and Hokuetsu. The Tasmanian chips will
be from eucalyptus species, while the chips from
New Guinea will be from taun and kwila tropical
hardwoods. These contracts are mostly over periods
of from 11 to 25 years and cover amounts from
600,000 tons per annum upwards. One price given
for eucalyptus chips was $80 per Bone Dry Unit
(BDV) equivalent to about one ton but it is not
clear whether this is the fob or cif price. In
addition it seems that there are plans to export
something like a quarter of million tons of chips
per annum from Sabah, ('World Wood' February 1971)
and it seems that these will be from hardwoods,
rather than rubberwood.

Japanese imports of wood chips have expanded
very rapidly in recent years and in 1968 total
imports of wood chips by Japan were given as over
2.5 million tons. (Pulp and Paper International,
January 1970). By the end of 1970, about a dozen
Japanese pulp and paper mills had about 20 chip
ocean carriers in service. Two-thirds of these
were operating between North America and Japan and
the other third were importing hardwood chips from
South East Asia and Australasia. The Japanese
companies involved in this trade were Daishowa,
Oji, Toyo, Honshu, Taio, Tokai, Kokoku, Chuetsu,
Jujo, Marusumi, and Sanyo.

However very little further information is
available on the price at which the residual timber
could be sold, or on the cost of extracting and
chipping it. The only information available is on
rubberwood. At present the only chipping plant is
at Port Swettenham. Rubber estates pay the operator
between $80 and $110 per acre to clear the rubber-
wood and leave the land fit for replanting. The
yield of rubberwood is reported to be about 25 to 30
tons per acre.

The chippers at Port Swettenham can take wood
up to 18" by 18", with large tree trunks being split
to enter the chipper. The cost of harvesting the
rubberwood, including depreciation, is about $10 per
ton. This includes felling and cross cutting,
debarking, and transferring to a road lorry. The
royalty rate is $0.60 per ton and the cost of trans-
porting the rubberwood about 60 miles to Port Swetten-
ham is about $8 per ton. The total rubberwood har-
vesting and transporting cost is therefore about $20
per ton at 40 percent moisture content. Chipping is
said to cost about $6 per ton including depreciation.
Ninety-five percent of the log is shipped to Japan
at an FOB price of about $38 per ton at 40 percent
moisture content, equivalent to about $54 per ton
bone dry.

The use of chips from tropical forest waste for
pulping is reported by this operator to have very
good potential. The pulp yield may be higher and
the pulping costs lower than from rubberwood where
the latex and its removal reduces pulp from a normal
conversion rate of 45 percent to 25 percent.

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[1] For a discussion of the uses of rubberwood, see
Wycherley (1968).

4.   THE POTENTIAL IN JOHOR TENGGARA

Daishowa, the company engaged in harvesting and chipping rubberwood for export to Japan, has expressed interest in handling the residual forest in the project area at a rate of up to one million tons per annum. The whole of the project area will be cleared over a period of 15 years with an average clearance rate in the first 10 years of about 25,000 acres per annum. The average yield of residual timber from an area of this size would be in excess of 500,000 tons per annum.

Setia Jaya Sdn. Berhad, advised by Daishowa, is currently building an access road and laying out the site for a chipping plant to be located at Johor Baharu port. This chipping plant is being constructed to chip rubberwood but an expansion to the plant could be constructed on or near the same site to handle hardwoods or a new site could be developed in Johor Tengah to handle residual timber.

As far as royalties are concerned no definite recommendations can be made. One of the reasons for recommending in the Draft Report that a chipping study be undertaken was to provide more information upon which royalty rates or fees to cover the various areas could be based. This should be initiated by those Departments most directly concerned, that is the Forest Department or, less obviously, FLDA. As in the case of areas with large merchantable logs, a system whereby lump sums are levied for particular areas rather than royalties specific to logs would probably lead to a more intensive and extensive utilisation of the forest resource.

A standard form agreement for residual timber utilisation is clearly not possible for the whole of the residual timber in Johor Tenggara, since there will be many agreement holders and clearance contractors involved in the area. It is therefore necessary to consider the types of area separately.

Within the project area feeding the complex the logging of residual timber could be done at the same time as the logging of the large merchantable trees. The amount involved is about 2½ million tons, the residual timber from 71,000 acres only, since 21,000 acres would be part of a water catchment and would not be exploited for residual timber. There should be little danger of erosion from exploiting the residual timber at the same time as the large acceptable species, since a substantial part of the forest cover would still be left and the area would in any case be cleared for agricultural development soon afterwards. It is essential, however, to take account of the erosion hazard and ensure that agricultural development follows within say six months to one year. The State Forest Department should not therefore impose any restrictions on the logs to be extracted. On the contrary it should encourage the company exploiting the area to take as much timber out as possible.

The same recommendations apply to the other areas in Johor Tengah which are yet to be logged.

For those areas with no acceptable timber ramaining, a different approach is necessary. In those areas which still contain logs of unacceptable species of four feet GBH and over, harvesting prior to clearing will probably result in better utilisation. In secondary forest, such as occurs in Tanjong Penggerang where the tree sizes are smaller and more uniform, it is suggested that harvesting and clearing could take place together. Thus in thos areas which have already been logged it seems sensible for the present procedure as followed on land to be developed by FLDA to be continued. That is, for tenders to be invited for the exploitation of residual timber with the licence going to the highest bidder, although once again greater utilisation would probably be encouraged by the imposition of a lump sum fee rather than royalties by both FLDA and the Forest Department.

It is again emphasised that if the recommendations are to be implemented they must be implemented quickly if they are to make any impact at all in Johor Tenggara, although if they are implemented in other parts of Johor and West Malaysia, they will bring corresponding benefits.

APPENDIX F

ROYALTIES, PREMIA AND LOG EXPORT CONTROLS

1. THE PRESENT SYSTEM AND RATES

The present system of taxing the extraction of timber in West Malaysia has two components, namely premium and royalty. Premium is charged by State Forestry Departments either as a fixed sum per acre or sometimes as a result of competitive bidding. Royalties are levied on each cubic foot of timber extracted, with different rates for different species or groups of species. The royalty and premium rates levied in Johor State are shown in Table F.1.

TABLE F.1 Royalty and Premium Rates in Johor State

1. Royalty Rates

1.1 For Logs of 3ft. GBH and Above

Species or Group	$ Per FD Ton of Logs(1)
Chengal	25.0
Balau, Resak, Membatu, Merbau, Kapur, Keladan	15.0
Meranti, Keruing, Mersawa, Mengkulang, Jelutong	10.0
All Others	7.5

1.2 For Logs of up to 3 ft. GBH

	Cents Per Cu.Ft.
– For Particle Board (at firewood rates)	2

	Cents Per Ton Weight
– For Chipping and Export	60(2)

	$ Per Ton of 50 Cubic Feet
– Poles	About $2 to $3(3)

2. Premium Rates

2.1 Forest Reserve – 'Guideline Premium' is based on a 10% Sample and is equivalent to about 20% of the Royalty(4)

	$ Per Acre
2.2 State Land – Virgin Forest	30–50
– Semi-Virgin	5–10

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(1) Royalty rates are levied on logs of 3 ft. GBH and above on the basis of cubic feet. The rates given are the approximate rates per FD ton.

(2) Recently introduced for rubberwood in Johor.

(3) Royalty rates are levied on 'poles' according to the girth and length, but they are approximately equivalent to between $2 and $3 per ton of cubic feet.

(4) The 'Guidance premium' for Reserved Forest is currently 35 percent of the total royalties, the latter being estimated on the basis of a 10 percent sample enumeration of all trees of 4.5 ft. GBH and above, allowing 25 percent for defects. But since royalties are levied on trees of 3 feet GBH and over; the 'Guidance premium' is somewhat less than 35 percent when based on actual royalties.

For the past two or three years the income of the Johor State Forest Department has averaged about $10–$15 per FD ton. In 1969, Johor State received about $7 million from forestry royalties and premia, but this included almost $2 million for a premium on part of Labis Forest reserve from which little timber was extracted in 1969. Deducting this, the average royalty and premium on 0.43 million FD tons was about $12 per FD ton.

The tendency is, however, for Johor State to put more and more Forest Reserve areas out to tender for the premium and in some cases the tendered price has been four or five times as high as the price usually received. The premium on State land forest is usually paid on the acreage of the block being paid in two instalments, one on delivery of the permit to fell, the second within one month of the delivery of the permit.

The average yield of timber from Johor State Forest Reserve seems to be about 15–18 FD tons per acre. From Forest Reserves, the average royalty and premium per ton is probably slightly above the average for both State Land and Forest Reserve, probably being about $13–$15 per FD ton. The average payment for each acre of Forest Reserve worked is therefore about $200–$250 of which about $50 would be premium.

2. RECOMMENDATIONS MADE IN JANUARY 1971.

In January 1971, the consultants made several recommendations on the levying of royalties and premia for large logs going to sawmills and plymills. (Draft Project Report and Report IV). The detailed submission was as follows:

"It is a common claim that the Malaysian timber industry is inefficient, in that the species in greatest demand (eg. Meranti and Keruing), are all taken, whereas other less popular species are either left in the forest, or are not worked up beyond the low value local market for sawn timber.

"In common with many others the consultants believe that this is in large part a result of the current premium and royalty rates (and, to a lesser extent, of the small size of the individual annual coupe). Two features of the present system appear unsatisfactory: first the combined premium and royalty rates on the popular species are too low and yield excessive profits at the expense of public sector revenue. Second, the rates on the less popular species and sizes are too high and discourage their use.

"An ideal premium and royalty policy would be one that encouraged the maximum utilisation of as many species as possible while allowing a reasonable return on capital investment. At the same time the royalties and premia should be high enough to give constant encouragement to the installation of more efficient logging and milling machinery, and to stimulate new uses, methods and processing of timber.

"Calculations made by the consultants suggest very high rates of return to timber operations, even on the present 'low' processing basis and it seems likely that if premium-cum-royalty rates were adjusted to allow a 20 percent rate of return on timber investment, then sufficient investment would still be attracted into the industry.

"It is recommended that government revenue per ton of timber extracted should be increased. There are several alternative ways of achieving this:-

(1) Royalties and premia could be replaced by a single price for exploiting forest. Forest areas would be let to licencees as a result of

competitive bidding. Sealed tenders would be invited for specific forest coupes in which a prior sample inventory would have been carried out. The inventory results would enable the Government to set a reserve price below which tenders would not be accepted. (This would be a safeguard against the possibility of tenderers forming a 'ring to keep prices down). Paying a single sum for the total content of a forest coupe should induce the successful bidder to make a more intensive, as well as extensive, utilisation of timber in the area. Thus variable royalty rates to encourage the use of the less acceptable tree species would not be required. The possible advantages of publishing bids in national newspapers should also be considered.

(2) The present system of separate premium and royalty could be retained, with royalty rates on popular species increased and rates on less popular species reduced or eliminated.

(3) An excise duty could be imposed on logs coming out of the forest. Variable rates of duty would be imposed on different species, depending on selling price and production costs. Forest checking stations would be manned by Excise Department officials rather than forest guards.

(4) An export tax could be imposed on export sales of processed timber products and an excise duty on local sales. The duty would be a specific sum per ton of produce, depending on the species and the percentage conversion from round logs. Duties could be varied between products to encourage higher value processing. The effective rates of duty per ton of logs could be made lower on mouldings or kiln seasoned timber than on air dried rough sawn timber.

"Forest revenue accrues under the present system to State funds. Excise and export taxes, however, accrue to Federal funds. If the present premium and royalty system were replaced, or at least, supplemented by excise taxes, revenue traditionally regarded as State funds would accrue to the Federal Government. Unless it is the Government policy to pass some forest revenue to Federal funds, the first alternative seems the best, since it is the one which minimises the need for a force of officials to administer the scheme and collect revenue. This alternative would also minimise the possibility of small scale corruption.

"Under this system, forest guards could be reassigned to more productive tasks, and their salaries reviewed in light of new responsibilities.

"Reserve prices per ton of timber of different species under the first alternative have been calculated (Table VII.2). They represent what the Government might realistically expect to levy from timber, allowing a reasonable (20 percent per annum) return on capital.

"It is stressed that the reliability of these estimates depends crucially on the estimates of selling prices, costs of logging and sawing, and conversion from logs to sawn timber. However, the costs are, if anything, too high rather than too low, and the table is set out so that the necessary adjustments can be made on the basis of more precise estimates. (For details of the costs, see Appendices I and J and for selling prices, see Appendix G).

"Table F.2 shows that with existing royalties, it is unlikely to be worthwhile taking out species other than Chengal, Balau, Merbau, Resak, Kapur, Keladan, Keruing, Meranti, Jelutong, Mersawa and Mengkulang. There would clearly be a greater incentive to take out more

TABLE F.2   Reserve Prices for Timber in Bidding for Right to Exploit Forest

Group Species	1	2	3	4	5	6	7	8	9
	Chengal	Balau Merbau Resak	Kapur Keladan	Keruing	Meranti Jelutong Mersawa Mengkulang	Kempas	Keranji	Other M.H.W.	Other L.H.W.
					$ per ton sawn timber				
Selling Price[1]	270	200	180	165	165	120	95	95	100
Cost of sawing [2]	53	53	53	53	53	53	53	53	53
Balance	217	147	127	112	112	67	42	42	47
					$ per ton of logs				
Balance[3]	130	88	76	67	67	40	25	25	28
Cost of logging[4]	40	40	40	40	40	40	40	40	40
Surplus (loss) or "Reserve price"[5]	90	48	36	27	27	—	(15)	(15)	(12)
Present royalty rates	(25)	(15)	(15)	(10)	(10)	(7.5)	(7.5)	(7.5)	(7.5)
Surplus (loss) with present royalty rates	65	33	21	17	17	(7.5)	(22.5)	(22.5)	(19.5)

[1] Ex-mill average prices for rough-sawn air-dried timber based on a combination of export and local prices depending on grade outturn (see Appendix G).

[2] As in Appendix J, but allowing a 20 percent per annum return on capital - variations between species are ignored.

[3] Based on 60 percent conversion from FD tons of logs to cubic tons of sawn timber.

[4] As in Appendix I, but allowing a 20 percent per annum return on capital - variations between sizes are ignored as are variations due to stand densities.

[5] Applicable to forest about 50-70 miles from port and consuming centres, and based on an average distance from forest to mill of 20 miles. Ideally variations in rates should be made for differences in distances from consuming centres.

species if the royalty rates were more dis-
criminatory. But rather than rearrange
royalty for the whole of a concession with
the price set on the basis of an assessment
of the volume within the concession. The
agreement holder having paid a lump sum,
then has every incentive to extract as much
timber from the area as possible.

"A system such as this might mean higher
average royalty rates depending on the volume
extracted but an analysis of the rates of
return suggest that the timber industry
could absorb higher average combined royalty
and premium rates. Thus the advantages of
a lump sum method of payment, with higher
average royalties, would be:

(1) the more intensive utilisation of
     species presently marketed;

(2) the utilisation of species not
     presently marketed; and

(3) redistribution of income from permit
     and licence holders to Johor State.

"It is estimated that a revised system such as
this will of course raise the revenue accruing
to the State from forestry, and that an appli-
cation of the reserve prices calculated to
give the agreement holder a 20 percent p.a.
return on capital will almost double the
State's revenue from forestry.

In addition to these recommendations on
royalties, the Draft Project Report also contained
recommendations that in future the export of logs
should not be subject to quota, and that the exis-
ting 10 percent ad valorem duty should be replaced
by a specific export tax of about $10 per FD ton.
The more detailed submission read as follows:—

"It is also recommended that changes should
be made in the policy of exporting logs.
Under the present system the export of logs
is allowed to Singapore, subject to an export
duty of 10 percent; but export of logs else-
where is subject to quota, supposedly con-
fined to logs unsaleable on the local market
and comprising a maximum of 25 percent popu-
lar species. Since in 1969, 40 percent of
logs exported (excluding exports to Singapore)
were Meranti and Keruing, the rules are
clearly broken, to the detriment of employment
and income in Malaysia."

"It is recommended that Singapore, should be
treated like any other foreign country, and
should no longer have favoured access to
Malaysian logs. It is further recommended
that the export quota be replaced with an
export tax of $10 per FD ton."

The Supporting Report went on to say,

"These export duty and royalty/premium mea-
sures would go some way in encouraging the
more intensive and extensive exploitation
of the forests and at the same time would
transfer some of the high profits from indi-
viduals in Johor to the State Government.
But the change to a general export duty
would be a more effective instrument if
linked with a revised royalty/premium system
introduced in all States in West Malaysia.
The change to an export duty on logs going
to countries other than Singapore would be
an improvement on the existing system, but
the UNDP study on 'Forest Industries' should
consider other incentives and methods to
ensure further processing of timber. These
could include specific subsidies or grants
to particular processing activities".

3. THE REVIEW GROUP'S REACTIONS

Subsequently, the Review Group established
by the Government to consider the recommendations

contained in the Draft Report that — "Because of
excessive profits in the logging industry it is
agreed that an upward revision of the royalty/
premium rates was desirable, subject to State
Government policy acceptance. This could also
be applied through a stumpage assessment of the
growing stock as proposed with a reserve price set".

In subsequent meetings, however, the consul-
tants were advised that it was premature to intro-
duce the recommended system in all states and that
it would be undesirable to introduce the new system
in the State of Johor alone. The reason given for
the latter was that, under the system recommended,
the logs would not be marked and there would be
no check on the origin of particular logs. Such a
check was a necessary aid to the control of illegal
felling, as well as the evasion of royalties.

The consultants advised that Sharikat Jengka
Sendirian Berhad had emphasised that there was
little incentive to take out the less popular species
because of the specific royalty system, and suggested
to the Johor State Forestry Department that a lump
sum payment system should be adopted but that logs
should continue to be marked for control and recording
purposes.

The State Forestry Department rejected this
recommendation on the grounds that it was premature
to introduce a lump sum or reserve price system in
the State as a whole and that if such a system were
applied to the Johor Tenggara area alone, there would
be complaints of "unfair treatment" from other licence
and permit holders. But the State Forestry Officer
did point out that in particular cases, he had the
power to vary the royalty and that such provisions
could be used to encourage the utilisation of the
less profitable or unprofitable species. These
powers are contained in the Johor Forest Rules of
1922, Enactment 58, as amended. Sub-sections of the
Enactment state that:—

"the Conservator or any Forest Officer em-
powered by him on this behalf may remit or
reduce the royalty on forest produce which,
on the report of a Forest Officer not below
the rank of Ranger, he may adjudge to be felling-
waste or of inferior quality".

and that:—

"With the previous approval of the Ruler in
Council in each case the Conservator may, from
time to time, if it appears to him desirable
in the public interest to expedite the removal
of forest produce generally or of any specified
kind of forest produce from any area, order
that royalty be levied on all or any specified
kind of forest produce removed from such area
at a rate or rates lower than the rate or rates
prescribed under these rules, provided that no
such order shall continue in force or a longer
period than two years".

4. CONCLUSIONS AND ASSUMPTIONS USED IN JOHOR
    TENGGARA.

It is arguable that a large proportion of the
costs shown in Table F.2 consists of the cost of
building access roads, logging camps and other
'fixed' facilities. If these costs are absorbed
by Meranti, Keruing, Chengal and the other more
profitable species, then it may be worthwhile, on
a marginal cost basis, to extract Keranji, Kempas
and the other less profitable species.

But on grounds of administrative simplicity
and to make the individual species or species
groups uniformly profitable, a lump sum payment
is still favoured by the consultants. If a lump
sum payment system is not introduced, there is a
danger that less of the timber will be utilised.
In the 92,000 acres in Johor Tengah that will feed
the logging and sawmilling complex, the timber that
might be left in the forest under the present
royalty system but which it may be worthwhile to
extract under a lump sum system could be more than

500,000 FD tons or more than 5 FD tons per acre. This would represent more than 30,000 FD tons per annum with a potential sales value as rough sawn air-dried timber of more than $3 million per annum.

It should be emphasised that the State Forestry Department would not lose revenue with the application of a lump sum payment. Table F.3 shows the calculation of the total royalties if the "less profitable" species were exploited. The total of royalties on the volume estimated on the basis of the 95 percent lower confidence limit is about $18.9 million. If the mean estimated volume of about 2.05 million FD tons is taken, the total royalties payable would be about $21 million. If a premium were payable equal to the "guidance premium" calculated by the State Forestry Department on the present Forest Reserves, another 20 percent would be payable. The total combined royalty and premium would therefore be about $25 million.

TABLE F.3   Johor Tengah – "92,000 Acres Complex" – Total Royalties

Species and Royalty Group 1 – Major Produce	Net Utilisable Volume Thousand Tons T.V.	Thousand F.D. Tons	Royalty Rate ($ Per F.D. Ton)	Royalty Payable ($ Million)
Class (1)				
Chengal	54	47	25	1.18
Class (2)				
Balau	103	90		
Membatu	13	12		
Merbau	9	8		
Resak	58	50		
Kapur/Keladan	148	128		
Total Class A(2)	331	288	15	4.32
Class B				
Keruing	194	169		
Red Meranti, Seraya, Nembesu	561	488		
White and Yellow Meranti	75	64		
Mengkulang	93	81		
Total Class B	923	802	10	8.02
Class C				
Keranji	58	50		
Kempas	132	115		
Kelat	98	85		
Other MHW	48	41		
Kedondong	141	122		
K. Semangkok	49	43		
Nyatoh	68	59		
Other LHW	224	196		
Total Class C	818	711	7.5	5.33
Total (Average All Classes)	2,126	1,848	(10.2)	18.85

This is equivalent to about $12.2 per FD ton on the mean estimated volume of 2.05 million FD tons. For the purposes of the main financial analysis of the timber complex in Part I of

this volume, it has been assumed that a combined royalty and premium would be payable in the form of a lump sum, but phased in accordance with the proportion of the total acreage that is worked each year. If the present specific royalty system continues to be applied, there is a grave danger that most of the logs under Class C would not be exploited and that the State's revenue from the 92,000 acres would be less than $20 million compared to the $25 million or more assumed here. In addition, a valuable opportunity for increasing Malaysian incomes from the forestry resource would literally go up in smoke.

APPENDIX G

1. PROCESSING IN WEST MALAYSIA

Output from forestry operations in West Malaysia has grown faster than the processing of timber. In 1960 exports of timber and timber products totalled about 500,000 cubic tons but by 1969, the exports of timber and timber products totalled about 1.9 million cubic tons valued at about $250 million (see Table 3.1 Chapter 3). But whereas in 1960, only about 17 percent of the log outturn in West Malaysia was exported as logs, by 1969 something like a quarter of the log outturn was being exported in unprocessed form. Admittedly the proportion of total sawmill output that was exported had grown during the decade from about a quarter in 1960 to over 40 percent in 1969 and the production of plywood and veneer had grown from virtually nothing in 1960 to more than 250 million square feet in 1969, but at the end of the 60's there were still no significant exports of mouldings and other components, chipboard, fibreboard, or even hardwood chips for pulping. (The input into plymills however still represented less than one-tenth of the log outturn in 1969).

The present yield of timber from each acre of forest reserve exploited is about 12-15 FD tons; the yield could and should be raised in two ways – firstly by a more intensive utilisation of the existing 'commercial' species, and secondly by making use of those species which are now left in the forest. It is the consultants' view that a major cause of the low level of utilisation is the royalty and premium structure which far from encouraging better utilisation probably acts as a disincentive to both more intensive and extensive utilisation.

Since there is no incentive for further utilisation, there exists in Malaysia little expertise in further processing techniques and in marketing. Linked to the problem of royalties and premia is the control of log exports. If the further processing of logs currently exported could be introduced, something like 3,000 to 4,000 additional jobs would be created in West Malaysia based on the volume of log exports in 1969 and assuming no further processing than merely sawmilling. (This is calculated on 1 million tons of logs exported which, when sawn, would give about 0.6 million tons of sawn timber. On the basis of about 150-200 tons of sawn timber output per employee per annum, Appendix J, this would mean another 3,000 to 4,000 full-time jobs).

2. THE PROSPECTS FOR FURTHER PROCESSING

The average f.o.b. price of timber products exported from West Malaysia in 1969 was a little over $140 per ton. The average price for exported logs was about $80-$85 per ton (f.o.b. before export duty) and the average f.o.b. price for sawn exported timber was about $200 per cubic ton. The average price on the local market varied depending on whether or not it was pressure treated from about $120 to around $170 per cubic ton at the point of use. The Census of Manufacturing Industries 1968 (Table 289) gives the average ex-mill value of sales as $118 per ton of rough sawn timber sold locally and as about $172 per ton for rough sawn timber exported. These prices are somewhat lower than the prices obtained for this report from individual sawmills in Johor but the export price in the Census is reasohably consistent with the average export price (given in Export Statistics) in 1968 of $188 per ton once an allowance is made for transport costs to the port. (But the volume stated by the Census of Manufacturing Industries as being exported in 1968, 750,000 tons, was very different from the export figure given in the export statistics for

1968 about 565,000 tons). Thus the weighted average ex-mill price of sawmill output in West Malaysia in 1969 was probably about $150 per ton.

Table G.1 shows the current prices of timber products at various stages of processing. The prices are also shown in terms of log input. These are the current prices and reflect the mix of species exported in these forms. The profitability of the processes should be the determining factor, but the data on costs are not reliable and prices have had to be used as a guide to the profitability. Using these prices and subject to further considerations discussed below the best marketing strategy is to sell as much timber as possible in the following order of preference; plywood, mouldings, kiln dried export timber, air dried export timber, and pressure treated timber for local sale (especially for timber housing). Plywood is ranked first because it has a comparatively large and well known market where it will be comparatively easy to sell suitable timber in a high value form. Sales of mouldings and kiln dried timber will need the establishment of new market links, which will take some time to develop.

When considering whether to process timber to later stages, the general principle should be to add to the processing so long as the additional profit is sufficient to give an acceptable return. If the processing company is Government-owned, this might mean that further processing should be required to earn a rate of return on the additional investment of at least 10 or 15 percent per annum. But there are several problems in assessing the best mix. These are:

(i) there may be some existing production capacity which will be put out of production by the new facilities because of a shortage of timber. The social rate of return might therefore be below the financial rate of return calculated when considering the new facilities alone;

(ii) Many of the further processes are untried in Malaysia and costs and selling prices are therefore not known except within very broad ranges;

(iii) the royalty and premia policy is such that what is profitable to the nation is not necessarily profitable to the company doing the processing. If the royalty structure is kept in its present form, some processing is commercially unprofitable;

(iv) little is known about likely future trends in selling prices, so that the future pattern of profitability may differ from that of the present.

The future price prospects for timber products seem promising. FAO publications (1961 and 1966) forecast that the estimated world consumption of sawn wood will rise from 1960 to 1975 at a rate of between 1 and 2 percent per annum, but the same publications forecast much faster rises in the consumption (in both SE Asia and the rest of the world) of wood-based sheet materials, such as plywood and particle board, and in pulpwood. The price prospects for reconstituted wood products are probably brighter than for sawn timber, but as studies by World Bank and FAO indicate an increasing world shortage of wood especially of the broad-leaved tropical hardwoods produced in Malaysia, the price prospects for sawn timber are also favourable. But since it is impossible to predict the likely price increases and since they are in any case not likely to be spectacular in the 70's, the prices in this report have been taken at current (1970) levels up to 1990.

As indicated earlier, processing in Malaysia beyond the sawmilling and plymilling stages is insignificant. There are however, prospects for reconstituted wood industries (Appendix E) and scope for

developing industries which may loosely be called 'joinery' industries.

TABLE G.1	Prices of Timber Products in West Malaysia	
	Average Price(1)	
	$ Per Ton	
	Of Product	In Terms of Log Ton
Exported as logs to Singapore	80	80
Sold as .6 tons rough sawn air dried timber on local market	120	72
Sold as .6 tons pressure treated rough sawn timber on local market	167	100
Exported as .6 rough sawn air dried timber	200	120
Exported as .6 tons rough sawn kiln dried timber	250	150
Exported as .5 tons plywood	310	155
Exported as .4 mouldings	450	180

(1) For exports, valued fob for local sales, valued at the point of consumption.

Note:

The profitability of the processes should be the determining factor, but the data on costs are not reliable and prices have had to be used as a guide to the profitability.

The most valuable products in this field are 'component' products such as knock-down furniture and mouldings. At present, the scope for furniture 'kits' for exports is not known but is under examination by the Pahang Tenggara project. At the moment the production of mouldings in Malaysia is small, and most of the production is for domestic consumption, exports in recent years having been less than 500 tons a year. The markets for mouldings — for door and window frames skirting boards, beadings etc — are at the moment mainly in North America and Europe; in both these areas demand is growing and the Australian market is promising. The main species presently moulded are Red Meranti, Jelutong and Ramin, but other species such as Kedondong, Medang and Merawan could also be successfully moulded.

"Component parts" must be reduced to and maintained at acceptable levels of moisture content (6-8 percent) if they are to compete on world markets. 'Green' or 'air-dried' lumber will plane more easily than 'kiln-dried' lumber but the material containing the higher moisture content will not finish as well. In Malaysia, kiln-drying seems to be limited to less than one-tenth of exports and probably a considerably smaller porportion of the domestic consumption. The profitability of kiln-drying will depend very much on the throughput; in a fully-occupied kiln, the cost of kilning say one inch thick Meranti is about $20-$25 per ton (Appendix K) while the charge commonly made is about $50 per ton. The extreme sensitivity of cost to capacity utilisation is due to the very high proportion of total costs that are fixed.

The major product of the wood industries in Malaysia is rough sawn air-dried timber. About two-fifths of sawn timber production is exported;

this comprises the higher grades of the more popular species which command a substantial price premium. The local market absorbs the lower grade timber. Table G.2 shows the prices for the different species if sold as rough sawn air-dried timber together with the quantities exported from West Malaysia in 1969. Most of the local market sales appear to go to the construction industry with small sales going to planing mills and joinery works for further processing. The bulk of the rough sawn timber appears to be sold in air-dried form although something like 10-15 percent is pressure treated with preservative. Pressure treated timber sells at a premium of about $45 per ton, compared to a cost of treatment of about $25-$30 per ton.

TABLE G.2   Current (1970) Prices of Rough Sawn Air Dried Timber in Malaysia

Species	Prices $ per ton			Quantity Exported from West Malaysia 1969 Thousand tons (rounded)
	Export fob		Local ex-mill	
	Select & Better	Standard Better		
Heavy Hardwoods				
Balau		250	200	1
Chengal		280	270	1
Keranji			95	–
Merbau		270	210	13
Resak	200			–
Medium Hardwoods				
Kempas		150	95	24
Keruing		200	110	192
Kapur & Keladan		200	180	40
Mixed M.H.W.		135	95	3
Light Hardwoods				
Lt. Red Meranti	230		120	97
Dr. Red Meranti	240		120	151
Red Meranti (mixed)	225		120	48
Mengkulang	240		120	15
Yellow Meranti	200		95	3
Mersawa	180		95	19
Jelutong	220		120	18
Nyatoh	215		95	12
Ramin	260		120	–
Sepetir	200		120	–
Mixed L.H.W.	140		95	10

Source: Discussions with trade.

Pressure treating the less popular hardwoods for use in pre-fabricated housing may be the best way of utilising them. The biggest demand for pre-fabricated housing currently comes from FLDA. Table G.3 lists the contracts for the whole of 1970 and the first four months of 1971 for housing units to be supplied to FLDA. The list shows the names of the contractors, the State in which they are located, the number of units to be supplied a and the location of the schemes to be supplied. The list shows that there is at present only one supplier (Sharikat Ong Kian Teck) who supplies from Johor State. The present sources of supplies for Johor schemes are therefore 50 miles or more

distant. The future demand in Johor will however be substantial. New households in the project regions (excluding those in Kluang and Kota Tinggi) are likely to be somewhat as follows:

	Number of household (thousands)	
	Tanjong Penggerang	Johor Tengah
1970 - 1975	.7.5*	1.8
1976 - 1980	4.9	4.5
1981 - 1985	3.3	3.1
1986 - 1990	2.5	0.9

* Includes all FLDA.

From 1975 onwards, the majority of the new households in Tanjong Penggerang arise in connection with the tourist centre on the east coast. The sawmill in Johor Tengah is unlikely to be in operation until after the end of 1974, but even from the beginning of 1975 to the end of 1985 the number of new houses required for agricultural settlements in the regions is approximately as follows:

	Number of units (thousands)
1975 - 1980	9.0
1981 - 1985	3.9

This represents an average over the 11 years of at least 1,000 units per annum, and would enable a constant annual output of at least 500 units to be maintained. If account is taken in the later years of a possible market in Kluang, Kota Tinggi and north-east Johor, it should be possible to sustain an annual output of at least 1,000 units for 15 years. Since each house requires something like four tons of timber, this represents a minimum timber market of about 4,000 tons per annum.

TABLE G.3   Housing Supply Contracts – FLDA - 1970 - April 1971

Name of Contractor and Location (State)	Number of housing units to be supplied		
	In Johor	In Other States	Total
Ho Siong & Eng Kwee – Pahang		1,884	1,884
Lim & Lim – Penang	159	425	584
Prefabricated Timber Houses Ltd., – Selangor	514	1,437	1,951
Mohd. Yusof bin Lalkhan – Negri Sembilan	48	837	885
Sharikat Ong Kian Teck – Selangor (also Johor)	210	1,235	1,445
Sharikat Perusahaan Kayu – Selangor	–	865	865
United Building Construction Co., – Pahang	–	776	776
Nordin bin Md. Amin – Negri Sembilan	–	300	300
Ho Hai Yong – Pahang	–	623	623
Sharikat Pemborong – Serbaguna – Negri Sembilan	–	446	446
T O T A L	931	8,828	9,759

FLDA specifies that heavy hardwoods (given as balau, chengal, merbau and resak) be used for posts, stumps and frames; that medium hardwoods (given as keruing, kempas, kulim, perupok, mengkulang and tualang) be used for rafters, purlins, tie-beams, floors and panel frames; and that medium or light hardwoods (given as meranti, ramin, bintangor, geronggang, and mersawa) be used for wall claddings, cover battens, shelving etc. Most of the wood used can therefore be medium and light hardwood.

A prefabricated operation would involve the following processes:

(i) Precutting and boring of bolt holes would require joinery facilities, such as narrow gauge bandsaws, cross-cut saws, and power drills; medium and light hardwoods would be pressure treated and all machining would be carried out before impregnation (both required by FLDA). Planing would be required for some components of settlers' houses, and, for more elaborate structures, some moulding would be needed. Facilities for planing would be available in the moulding section of the sawmill;

(ii) Pressure treatment facilities are included in the sawmill complex;

(iii) Assembly: hand tools and simple jigs would be needed to assemble the panels. Simple doors and shutters, door and window frames, could be completely manufactured at the plant.

(iv) Erection would take place on site requiring only hand tools.

For calculating the sales values of the output from the Johor Tengah complex, only the sales value of the pressure treated timber is included. Profits on assembly are excluded (see subsection 4 of this Appendix).
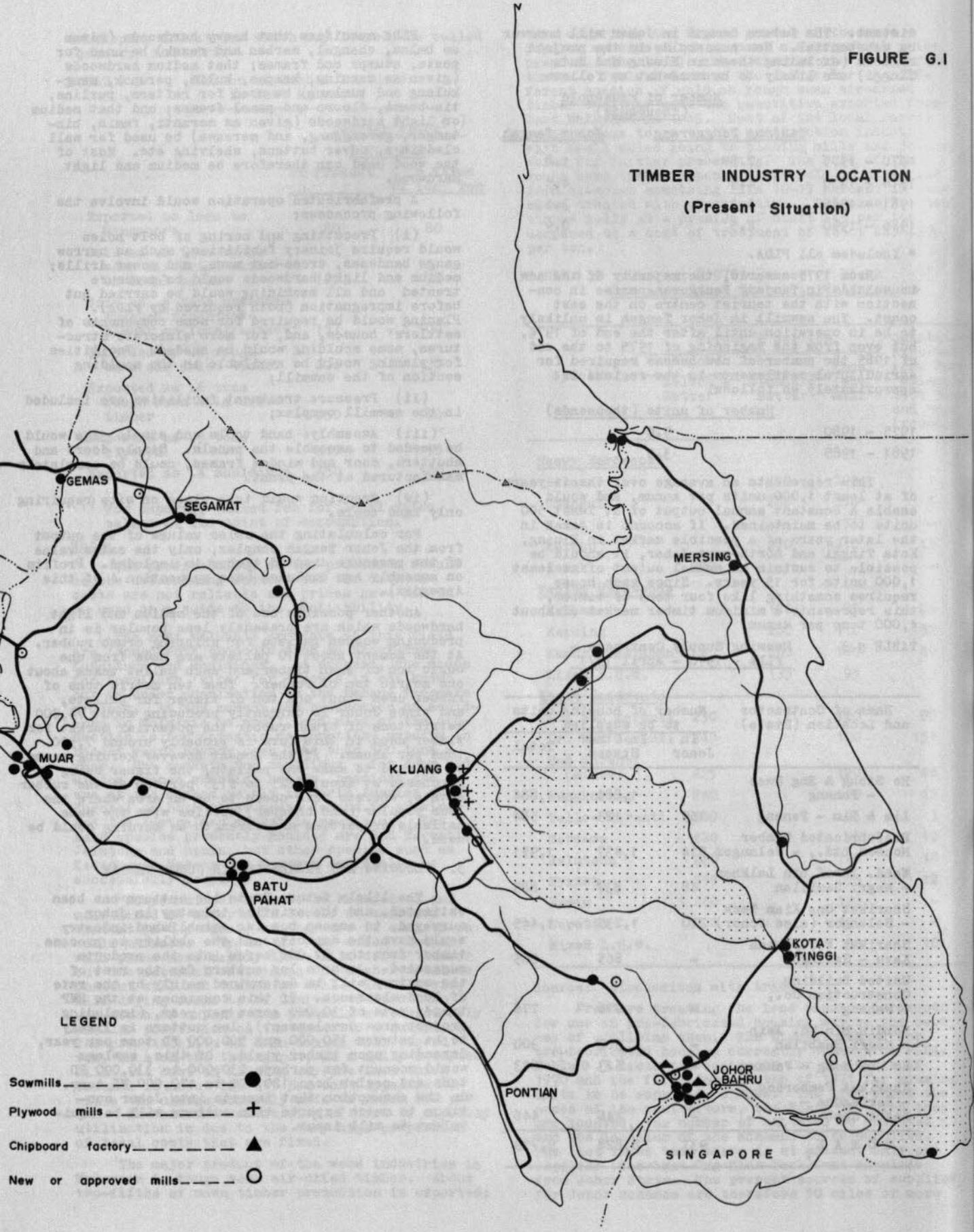
Another possible use of the medium and light hardwoods which are presently less popular is in producing wooden pallets for shipping crumb rubber. At the moment about 10 pallets are made from one cubic ton of sawn timber and each pallet takes about one metric ton of rubber. Thus ten metric tons of rubber uses about one ton of timber for pallets, and since Johor is currently producing about 75,000 metric tons of crumb rubber the potential market for timber used in this form is probably around 7,500 tons per annum. At the moment however keruing seems to be used to make the pallets, the timber being purchased at about $125 to $135 per ton at the rubber estate, whereas this seems to be an area where the less popular (and cheaper) species with the same nailable properties and strength as keruing could be used.

3.   LOGGING AND PROCESSING IN JOHOR TENGAH

The likely future State log outturn has been estimated, and the existing industry in Johor surveyed, to assess how far established industry would have the capacity and the ability to process timber from the 92,000 acres into the products suggested. Johor's log outturn for the rest of the century will be determined mainly by the rate of land clearance. If this continues at the SMP target rate of 30,000 acres per year, (including project area development), log outturn is likely to be between 350,000 and 500,000 PD tons per year, depending upon timber yield. Of this, sawlogs would account for perhaps 230,000 to 330,000 PD tons and peeler logs 120,000 to 170,000 PD tons. On the assumption that imports into Johor continue to match exports then outturn will be equivalent to mill input.

TIMBER INDUSTRY LOCATION

(Present Situation)

GEMAS

SEGAMAT

MERSING

MUAR

KLUANG

BATU
PAHAT

KOTA
TINGGI

PONTIAN

JOHOR
BAHRU

SINGAPORE

LEGEND

Sawmills _ _ _ _ _ _ _ _ _ _ _ _ _ ●

Plywood mills _ _ _ _ _ _ _ _ _ +

Chipboard factory _ _ _ _ _ _ ▲

New or approved mills _ _ _ _ ○

1:1013760

Scale 16 Miles to an inch

Miles 16   8   0   16

The capacity of Johor State's plymills and sawmills is likely to rise (Table G.4) from 437,000 FD tons actual input in 1969 to about 800,000 FD tons of logs annually in a few years time.

If sawmills increased the intensity of operations (in 1970 only four out of 41 sawmills were working two shifts) by raising working hours to an average of 12 per day this capacity would rise to about 1.1 million tons annually. If capacity is installed in the project area to handle 120,000 FD tons per annum then this capacity of 0.8 to 1.1 million tons would be competing for 230,000 tons to 380,000 tons of logs per annum.

TABLE G.4   Johor Wood Mills: Existing and Approved: October, 1970

| | Number | Log input capacity thousand tons FD true | |
		A(1)	B(2)
Established			
Sawmills	41	356	534
Plymills	5	81	81
New mills gearing up or existing mills being extended			
Sawmills	5	95	142
Approved, and intended but not yet operating			
Sawmills	10	187	280
Plymills	7	85	85
T O T A L	–	804	1,122

(1) Input A; Existing Mills : 1969 input
            New Sawmills : estimated on basis of 1 shift/day.
            New Plymills : estimated on basis of 2 shifts/day.

(2) Input B; Existing Mills : 1969 input plus 50 percent.
            New Sawmills : estimated on basis of 1½ shifts/day
            New Plymills : estimated on basis of 2 shifts/day

But even though capacity would be adequate on existing standards, it might not be geared to meeting the opportunities of the new high value markets already mentioned. Plymills within the State appear generally efficient, but sawmills show a wide range of competence. Even assuming large scale expansion in mill capacity it is believed that only a minority of mills with a capacity of about 220,000 tons (one shift basis) per annum will have both automatic headrigs and ponyrigs capable of producing timber sawm accurately enough to command the highest prices or of producing mouldings. There is at present no moulding industry and little dry kiln capacity in Johor.

If, therefore, project area timber is sold to existing industry, nothing will have been done to improve the average quality and grades of Johor timber. Additional mill facilities in the project area would however achieve this. As much timber as possible would be moulded and as little as possible sold as air-dried rough sawn lumber.

But it would be difficult to justify extra plymilling capacity, since the plymills in Johor seem to be efficient and their capacity will be between 150,000 and 200,000 FD tons per annum by the time that the first logs start to come from the

92,000 acres. This will be more than adequate for the likely outturn from Johor State.

The Draft Project report stated that:

"The establishment of a sawmill with a through-put of about 50,000 FD tons per annum is therefore recommended. A mill of this capacity could expect to produce specialised products over a 15 year period, which is long enough for economic viability. This period would also provide time to find markets for species not now used, to attract external participants and to train Malays. But the new enterprise should compete for logs on the open market on the same terms as existing sawmills and should be separate from the logging activities. Existing efficient interests would not therefore be jeopardised by the new sawmill proposed".

The Supporting Report to the Draft Report stated that:

"This recommendation derives from the wider view that the industry is at present subject to too much administrative regulation. Market forces, aided by a modified royalty and premium system, should be allowed to exert a greater influence".

"The implication of the measures recommended is that there will be much greater pressure on profits in the timber industry. The basic 20 percent return on invested capital postulated earlier for timber processing plants would only be achieved if a much higher level of capacity working or processing is attained than at present. Mills which did not, or could not, obtain enough logs to enhance their efficiency would earn lower profits".

"The effect of such a change in policy would be a stream-lining of milling capacity to a level more commensurate with prospective log supplies".

"In this situation there would be no need to license sawmills to keep capacity in line with log supply, and it is recommended that sawmill licensing by the Forest Department be abolished. Furthermore competitive forces should not be lessened by long term logging agreements guaranteeing a mill an assured supply of timber for up to 20 years. It is recommended that the maximum logging agreement period be reduced to three years".

The views of the Review Group of the Government in regard to these recommendations were as follows:

"It is considered however that higher royalties would not be sufficient to induce fuller utilisation of the standing timber. The Group considered that the proposed processing complex in Johor Tengah should be integrated with logging. Peeler logs from the logging operation can however be sold to the existing industry. For this purpose it is recommended that the concession for logging in Johor Tengah should be allocated to the timber complex to be set up".

For the purposes of calculating the profitability of the complex in Johor Tengah, this report has therefore assumed that logging would be done by one organisation, that this organisation would sell peelers to the existing plymills and that sawlogs would as far as possible be processed in facilities managed and operated by the same organisation. The capacities of the processing facilities have been based on the inventory tonnages in the 92,000 acres but the Project Area need not confine itself to Project Area timbers, especially as regards higher value products, and it could act as a leading agent in developing sales of kiln-dried timber and mouldings. But for the purposes of calculating

Composition of Reliable Minimum Estimate of Utilizable Timber 92,000 acres.

GROUPS AND SPECIES	INVENTORY SPECIES GROUP (1)	UTILIZABLE SPECIES AS % OF SPECIES GROUP (2) %	FORM CLASS CONVERSION FACTOR (3)	ESTIMATED TONNAGE 000 BY SPECIES INCLUDED IN RME TOTAL — N.E. AREA 27,000 acres — Thousand true volume tons	N.W. AREA 65,000 acres	% of TOTAL %
HEAVY HARDWOODS						
Balau	1	28	.84	25.1	77.9	4.8
Chengal	1	14	.84	13.1	40.7	2.5
Keranji	1	16	.84	14.2	44.0	2.7
Membatu	1	3	.84	3.3	10.2	0.6
Merbau	1	2	.84	2.2	6.8	0.4
Resak	1	15	.84	14.2	44.0	2.7
Sub-Total				72.1	223.6	13.7
MEDIUM HARDWOODS						
Kapur and Deladin	4	100	.90	70.5	77.0	7.0
Kelat	5	24.8	.70	28.7	69.1	4.6
Keledang	5	.7	.70	0.9	2.0	0.1
Kempas	2	100	.96	37.0	94.9	6.2
Keruing	3	100	.93	32.2	162.0	9.1
Merawan Batu and) Simput Jantan)	5	1.59	.70	1.7	4.5	0.3
Rengas	5	6.0	.70	6.9	16.3	1.1
Simpoh	5	3.8	.70	4.4	12.2	0.8
Sub-Total				182.3	438.0	29.2
LIGHT HARDWOODS						
Jelutong	15	100	1.00	3.1	9.2	0.6
Kedondong	17	20.7	.75	43.4	98.0	6.7
Kumbang Semangkok	17	7.2	.75	15.1	34.2	2.3
Machang	17	1.2	.75	2.5	5.7	0.4
Mata Ulat	17	2.3	.75	4.8	10.7	0.7
Medang	17	7.8	.75	16.5	37.3	2.5
Melunak	17	0.9	.75	2.0	4.4	0.3
Mengkulang	16	100	.89	13.4	49.4	3.0
Merpauh	17	0.7	.75	1.4	3.1	0.2
Merawan	17	4.6	.75	9.5	21.5	1.5
Mersawa	13	100	1.00	5.8	13.1	0.9
Nyatoh	17	9.9	.75	20.7	46.8	3.2
Pelong	17	0.3	.75	0.6	1.3	0.1
Ramin	17	0.4	.75	0.8	1.9	0.1
Red Meranti	11			(122.8)	(437.7)	(26.5)
M. Melanti	6	100	.98	15.6	57.2	3.4
M. R. Daun	7	100	.96	10.5	23.7	1.6
M. S. Punai	8	100	.92	11.4	34.1	2.2
M. Tembaga	9	100	.92	24.5	71.6	4.6
Seraya	10	100	1.00	23.9	54.0	3.7
Nemesu	11	34	.92	12.5	67.0	3.7
Other Spp.	11	66	.92	24.4	130.1	7.3
Sepetir	17	1.8	.75	3.9	8.8	0.6
Bintangor	17	6.3	.75	13.1	29.7	2.0
Durian	17	4.2	.75	8.9	20.2	1.4
Geronggang	17	1.3	.75	2.8	6.3	0.4
Terentang	17	0.6	.75	1.4	3.2	0.2
White Meranti	12	100	.87	4.0	11.8	0.7
Yellow Meranti	14	100	.87	7.4	52.0	2.8
Sub-Total				303.9	906.3	57.1
Area Totals RME				558.3	1567.9	
Grand Total					2126.2	100

(1) See Appendix C Table C6 (a)
(2) See Appendix C Table C18
(3) on the basis of data shown in Appendix C Table C8

TABLE G.6

Project Processing Mix and Sales

Species or Group of Species	Net Utilisable Volume – Thousand F.D. tons (1)	Sold as Logs to Pyrills – Thousand of tons F.D. tons	Price Kluang/J.B. ($ per F.D. ton)	Sawmilling (Thousand of sawn timber) – Thousand F.D. tons (2)	Sold as Rough Sawn air-dried timber – Thousand tons of sawn timber	Price fob or in JB $ per ton	Kiln dried timber – Sold as rough-sawn kiln-dried timber Thousand tons of sawn timber	Price (fob or delivered) $ per ton	Mouldings Volume (Thousand tons) Input	Output (3)	Price (fob or delivered) $ per ton	Pressure treated timber Thousand tons	Price (fob or delivered) $ per ton
Heavy Hardwoods													
Chengal	47			47	12		28	280					
Membatu	12			12	7		2	210					
Balau	90			90	54		54	210					
Keranji	50			50	50		30	105					
Merbau	8			8	5		5	210					
Resak	50			50	30		30	210					
Sub-total and (average price)	257			257	154	(195)	107	105					
Medium Hardwoods													
Kapur/Keladan	128			128	77	190	23	280					
Kempas	115			115	69	130	35	130					
Keruing	169			169	101	175	71	175					
Kelat	85			107			64	175					
Other MHW	41	19	50	50			20	275				44	178
Sub-total and (average price)	538	19	(50)	519	311	(145)	193	(175)	74	74	(178)	44	(178)
Light Hardwoods													
Dark Red Meranti, Nemesu and Seraya	138			138	80	85	25	58	130	130		58	
Light Red Meranti	350	193	157	94	38	57	130	130	450	450	450	47	
White and Yellow Meranti	64	64	65	38									
Mengkulang, Durian, Nemesu	96	96	100	55	21		14					32	
Nyatoh	59	25	34	34	7		14						
Kedondong	122	146	50	200	120	110	225	225	50	3	225	450	140
Jelutong	10												
K. Semangkok	43												
Other LHW	171											67	
Sub-total and (average price)	1,053	524	(72)	529	318	(127)	179	(225)	162	108	(140)	67	(140)
Total	1,848	537		1,235	732		406		223	150		102	
1974/5 Sales as Savlogs	6	70	51	14	73	30	18	17	12	7	9		
Total RME and (average price)	1,848	537	(71)	1,235	732	(161)	406	(269)	223	150	(155)	102	(155)
Sales Value $ Million	189.06	38.38	–	4.41 (3)	65.37	–	19.64	–	45.45	–	–	15.81	–

(1) Only the Total represents RME. Species and group volumes have been estimated on a proportional basis.
(2) 60% Conversion Factor.
(3) 66% Conversion Factor.
(4) Savlogs sold at $63 per F.D. ton.

Species and group volumes have been estimated on a proportional basis.

staffing and costs, a product split (Table G.6) has been assumed.

4. ESTIMATES OF UTILIZABLE TIMBER

Table C6 in Appendix C sets out the mean and RME estimates of true volume per acre for the lowland and hill forest blocks. Table C6(a) shows similar figures for the two areas comprising the lowland forest blocks; these have been called the North East and North West areas. The extent of these two areas are 27,000 and 65,000 acres respectively.

Using the inventory data given in these tables, estimates of Utilizable timber have been made and are given in table G.5. The Utilizable volumes have been estimated on the following basis.

Mean values have been used to estimate the volumes of those species in each area which are considered as utilizable. The volumes of this timber are 76 and 78 percent of inventory volume for the respective areas. A further reduction has been made to account for form class. This factor varies between 0.7 and 1.0 according to the species and reduces the net utilizable timber to 64 and 67 percent of the inventory volumes respectively. The total volume so obtained for each of the two areas has been reduced by 10.7 percent and 9.2 percent to give R.M.E.s for the total utilizable timber for the North East and North West areas respectively. The percentages used represent the variation of the sum of the RMEs of the three main group (Heavy, Medium and Light Hardwoods) from the sum of their mean values. The RMEs for the two areas are 558 and 1568 thousand true volume tons giving a total RME of utilizable timber of 2126 thousand true volume tons. The mean volumes of individual species have been reduced by the same percentages as the total. The individual species' volumes are therefore only orders of magnitude and do not reflect the RME of the individual species. These would in most cases be substantially lower. Using the data obtained from the inventory on the proportion of logs within species suitable for peeling and other market information an estimate of peeler logs of 456 thousand true volume tons has also been made.

5. SALES AND CAPACITIES IN THE JOHOR TENGAH COMPLEX

The estimates of sales value given in table G6 are based on the utilizable timber given in table G5. It will be seen from table G7 which compares the proposed Johor Tengah log outturn with recent average Johor and West Malaysian log outturns in table G7 that an increased proportion of certain species mainly heavy and light hardwoods will be marketed.

These species are the lower priced species which are less popular at the present time. However it is considered that with the additional processing proposed for these species (table G6) and with alteration in the present systems of royalty payments, the volumes of these species given here can be sold at the prices indicated. These prices are 1970 ex-mill average prices (table G2) plus an allowance of $10 per ton to cover transport from the mill to the port or consumer.

The proposed mix of processing capacity is also shown in table G6. All export grade Meranti, Jelutong, Kedondong, Medang, and Merawan is assumed to be sold as rough sawn air-dried lumber. Export grades of the medium hardwoods and non-mouldable light hardwoods are assumed to be exported as kiln-dried rough sawn. About half the local market grade mixed light hardwoods are for use partly in timber housing. But some of the timber classified here as marketable would be difficult to market. Keranji in particular presents a problem: it is not exported and is an unpopular species on the local market. It may be possible to use it in the production of parquet flooring blocks and flooring strips. This requires further research.

TABLE G.7   A Comparison of Timber Volume by Species in Johor Tengah with Outturn in Johor State and West Malaysia

Hardwoods Groups and Species	Johor Tengah[1]		1967 Outturn[2] -%	
	Thousand FD Tons[3]	Percentage	Johor State	West Malaysia
Heavy Hardwoods				
Balau	90	5	3	4
Chengal	47	3	1	1
Other HHW	120	6	1	2
Medium H/Woods				
Kapur, Keladan	128	7	9	6
Kempas	115	6	7	3
Keruing	169	9	21	20
Other MHW	127	7	7	6
Light Hardwoods				
Red Meranti, Nemusu and Seraya	138 }			
Red Meranti (other)	350 }	26	31	36
Yellow Meranti	50	3	2	2
White Meranti	14	1	1	1
Jelutong	10	-	1	1
Durian, Mersawa, Mengkulang	96 }			
Other Light Hardwood	394 }	27	18	19
Total Utilisable Timber RME	1,848	100	100(4)	100(4)

Notes:

(1) 92,000 acres which includes 21,000 acres of water catchment.

(2) Annual Forestry Report for West Malaysia, 1967.

(3) Reliable minimum estimate that is mean total volume less twice the standard error of the mean. Species and group totals are used solely to indicate orders of magnitude.

(4) Does not sum due to rounding.

APPENDIX H

ORGANISATION, TIMING AND TRAINING

1. TIMING

The only experience in Malaysia of the timing of a project similar to the one considered here for the Johor Tengah region has been the Jengka Triangle forestry project.

The Jengka forestry project was based on a comprehensive study of the Triangle by Tippetts-Abbett-McCarthy-Stratton and Hunting Technical Services Limited presented in January 1967. The report recommended an integrated forest industry complex, including sawing, plymilling, and pre-fabricating facilities. The capital investment required during the first three years was estimated to be more than $25 million. To bring about a high degree of utilisation in the necessary time and at the same time to manage an investment of this size, it was thought desirable "to establish a joint venture between a Malaysian partner and a company from the United States, Canada, the Philippines, Japan or Australia that can supply the necessary management, capital and captive markets (or sufficient skill to obviate the need for captive overseas markets)".

However, according to the Second Jengka Triangle Report (IBRD April, 1970), MARA had already, in 1966, been made responsible for developing the Jengka Triangle's timber resources. But no formal agreement with the State Government of Pahang had been signed and the MARA subsidiary (Sharikat Kebangsaan Kayu Kayan Berhad), which was responsible for the operation until 1969, worked on annual licences. Exploitation of the forestry potential under this subsidiary was, according to the World

Bank report, poor, and in September 1969 an agreement was signed between Cantrans (Canadian Transoceanic Technical Services Limited) and MARA providing for the management and operation by Cantrans of logging and timber processing in the Triangle. This agreement followed a proposal put forward by Cantrans which was, at least in part, based on reports submitted by Charnell International Consultants Limited and S.G. Gardiner Engineering Services Limited (March 1968).

In April 1970 a company Sharikat Jengka Sendirian Berhad (SJSB) was formed to establish and operate the forest industry complex in the Jengka Triangle with an authorised share capital of $20 million of which up to $10 million could be issued for cash subscriptions by MARA and another $3 million by the Pahang State Development Corporation. An additional $4.5 million was issued in non-voting shares to 1800 timber licence holders in the Triangle in exchange for logging rights. These latter shares will be redeemed at par when SJSB has completed logging operations over 90,000 acres. In addition a World Bank loan would provide US$8.5 million ($25.5 million) to finance the foreign exchange costs including interest. The forestry loan is for 12 years with a grace period of 4 years. The interest rate was not given in the IBRD report.

The organisation chart for SJSB, as given in the World Bank report, is reproduced in Figure H.1. It is stipulated that the Board of Directors will have not less than 3 nor more than 15 members. According to IBRD, 1970, fourteen directors have been appointed; they include representatives of MARA, the Ministry of National and Rural Development, the Treasury, Pahang
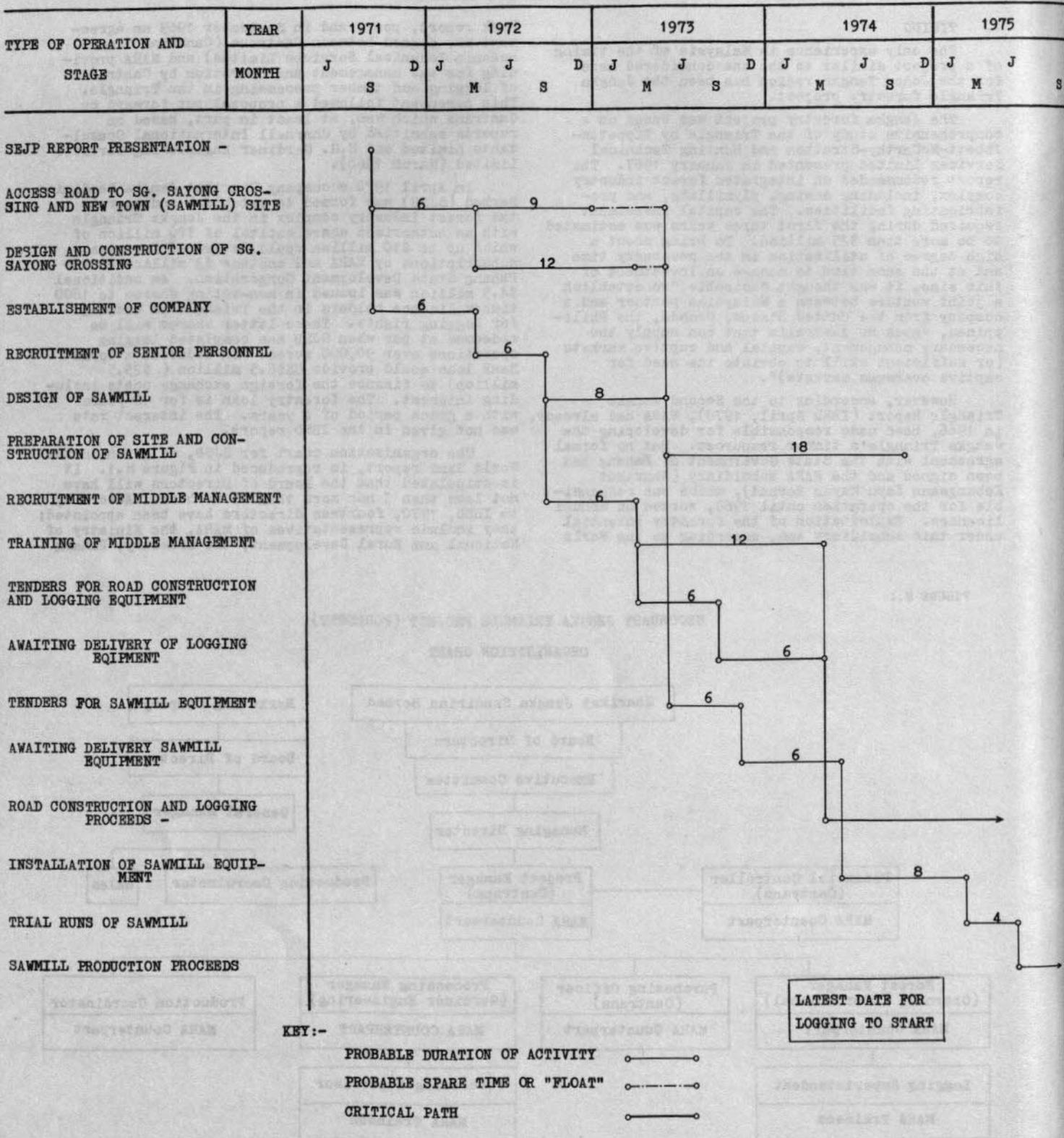
FIGURE H.1

SECONDARY JENGKA TRIANGLE PROJECT (FORESTRY)

ORGANISATION CHART
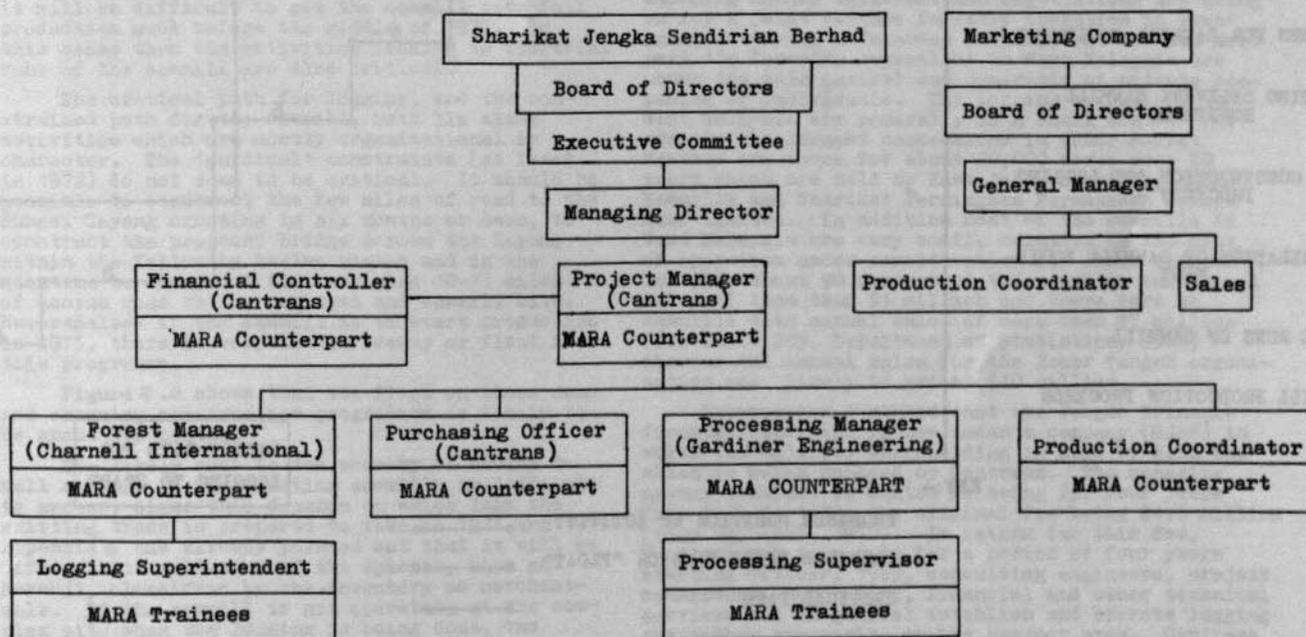
SOURCE: ANNEX 22, IBRD, 1970

TYPE OF OPERATION AND STAGE	YEAR	1971		1972		1973			1974		1975
	MONTH	J S	D	J M	J S	D	J M	J S	D	J M	J S

SEJP REPORT PRESENTATION –

ACCESS ROAD TO SG. SAYONG CROSSING AND NEW TOWN (SAWMILL) SITE

DESIGN AND CONSTRUCTION OF SG. SAYONG CROSSING

ESTABLISHMENT OF COMPANY

RECRUITMENT OF SENIOR PERSONNEL

DESIGN OF SAWMILL

PREPARATION OF SITE AND CONSTRUCTION OF SAWMILL

RECRUITMENT OF MIDDLE MANAGEMENT

TRAINING OF MIDDLE MANAGEMENT

TENDERS FOR ROAD CONSTRUCTION AND LOGGING EQUIPMENT

AWAITING DELIVERY OF LOGGING EQIPMENT

TENDERS FOR SAWMILL EQUIPMENT

AWAITING DELIVERY SAWMILL EQUIPMENT

ROAD CONSTRUCTION AND LOGGING PROCEEDS –

INSTALLATION OF SAWMILL EQUIPMENT

TRIAL RUNS OF SAWMILL

SAWMILL PRODUCTION PROCEEDS

LATEST DATE FOR LOGGING TO START

KEY:-

PROBABLE DURATION OF ACTIVITY   o———o

PROBABLE SPARE TIME OR "FLOAT"   o—·—·—o

CRITICAL PATH   o═══o

Development Corporation and FLDA. A former MARA official has been appointed Managing Director, and an executive committee has been formed to manage the day-to-day affairs of the company; it has seven members including the Deputy Chairman and Managing Director of SJSB, and representatives of the Treasury, Pahang State, MARA and FLDA.

In June 1970, logging by SJSB began, and clearing land for the sawmill and plymill began in June and July, 1970. The first trial of the sawmill runs were expected to start in about May or June of 1971 and the first runs through the plymill were expected in 1972.

Thus, the period between the Jengka report and the establishment of a company to operate the forestry complex was about three years. The period between signing the managing agency agreement and the starting of logging was about six months. The time that it took to design the sawmill in detail, to clear the land and to get the mill into operation will have been about one and a half years. The time elapsed between signing the agreement with the managing agents and the commissioning of the sawmill will have been about one and a half to two years.

Figure H.2 shows the anticipated phasing of the forestry project in Johor Tengah based on the experience of the Jengka operation. The phasing is shown for a public sector organisation with staff being recruited on a direct recruitment basis. This is not the only possible type of organisation - the advantages and disadvantages of other possible types of organisation are discussed in sub-section 3 of this appendix.

If the clearing of land for agricultural development is not to be delayed, logging should start by middle of 1974. The activities requiring this to be done constitute the critical path, but if the processing facilities are not in operation by the time that logging begins, some of the sawlogs will have to be sold to the existing sawmills. In as much as the reason for proposing the establishment of a new sawmill is to increase the utilisation of logs, any delays will mean a net cost to the economy as well as to the company managing the complex. But Figure H.2 shows that it will be difficult to get the sawmill into full production much before the middle of 1975. In this sense then the activities leading to the trial runs of the sawmill are also critical.

The critical path for logging, and the constrained path for the sawmill, both lie along activities which are mostly organisational in character. The 'physical' constraints (at least in 1972) do not seem to be critical. It should be possible to construct the few miles of road to the Sungei Sayong crossing in six months or less, to construct the proposed bridge across the Sayong within the following twelve months and in the meantime to construct the remaining 10-15 miles of access road to the new town and sawmill site. Nevertheless if the sawmill is to start production in 1975, there is very little leeway or float in this programme.

Figure H.2 shows that the float on these road and crossing construction programmes is likely to be about two months.

The likely cost to the economy of having to sell sawlogs to the existing sawmills is difficult to assess, since this depends on which logs the existing trade is prepared to take in 1974 and 1975. Appendix G has already pointed out that it will be difficult to sell some of the species, such as keranji, classified by the inventory as merchantable. If the sawmill is not operating at the complex site when the logging is being done, the likelihood of profitably extracting some of the less popular logs is reduced. SJSB expects to raise its extraction rate, once its sawmill comes into operation, from the present 16 FD tons per acre to at least 20 FD tons per acre. If this is taken to be a measure of the loss from not having a sawmill in operation under the control of the complex, the loss of sales would (at something like $100 per ton of sawn timber and about 4 FD tons of logs per acre) be about $100 x 4 x 60 percent equals about $240 per acre. This is almost certainly equivalent to more than $180 per acre in terms of value added (payments to labour, capital and in the form of royalties). If this is a reasonable measure of the loss to the economy through delays in the programme, it implies, that with a logging programme of about 500 acres per month, the loss from delays in getting the sawmill into operation would be about $90,000 per month or about $1 million per annum.

Whether it is worth deferring the logging programme and therefore the agricultural programme to coincide with the start of the sawmill depends on whether alternative land is available for immediate agricultural development, as well as on the losses involved in not having the sawmill ready when logging starts. If no other land is available for agricultural development, the value added lost from deferring, for example, an oil palm scheme by a year would be about $300 per acre. But even if other oil palm land is available for development, once the losses involved in deferring the logging programme (interest on the sales of logs that would otherwise be made) are taken into account, it is probably not worthwhile deferring the logging programme to await the start of the sawmill, if by so doing the agricultural programme is held up.

2. PRESENT LOGGING AND SAWMILLING ORGANISATIONS IN MALAYSIA AND INDONESIA.

Before considering the advantages and disadvantages of different types of organisation, it is useful to outline the types of organisations already operating in Malaysia and Indonesia.

2.1 West Malaysia

The large majority of logging and sawmilling organisations operating in West Malaysia are private companies or individuals. As stated, the Jengka Triangle operation is operated by Cantrans under a managing agency agreement and negotiations are going on for a joint venture forestry operation in Trengganu involving a Japanese company, but for the most part the forestry operations in West Malaysia are under the sole control and ownership of private companies or individuals. The logging operations in West Malaysia are generally on a small scale. For example the largest concessions in Johor Forest Reserve are those for about 20,000 acres over 20 years which are held by East Johor Sawmills, Endau Sawmills and Sharikat Perniagaan Perusahaan Melayu Muar Limited. In addition most of the sawmills in West Malaysia are very small, relative to the size of operation under consideration for Johor Tengah. In 1968, about 90 percent of the sawmills had annual sales of less than $1 million and there were no sawmills with annual sales of more than $5 million (see Table 285, Department of Statistics, 1968) whereas the annual sales for the Johor Tengah organisation are likely to exceed $10 million.

Sub-section 1 stated that the Jengka Triangle forestry operation is now under a company (SJSB) in which the majority shareholding is held by MARA and which is being managed by Cantrans. The managing agency contract is stated as being for four years from 1969 to 1973, the original fee being $4.8 million (page 24, IBRD, 1970). In return for this fee, Cantrans was to supply for a period of four years starting October, 1969, consulting engineers, project management, purchasing, financial and other technical services and in general establish and operate logging and timber processing in the project area. Cantrans was also to train Malaysians locally and in Canada with a view to their being able to take over at the end of the four years (page 24, IBRD, 1970).

Table H.1 shows that under the agreement as envisaged at the time that the IBRD report was written, Cantrans were to supply 580 man-months or about 50 man-years of specialists' time.

TABLE H.1   **Malaysia**
2nd Jengka Triangle Project (Forestry)
Personnel to be supplied by Cantrans
for carrying out the Forestry Project

	Months
Overall Management	
Project Manager	48
Purchasing Representative	36
Installation Supervisor	24
Controller - Accountant	36
Book-keeper	36
Secretary	36
Clerk	36
	252
Logging Division	
Executive Forester	20
Forest Manager	48
Forest Engineer	30
Mechanical Superintendent	24
Logging Superintendent	20
Logging Foreman	18
	160
Processing Division	
Resident Manager	24
Accountant	12
Production Superintendent - Sawmill	24
Production Foreman - Sawmill	12
Dry Kiln Foreman	12
Production Superintendent, Plywood	24
Green End Foreman	12
Reparation and Glue Foreman	12
Finish End Foreman	12
Mechanical Engineer	12
Electrical Engineer	12
	168

November 14, 1969

SOURCE: ANNEX 23, IBRD, 1970.

As far as is known, Jengka forestry products are currently being marketed by East Asiatic Company (the Malaysian subsidiary of a Danish company) under an interim agency agreement concluded in March 1970 with MARA. At the time that the IBRD report was written it was envisaged that the interim agreement would remain in force until a long term agreement is concluded. The long term agreement was expected to be drawn up to cover a ten year period and to provide for the establishment of a Joint Marketing Corporation owned equally by SJSB and East Asiatic. The Marketing Corporation was to handle all local sales and East Aisatic itself all export sales on a five percent commission (page 28, IBRD, 1970)

It seems that the interim agreement is still in force with East Asiatic handling all export sales on a 5 percent commission and SJSB handling all local sales.

2.2 East Malaysia

Logging contractors are generally very much larger in East Malaysia than in West Malaysia. Some of the major companies operating in Sabah are Wallace Bay Timber Company (a subsidiary of Bombay Burmah Trading Company), North Borneo Timber (another subsidiary of the B-B Trading Company), the Kennedy Bay Timber Company (a subsidiary of an American Company), Hup Seng and Teck Fatt, but recently the dozen or so major operators in East Malaysia had their long-term concessions terminated. The long-term plan in Sabah is for the forest to be worked by the Sabah Foundation in which every adult Sabahan has one non-transferable $50 share. The Sabah Foundation has, it seems, one year contracts with seven registered contractors who are paid a fee for every cubic foot of logs extracted.

2.3 Indonesia

Much of the forest area in Indonesia is under the control of Perhutani, the State Forest Enterprise. Prior to President Suharto coming to power, most of the forest areas were worked under Production Sharing Agreements drawn up between Perhutani and mostly, Japanese companies. Production Sharing Agreements were, in a sense, joint ventures, Perhutani paying, from the sales of logs from the area for equipment provided by the Japanese company. This type of agreement is no longer made although some are still in effect.

3. THE ADVANTAGES AND DISADVANTAGES OF ALTERNATIVE TYPES OF ORGANISATION

3.1 The Objectives

There are clearly a large number of different types of organisation which should be considered. These are:

  (i) concession to a private company;

  (ii) a joint venture between the public sector (a Federal Government authority or department or the State Government) and the private sector under joint management and ownership or under a Production Sharing Agreement;

  (iii) public sector ownership with logging and processing being sub-contracted to the private sector;

  (iv) public sector ownership with management by the private sector under a managing agency agreement;

  (v) public sector ownership and management by direct recruitment.

But when looking at the advantages and disadvantages of types of organisation for the forestry project in Johor Tengah, the organisations should be considered in the light of the national objectives as follows:

  (i) the maximisation of the rate of return to the Malaysian economy;

  (ii) the training of Malays in efficient technique of exploiting the forest and in timber processing; and

  (iii) the distribution of income to the have-nots in Malaysian society.

In this sub-section each of the possible types of organisation are briefly considered in relation to these objectives.

3.2 Private Company

One alternative is to tender the whole of the 92,000 acres to a private company or individual with the concession being allotted to the company submitti

the highest tender. A reserve price could be
set to avoid the possibility of some sort of
ring being formed between the companies submit-
ting tenders,although this is unlikely if the
tenders were open to all-comers including all
companies and individuals working in East Malay-
sia and foreign companies as well as West
Malaysian companies. Under this arrangement the
fee would be in the nature of a premium for the
whole of the area, and the fewer restrictions
placed on the contract the more effective the
arrangement is likely to be.

It might be desirable to have some restric-
tions in the contract. One obvious one would be
the requirement that specified areas would need
to be logged by certain dates so that the agri-
cultural programme is not delayed. If the
company holding the concession had to vacate a
particular area by a specified date, there would
be every incentive, under a fixed sum system, to
log the area as quickly as possible. The incen-
tive would be greater under a fixed sum system
and would therefore be another advantage of such
a system. Alternatively the company could be
required to pay a penalty clause for delays - this
should probably be about $100 per acre for every
year of delay, since this is the likely social
cost of deferring the agricultural programme.

The reserve price would probably have to be
low enough to allow for a rate of return of at
least 20 percent per annum on capital otherwise it
is unlikely that tenders above the reserve price
would be received. In Part I the rate of
return is shown to be about 28 percent per annum,
before the payment of any royalties on premia.
If the reserve price were set so as to give a rate
of return of about 20 percent on capital, the
reserve price would need to be about $25 million
assuming that the fee were payable in equal annual
instalments over a period of 15 years. The whole
of this reserve price would, under this arrange-
ment, accrue to the Johor State Government.

The disadvantages of this arrangement would
be that the second and third objectives are un-
likely to be met. The second objective might be
achieved by specifying a quota for Malay employ-
ment, either in total as is presently applicable
to Pioneer Companies, or in particular salary
ranges or even positions since otherwise the whole
of the Malay employment might be concentrated in
felling, bucking and general labouring rather
than in the supervisory positions.

The third objective would not be met at all
if a private company or individual were to operate
the concession.

The first objective would be achieved to a
greater extent if the company were a local as
opposed to a foreign one, although not if the
foreign company were so much more efficient that
despite repatriating profits the return to the
economy was greater or if the profits were in any
case reinvested indefinitely in Malaysia.

But it is probably worth emphasising that if
this arrangement is undertaken, there should be no
restrictions other than those specified above.
The company should not have to apply for a sawmill
licence (but it might be excluded from developing
a plymill because of the possibility of overcapa-
city in plymilling) it should not be charged
royalties specific to particular logs, and there
should be no restrictions on the logs to be
extracted from the area except possibly in the
21,000 acres of water catchment which is not to be
cleared for agriculture. The State Forest Depart-
ment could however mark the logs on extraction for
its own record and control purposes (see Appendix F
of this volume).

3.3 Public Sector Ownership

Alternatively, the 92,000 acres could be
worked by a company in which the majority or whole
of the share capital is held by the public sector.
The public sector could be a Government agency
specially created to operate an enterprise of this
sort (with dividends being distributed to all indi-
viduals in West Malaysia on the lines of the Sabah
Foundation), it could be a Department of the Civil
Service, or it could be an existing Statutory
Authority such as MARA.

Even if the ownership is wholly within the
public sector, a company should probably be created
for administrative convenience and in order that
the objectives of the organisation be clearly
specified.

The advantages of public sector ownership would
be that income is likely to be more widely distri-
buted and if the agency owning the capital of the
comapny were MARA, the company would be likely to
employ Malays at fairly high levels.

The disadvantages of this type of ownership
are that the rate of return to the economy may be
low, because of lack of expertise or because of the
lack of well-defined objectives. It should be
possible to overcome the second objection, simply
by treating the organisation in the same way as a
private company, even to the extent of having a
'delay penalty clause' built into the concession
agreement. But at the same time, there should be
as few restrictions as possible on the company's
operations.

The first disadvantage, the lack of expertise,
might be overcome in a number of ways. These are:

(i) by employing a managing agency to run the
     enterprise and to train local personnel;

(ii) by the recruitment either directly or
     through technical assistance, of overseas
     personnel for certain positions within the
     organisation.

Alternatively there could be a joint operation
under which a local or foreign timber company pro-
vides some of the capital and the management for
operating the complex. A joint venture operation
may avoid some of the disadvantages of the managing
agency in as much as there would be a greater incen-
tive to work towards profits but problems might still
arise on the pace of training local personnel.
Furthermore part of the objection to the private
company arrangement would still remain - namely that
part of the profits would be repatriated from the
country or that the profits would not be widely
distributed.

The managing agency type of agreement is not
limited in West Malaysia to the forestry operation
in the Jengka Taiangle. A considerable proportion
of the plantation sector in Malaysia is managed
under agency agreements. The type of agreement
which is common in the Malaysian plantation industry
is for the agency house to provide a limited number
of managerial and supervisory staff to run the pro-
perty as well as certain 'head office' services
covering estate supplies, insurance, marketing,
shipping and consultancy expertise. These arrange-
ments usually however have only a small training
component, and the standard type of agreement incor-
porates charges on the following scale:

Agency fee - $3 per planted acre per annum
             plus a fixed fee of $25

Selling commission - 1½ percent of gross proceeds

Buying commission - 2½ percent on purchases

Shipping - ½ cent per pound of rubber

In addition there may be charges for advisory
services for mill construction and engineering services.

The disadvantage of this type of managing agency agreement, even if a training element is included, is the way in which the fee is based not on the efficiency or profit of the operation, but is made up of fixed components or of percentages on sales and purchases. There is therefore little pressure on the managing agents to minimise the costs of the plantation or to maximise yields. These disadvantages may be small in the plantation industry in view of the long experience of Malaysia with tree crops and with managing agencies, so that a company can fairly easily compare its own costs and yields under one managing agency with the costs experienced by other companies.

But in sectors of industry which are new to this type of arrangement, these disadvantages may be very much greater. There does in fact seem to have been some dissatisfaction with the results of the Jengka Triangle complex as operated to date. There have been complaints of insufficient drive towards cutting costs and of slow progress in training local personnel.

If there is to be a managing agency type of agreement, it is preferable that some part of the fee be geared to the profits of the organisation. But then there may be problems in training since the costs of training will add, at least in the short run, to the costs of the operation. In this situation it might be preferable to draw up an agreement whereby the fee consists largely of a fixed element but with deductions or additions for increases or decreases from standard costs. But establishing 'standard' costs for a relatively new operation such as the forestry complex in Johor Tengah may be difficult.

To avoid the disadvantages attached to a managing agency agreement, namely the slow progress in training and the lack of pressure on costs, it might be preferable for a public sector company to manage the company itself but to employ experts from overseas if necessary in particular positions. This is the sort of arrangement which some people in MARA would like to see. Marketing of export sales would probably be done through an agent on a commission basis, but overseas production personnel would be recruited directly on 2 or 3 year contracts. They would be directly responsible to the management of the company.

Whatever the type of organisation decided upon, the decision should be made quickly, and quickly here means within one month. The assumption in this report is that the complex will be controlled and most of the capital supplied by MARA. Senior management is assumed to be recruited directly and middle management to be trained over periods of up to 18 months. The assumptions are set out in detail below.

4. COMPLEX FINANCE, STRUCTURE AND CONTROL

4.1 Sources of Finance

The capital required for the type of facilities and product mix suggested in this report for the 90,000 acres of forest in Johor Tengah would probably be between $12 million and $15 million. The precise amount will obviously depend on the royalty and premium arrangements, on the phasing of the project and on the size and type of processing facilities adopted. This report assumes that the majority of this finance would be provided by MARA, that a subsidiary company would be formed by MARA, and that some of the capital would be provided by the Johor State Government - probably through the SEDC.

But the Federal Government is likely to want to put this project forward as a candidate for bilateral or, more probably, multilateral financing. The most likely possibility is that this project would be the subject of a request for a World Bank

loan. The possible dangers of this approach are twofold:

(i) the project may be delayed while the loan request is considered;

(ii) the World Bank may object to the type of organisation and management proposed.

The first objection should not be allowed to delay the project since the World Bank has in the past retroactively provided finance for soundly-conceived projects. Part of the finance provided for the Jengka forestry operation was in fact provided retroactively - see page 16 of IBRD, 1970.

Neither should the second objection be insurmountable. The organisational structure proposed for Johor Tengah provides for the recruitment of overseas personnel where necessary, and if those positions which require expertise in 1971 and 1972 such as those of the managing director, logging and processing managers and possibly the finance director are filled by well-qualified and experienced people, this should satisfy the World Bank. But it should not be necessary to employ a consultancy organisation, the managing body would probably recruit directly and specifically for the particular job, so that one is not necessarily buying the experience of the company.

For the SJSB loan[1], the World Bank laid down the following conditions (or obtained the following assurances):

(i) that tendering for equipment and buildings should be on the basis of international competitive tendering (p.17, IBRD, 1970);

(ii) that no licenses would be issued in the Jengka Triangle other than to MARA or SJSB and licenses would be issued to SJSB as and when required (p.24, IBRD, 1970);

(iii) that about 300,000 acres in the Tekam, Tekai and Berkelah Forest Reserves would be set aside for logging operations by SJSB on completion of logging operations in the Triangle (p.24, IBRD, 1970);

(iv) that the forest areas would be adequately policed and supervised by the Pahang Forest Department (p.24, IBRD, 1970);

(v) that SJSB would employ consultants acceptable to the Bank to carry out and manage the project (p.24);

(vi) that the Bank would be consulted before any changes were made in the positions of Managing Director, Project Manager and Financial Controller (p.24);

(vii) that SJSB would not distribute any profits before the Closing Date of the Bank loan without the prior approval of the Bank and thereafter unless adequate provision had been made for meeting SJSB's obligations including debt service (p.25);

(viii) that SJSB would not incur any indebtedness over US$100,000 in the aggregate without the prior approval of the Bank (p.25);

(ix) that quarterly comprehensive financial reports on the project should be transmitted to the Bank (p.25);

(x) that the accounts would be audited annually by a firm of auditors satisfactory to the Bank and that copies of the accounts and a uditors' report would be sent to the Bank not later than four months after the close of each financial year. (p.26).

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(1) The loan was in fact made to the Federal Government not directly to the project and was passed on to the SJSB (see p.15, IBRD, 1970) but for brevity the loan is here referred to as the "SJSB loan".

FIGURE H.3

JOHOR TENGAH TIMBER PROJECT - TENTATIVE ORGANISATION
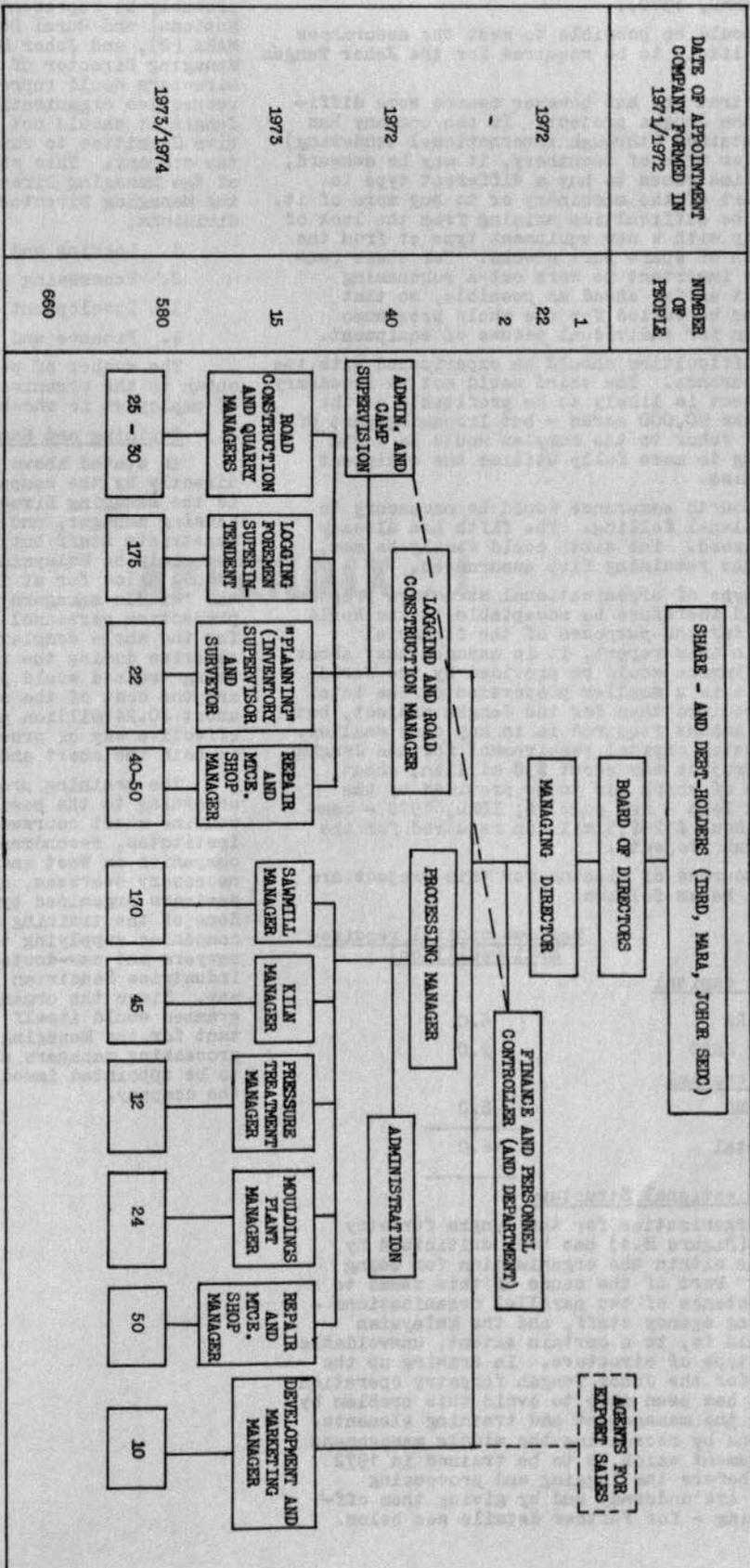
and (xi) that marketing arrangements satisfactory
to the Bank would be concluded prior to
the effectiveness of the loan (p.28,
IBRD, 1970).

It should be possible to meet the assurances
which are likely to be required for the Johor Tengah
Project.

The first one has however caused some diffi-
culty on the Jengka project. If the company has
already obtained (through international tendering)
a particular type of machinery, it may be awkward,
when the time comes to buy a different type to
replace part of the machinery or to buy more of it.
There may be difficulties arising from the lack of
familiarity with a new equipment type or from the
duplication of spare part stocks. For these rea-
sons it is important to work out a purchasing
requirement as far ahead as possible, so that
tenders can be called for the whole programme
rather than for individual pieces of equipment.

No difficulties should be experienced with the
second assurance. The third would not be necessary
- the project is likely to be profitable on the
basis of the 90,000 acres - but licensing part of
North East Johor to the complex would be worth
considering to more fully utilise the equipment
and expertise.

The fourth assurance would be necessary to
prevent illegal felling. The fifth has already
been discussed. The sixth could easily be met,
as could the remaining five assurances.

The type of organisational structure proposed
here should therefore be acceptable to the World
Bank, and for the purposes of the financial
analysis in this report, it is assumed that about
half the finance would be provided by the World
Bank. This is a smaller proportion of the total
capital required than for the Jengka project, but
the total amount required is in any case smaller.
(The estimated capital requirement for the Jengka
forestry project was about $38 million, about
two-thirds of which was to be provided by the
World Bank loan - see page 16, IBRD, 1970 - com-
pared to about $12-$15 million required for the
Johor Tengah project).

The sources of finance for this project are
assumed to be as follows:

	Maximum capital require- ment ($million)
Share capital	
MARA	6.0
Johor SEDC	2.0
Debt capital	
IBRD	8.0
Total	16.0

4.2 Organisational Structure

The organisation for the Jengka forestry
operation (Figure H.1) has been criticised by
many people within the organisation for being
top-heavy. Part of the cause of this seems to
be the existence of two parallel organisations -
the managing agency staff, and the Malaysian
staff. This is, to a certain extent, unavoidable
with this type of structure. In drawing up the
proposals for the Johor Tengah forestry operation
an attempt has been made to avoid this problem by
separating the management and training elements.
This is done by recruiting the middle management
(the management which is to be trained in 1972
and 1973) before the logging and processing
operations are underway and by giving them off-
site training - for further details see below.

Figure H.3 shows a tentative organisation
chart for the Johor Tengah forestry project. The
voting members of the Board of Directors would
probably be representatives of the Ministry of
National and Rural Development, the Treasury,
MARA (2), and Johor State (2), as well as the
Managing Director of the company. The board of
Directors would represent the interests of the
respective organisations on the Board, but unlike
Jengka it should not necessary to form an Execu-
tive Committee to run the day-to-day affairs of
the company. This should be the responsibility
of the Managing Director of the company; under
the Managing Director, there would be four
divisions;
    1. Logging and Road construction
    2. Processing
    3. Development and Marketing
    4. Finance and personnel

The number of people within each division is
shown in the organisation chart. The total number
of employees is shown to be about 660.

4.3 Training and Management

As stated above all staff would be recruited
directly by the company. The senior staff, that
is the Managing Director, logging manager, pro-
cessing manager, and financial controller might be
expatriate staff but the other staff could almost
certainly be Malaysians since the proposed phasing
should allow for at least 12 months training of
the 'middle managers' and some of the specialist
production personnel. The total training costs
for the whole complex including the wages and
salaries during the period of training of the staff
being trained would probably be about $1 million,
and the cost of the senior management would be
about $0.24 million per annum. This should be an
effective way of providing the necessary expertise
in both the short and long terms.

The training programmes will of course vary
according to the positions but the programmes should
combine short courses at home and overseas technical
institutes, secondment to logging and processing
companies in West and East Malaysia and again if
necessary overseas, and attendance at courses and
seminars organised by UNIDO and similar agencies.
Some of the training could be provided by the
companies supplying the machinery. Some of the
sawyers and saw-doctors working with Malatab
Industries Sendirian Berhad were trained in this
way. Since the organisation of the training pro-
grammes would itself be a large task, it is impor-
tant for the Managing Director, the logging and
processing managers and the Financial Controller
to be appointed immediately after the formation of
the company.

APPENDIX I

THE COSTS AND METHODS OF LOGGING

1. THE AGRICULTURAL REQUIREMENTS

The logging capacity required for the complex depends on choice of the first year of operation. The agricultural development requirements are set out in Part 2 of this volume which requires that logging in the 'complex' area be commenced by mid 1974.

A start in 1975 would mean that the logging programme would have to average, – at least for the first five years, – a programme of about 7,000 acres per annum. For the purposes of calculating the costs of logging, an annual programme of 6,000 acres is assumed with the first logging starting in mid 1974. In that year, therefore it is assumed that only 3,000 acres are logged.

2. THE METHOD

There are various methods used throughout the world for the extraction of logs. These range from the 'static' winch systems such as the High-Lead, through the 'skidder' operation, to the method most common at present in West Malaysia, namely the winch lorry system. The winch lorry is commonly referred to by loggers in West Malaysia as the 'Jungle King' or San Tai Wong and the method using winch lorries is here referred to as the San Tai Wong system.

The San Tai Wong system as commonly used in West Malaysia is briefly as follows:-

- tracks are bulldozed by a bulldozer-equipped tractor from the nearest road to the closest possible point to each stump;

- trees are felled and bucked into 28 foot lengths;

- the logs are parbuckled (loaded by winch driven from the main driveshaft of the lorry) onto a winch lorry (the San Tai Wong);

- these San Tai Wongs then carry the logs to the forest road where they are unloaded;

- timber lorries then drive along the forest roads picking up these logs which may have been cut or bucked to an acceptable size for carrying on public highways.

A more detailed description of this method is provided in 'Jengka Triangle Timber Extraction Study – West Malaysia' – Charnell International Consultants Ltd. (March 1968).

The skidder operation as used in the Jengka Triangle by Sharikat Jengka Sendirian Berhad as well as by other loggers in West and East Malaysia can be briefly described as follows:-

- a crawler tractor 'constructs' skid trails from the tree to forest landings;

- the logs are dragged to the landings by wheeled 'skidders';

- at the landings the logs are loaded onto truck and trailer units by front-end forked loaders;

- the units take the logs to the sawmills.

Detailed descriptions of this system are given in the Charnell report and the Jengka Triangle report – (Tams/Huntings 1966).

Little research has been done into the economics of the various systems in Malaysian conditions. It seems however that the High Lead system is only economic when used in steep terrain, and where the densities are great, as in parts of Sabah. Otherwise the choice seems to be limited to either the skidder system or the San Tai Wong. But here again no meaningful comparison of the relative economics of these systems has been done. Having said this it should however be emphasised that it is possible to imagine a large number of systems which combine elements of the two systems and it is of course possible to imagine a San Tai Wong being specially designed for more intensive use in Malaysia than is current for this system.

For the purposes of calculating the costs used in this paper, a skidding operation is assumed, since these are the only detailed costs available to this project for the sort of large-scale operation envisaged.

3. LOGGING COSTS – THE 'SKIDDER METHOD'

These costs are based on actual operations by Sharikat Jengka Sendirian Berhad in Pahang supplemented by material from other sources. For example the costs of machinery were obtained from various companies dealing in named equipment. The consultants do not however, recommend the use of any particular equipment. For simplicity of presentation the cost figures have been rounded, but as the final section shows, these costs are in broad agreement with those found in other sources.

The costs are summarised in Table H1, and the following notes give the detailed assumptions behind the costs.

(i) Capacity, phasing and outturn

The costs (Table I1) are on a year-by-year basis for 17 years from the date of first starting the access road. The logging programme is assumed to extract just over two million tons t.v. of timber during a logging period of 15 years; the logging area is assumed to be about 90,000 acres implying an average coupe of about 6,000 acres. The yield per acre is therefore assumed to be about 23 tons t.v. or about 20 FD tons. There are assumed to be 300 working days in the year, which for some activities is assumed to be cut to the equivalent of 240 because of rain. It should be noted that this rate of logging is less both in terms of area and tonnage than the rate projected for Jengka. It is expected that something like 10,000 acres will be logged by Sharikat Jengka in 1971.

(ii) Road construction

The road building is assumed to run about one year ahead of the logging. With skidders the following are the road requirements;

Type	Operation width (feet)	Length (miles)	Location
Main	24	22	NW-SE main road and N-S road at west of area
Secondary	18	40	Other roads shown on map 1
Spur	14	215	Not shown on map

TABLE I1

Logging Costs – 'Skidder' Method – South East Johor Project Costs ($ Million P.A.)

Year	0	1	2	3	4	5	6	7	8-10	11	12	15-16	17	18	Total Costs – Not discounted	Total Costs – Discounted at 10% p.a. (1)	Cost Per FD Ton – At no discount rate p.a.	Cost Per FD Ton – At a discount rate of 10% p.a.
	1972	1975	1974	1975	1976	1977	1978	1979	1980-82	1985	1984	1985-88	1989	(1990)				
Capacity																		
– FD tons logged (thousand)	–	–	60	120	120	→								100	184.0	799.94	–	–
– Acres (thousand)	–	–	5.0	6.0	6.0	→								5.0	92	40.02	–	–
Road Construction																		
– Equipment Costs	–	2.14	–			1.95			1.95						6.00	3.71	3.5	4.6
– Operating Costs – Equipment (inc. drivers and repairs)	–	0.24	0.48	0.48	0.48	0.48	→						0.48		7.44	5.54	4.0	4.4
– Other Labour	0.05	0.05	0.05	0.05	→								0.05		.83	.42	0.5	0.5
– Total – Road Construction	0.05	2.43	0.53	0.53	→	2.46	→		2.46	0.55	→		0.53		14.27	7.67	7.8	9.6
Felling, Bucking, Loading (Exc. transport to mill)																		
– Equipment Costs	–	–	2.29				2.06			2.06		→			6.41	3.61	3.5	4.5
– Operating Costs – Equipment (inc. drivers)	–	–	0.24	0.48	0.48	0.48	→						0.48		7.56	3.20	4.0	4.0
– Other Labour	0.05	0.10	0.30	0.60	0.60	0.60	→						0.60		9.55	4.14	5.1	5.2
– Total – Logging	0.10	0.10	2.85	1.08	1.08	1.08	3.14	1.08	1.08	3.14	1.08	→		.90	25.12	10.95	12.6	15.7
Transport and Main Landing Costs																		
– Equipment	–	–	1.60				1.46			1.46		→			4.52	2.54	2.5	3.2
– Operating Costs	–	–	0.24	0.48	0.48	0.48	→						0.40	0.40	7.56	5.20	4.0	4.0
– Total Log Transport	–	–	1.84	0.48	0.48	0.48	1.94	0.48	0.48	1.94	0.48	→	0.40	0.40	11.88	5.74	6.5	7.2
Management, Administration and General Equipment																		
– Equipment	–	0.50	0.10				0.60			0.60		→			2.60	1.34	1.4	1.7
– Planning Staff	0.05	0.10	0.10	→										0.10	1.75	.85	0.9	1.1
– Management, Administration	0.20	0.40	0.20	0.20	0.20	→								0.20	3.80	1.99	2.1	2.5
– Total Management, etc.	0.25	1.00	0.40	0.40	→			0.90	0.90	0.40	→		0.40	0.40	8.15	4.18	4.4	5.2
Total Costs	0.55	5.55	5.60	2.49	2.49	4.42	6.01	2.49	4.92	6.01	2.49	2.49	2.49	1.70	57.42	28.55	51.2	55.7

(1) Year (1) has the factor 1.00

This represents about 0.25 chains per acre logged which tallies with the experience of Sharikat Jengka. The main and secondary logging roads shown (Figure 1.3) for the most part cross permanent agricultural development areas and the alignments have been co-ordinated with these needs in mind. However the profile, gradients, culverts, bridges and cuttings of development roads may well be of a higher standard than is necessary for logging roads. It is probable that a surface of four inches of laterite or tin tailings, graded from time to time, and wooden culverts and bridge work will be adequate for logging purposes. It is clearly desirable, however, to construct the main and secondary roads to a higher standard than is necessary for logging, since the same roads can then be used for agricultural development. This is being done in the Jengka Triangle and a cost-sharing agreement is being drawn up between FLDA and Sharikat Jengka.

The cost of main roads built to FLDA's standard is $140,000 a mile or more, compared to a cost for logging purposes of about $40,000 per mile. For calculating the costs attributable to logging in this project, a standard sufficient for logging has been assumed. A surface of four inches of laterite or tin tailings has therefore been assumed. Laterite is not available in Johor Tengah but there are adequate supplies of tin tailings in the Linggiu and Tengkil valleys which can easily be transported into the forest area.

In addition to the mileage shown above seventeen miles of access road will be required outside the forest to link up with the existing road network; all of this follows the proposed alignment of the major development road. The main access road crosses the Sungei Sayong; if construction of the sawmill is to start in 1973, it is essential that this crossing should be completed by mid-1972. The cost of the access road to a standard necessary for logging has been charged to the logging enterprise with the access road being constructed in 1973.

With the skidder system, the secondary roads branch out into spur roads, from which skidding trails are constructed. Every 2,000-3,000 feet along the spur roads, the exact distance depending on the terrain, landings (loading areas) are bulldozed. From these landings, skidder trails are cleared and the logs are skidded to the landing for loading. Thus a landing serves something like 100 to 200 acres, and something like 40 landings would need to be constructed each year to log 6,000 acres.

In 1973 and 1974 some 40 miles of main road and a further 15 miles of spur road should be constructed in addition to the 40 landings needed for the first year's logging. The equipment (Table I 2) is estimated to be sufficient to construct this mileage to logging standards. If the roads are to be constructed to 'development' standards, additional equipment would be required but the cost of this is assumed to be borne by the land development.

The tin tailings would on average be about 25 miles from the point of road construction. The annual requirement of tin tailings for roads of logging standard would be about 35,000 cubic yards, consisting of about 20,000 cubic yards for new roads and about 15,000 cubic yards for maintenance. The tin tailings are assumed to be bulldozed by a D9G tractor, loaded by a 966C loader and transported to the road construction site by dump trucks with a load of 7 cubic yards. The equipment at the

site of tin tailings is assumed to work one shift per day and about 240 working days per annum. To transport about 150 cubic yards a day would require about 20 truck loads. Each truck is assumed to make four trips in a full working day and therefore about 5-6 dump trucks would be needed.

On road construction, two shifts working for a maximum of about 240 full working days are assumed. The maximum number of working hours per annum would therefore be about 3,000.

The cost of the drivers and repairs is included in the hourly equipment costs. In addition about 10-20 other people would be employed directly in road construction. The annual cost of this labour including the cost of the construction and quarry foremen - who are assumed to be Malaysians - would be about $50,000 per annum. The cost of mapping and laying out the road alignments is included under 'Planning' costs. The total annual cost of road construction is therefore estimated to be about $900,000, equivalent to a cost of about $45,000 per mile. This is, it should be emphasised, the cost of constructing roads to logging standards only. If the roads are constructed to higher standards for development purposes, it is assumed that the additional cost would be reimbursed to the logging company.

(iii) Felling, bucking, loading

At present, Sharikat Jengka are operating four 'sides' in the Jengka Triangle which could produce about 450 FD tons per day. A 'side' is a production unit consisting of one crawler tractor (D6C) and two skidders (Clark 668). Two 6-hour shifts are worked at the landings with the fellers and skidders working one 8-hour shift per day. This rate of working - about 100 FD tons per side per day agrees with proposals in the Charnell Report. To produce the 500 FD tons per day required for the complex, five 'sides' would be required, (Table I 3). In addition to the loaders needed at the skid landings, three loaders would be needed at the main landing (sawmill site), but these are included under log transport. Two front-end 980 loaders should be sufficient to service the five sides. One additional D6C tractor and an additional 668 skidder are assumed to be required to allow for breakdowns. The total initial logging equipment costs would be about $2.3 million, with operating costs of about $0.48 million per annum. These operating costs include the costs of drivers and repairs. In addition to the drivers, about 20 workers would be needed for each side, including landings, and after including logging foremen and the logging superintendent the total additional labour required would be about 125. The average annual cost including all fringe benefits of these additional employees (all of whom are assumed to be Malaysians) is estimated at about $0.60 million, with the average wage for all but the top five workers being about $4,000 per annum. Appendix 8 of Charnell, 1967 estimated the average cost of semi and unskilled logging labour to be about $5,000 per employee but this appears too high for the relatively accessible Johor Tengah area.

(iv) Log transport and main landing costs

In Johor Tengah, it is likely that the logs would travel an average of about 20 miles to the processing site. For Jengka (Charnell, 1967) it was assumed that truck and trailer units carrying about 25-30 FD tons per load would be used, whereas in fact, Sharikat Jengka is using truck and trailer units with payloads of about 40-50 FD tons. For this project it is assumed that truck and trailer units each carrying about 25 FD tons will be used. The cost (including import duties) of each of these is about $0.13 million compared to the cost of the

Capital And Operating Costs Of Road Construction Equipment

Item	Number of Items	Capital Cost		Life (Years)	Operating Costs				Total Costs
		Thousand Dollars per item	Total Capital Cost (Thousand Dollars)		Annual Capital Cost (Thousand (1) Dollars)	Hourly Cost (Dollars per item)	Thousand Hours per annum per item	Total Operating Cost (Thousand Dollars per annum)	(Thousand Dollars per annum)
Major Items Of Equipment									
1. Quarry									
D9G Tractor	1	367	367	5	66	40	2.0	80	146
966C Loader	1	158	158	5	28	16	2.0	32	60
Dump Trucks (7 cubic yards)	6	50	300	5	54	11	2.2	145	199
2. Road Construction									
D8H Tractor	2	241	482	5	87	23	1.5	69	156
D7F Tractor	2	185	370	5	67	17	1.5	51	118
J621 Scraper	1	246	246	5	44	34	2.0	68	112
14E Grader	1	113	113	5	20	13	2.0	26	46
Minor Equipment									
(Crushers, Rollers, Drills, Saws)	–		100	5	18			10	28
Total Cost			2,136		384			481	865

(1) Assuming a 10 percent trade-in or scrap value

TABLE I.3

Costs Of Logging, Log Transport

Item	Life (Years)	Number of Items	Capital Cost		Operating Costs		
			(Thousand Dollars) Per Item	Total Capital Cost (Thousand Dollars)	Cost (Dollars Per Hour)	Hours Per Annum Per Item	Cost (Thousand Dollars Per Annum)
Felling, Bucking, Loading							
D6C Tractors	5	6	133	798	13	1.7	130
Clark 668 Skidders	5	11	88	968	11	1.8	220
Loaders - 980	5	2	186	372	24	2.2	106
Others (Saws, Pick-ups, Motorcycles, Etc)	5	-	-	150	-	-	20
Total Equipment Costs				2,288			476

					No. of workers	Ave. annual cost per worker	
Other Labour Costs (Unskilled and Semi-skilled)					120	$ 4,000	480
Other Labour Costs/(Skilled and Supervisory)					5	$24,000	120
Total Felling, Bucking & Loading Operating Costs							1,076

					Cost ($ per hour)	Hours p.a. per item	
Log Transport and Main Landing							
Truck and Trailer Units - 25 tons payload	5	8	130	1,040	14	2.2	248
Loaders - 980	5	3	186	558	24	2.2	159
Equipment Costs				1,598	-	-	407
Other Labour Costs (24 workers @ $3,000 per worker p.a.)							72
Total Transport and Main Landing Operating Costs							479

Pacific Trucks used in Jengka of about $0.23 million. The total number of truck and trailer units needed to move 500 FD tons per day would be about 8 assuming an average load of 20 FD tons and about 3 trips a day. The capital and operating costs are shown in Table I.3. The detailed operating costs of the truck and trailer units are shown in Table I.4. On the basis of an annual mileage of 28,800 and a life of five years the total cost per mile is about $1.1, and the cost per ton mile is about 11 cents.

In addition to the costs of the truck and trailer units, the costs of unloading and bucking for the sawmill are included in this heading - for equipment details see Table I.3 Minor equipment used on the main landing is included under the heading 'other equipment'.

In addition to the drivers of the equipment, about 24 workers would be employed at the main landing and on the trucks. The main landing would probably work two 12-hour shifts, and would employ buckers and scalers in addition to the loader drivers and attendants. The cost of this additional labour is estimated at about $72,000.

TABLE I.4   Truck and Trailer Unit (25 tons payload) - Costs

1. Operating Characteristics

Trips/Day – 3	miles/trip – 40	hours/ trip – 3	FD tons/ trip – 20
Days per annum – 240	miles per annum – 28,800	hours per annum – 2,160	
Trips per annum – 720	Total miles – 144,000	total hours – 10,800	ton-miles per trip – 800
			ton-miles per annum – 576,000

2. Operating Costs

	Cost		
	Thousand dollars per annum	Dollars per hour	Cents per ton-mile
Driver	3		0.5
Reparis and parts	17		3.0
Fuel, oil, lubricants	4		0.7
Insurance, tax, etc.	7		1.2
Total	31	14	5.4

3. Owning costs and total costs per ton-mile

	Cost	
Capital cost $130,000 Scrap/trade-in value 10%	Thousand dollars per annum	Cents per ton-mile
Depreciation and interest at 10 p.a.	32	5.5
Operating costs	31	5.4
Total costs	63	10.9

(v) 'Other equipment' costs

These would include minor equipment including saws at the main landing, HQ cars and landrovers, offices, canteens, and radio, workshop and office equipment. The total cost of this is unlikely to exceed $500,000 and the average life of the equipment is assumed to be about 10 years. The operating costs of such equipment and the costs of supplies (but not food since this is assumed to be either charged to individual workers or included in the assumed wages) is assumed to be about $100,000 per annum.

(vi) 'Planning' costs

The costs of planning include the costs of 'cruising', mapping and laying out the road alignments. Although the detailed inventory or 'cruise' in Jengka does not, at present, determine the road layout, it is said to be necessary for integrating logging and sales, either to the saw-mill or to the outside purchasers. Cruising, mapping and laying out the road alignments are all carried out at ground level in Jengka.

The company operating in Johor Tengah might usefully review whether the costs of a detailed inventory outweigh the benefits and, if not (that is if a detailed inventory is still worthwhile), whether the inventory and mapping could both be done by aerial photography. For purposes of calculating costs in this report, it is assumed that ground methods will be used and that the number of employees involved will be about 10 in cruising and about 12 in mapping and laying out. All these employees are assumed to be Malaysians and the annual cost including the costs of training the surveyor and inventory supervisor, is assumed to be about $100,000.

(vii) Management and administration

In addition to the employees noted in the previous sections, further staff would be needed for first aid, cooking, carpentry, selling, personnel and general administration and accounting.

The costs of selling and marketing are assumed to be done by an agency, as in Jengka but are included in the sawmilling costs.

The main financial control is assumed to be under a Financial Controller responsible for accounting for all the company's operations. The cost of the financial controller, who might be one of the three or four expatriates exmployed by the company, and the cost of the finance department attributable to the logging operation is assumed to be between about $50,000 and $60,000. The financial department would be responsible for all purchases.

The cost of all other labour, including personnel administration, is assumed to be about $80,000 with about 20 people being employed.

Finally, the cost of the logging manager (who might be an expatriate) is assumed to be about $60,000 per annum inclusive of all fringe benefits.

The total cost of all management and administration, including a share of the costs of the Finance Department but excluding the costs of selling which are included in the sawmilling costs, is therefore estimated as $200,000 per annum.

In addition, in or before year one, there is likely to be a substantial expenditure on training Malaysians by seconding them to work with other companies in Malaysia and by sending them on conferences and courses - for more details, see Part I of this volume. At least a quarter of the total logging employees would receive some form of off-site training but intensive training would be given to up to 10 employees. The total cost of this training would probably be up to $300,000 and would be incurred during 1972 and 1973.

4. LOGGING COSTS - SUMMARY AND COMPARISON

The choice of logging method for Johor Tengah lies between the Skidder and San Tai Wong systems, but little detailed information is available to enable a meaningful comparison of the systems to be made. There are various ways in which the skidder system can be operated. In Pahang, Sharikat Jengka uses two or more skidders to one crawler tractor, whereas in East Malaysia, the ratio of skidders to tractors is often reversed.

Similarly there are various alternative ways in which elements of the skidder and San Tai Wong systems can be combined. For example a winch lorry could be used to replace skidders, loaders and trucks, but still using logging trails made by tractors and transferring to other lorries, where appropriate, in the main landing. Since the skidder system broadly speaking, makes more use of specialist equipment, it is likely to be superior to the San Tai Wong system under the following conditions;

(1) it is likely to be less sensitive to the weather, and hence operable for more days during wet periods;

(2) it is likely to have greater economies of scale, its costs rising less sharply than the costs of San Tai Wong's with increases in the log outturn per acre.

The first advantage is likely to mean greater utilisation of the sawmill or a higher average selling price for logs because of a greater proportion of logs being sold in the wet season when prices are higher.

The second advantage is likely to accrue because of the more intensive use of relatively specialised machinery. Crude calculations during The Project study indicate that the costs of the San Tai Wong system may be lower for yields of around 15 FD tons per acre, but there is insufficient information available to draw any definite conclusions. Much of the doubt focusses on the output possibilities of the San Tai Wong. Most of the lorries used in this system in Malaysia are many years old and the annual output capacity estimates received by the project for a San Tai Wong range from 1,500 to 3,000 FD tons per annum. The quoted contract price is currently about $7 per FD ton which compares with a cost for skidders, loaders and trucks in this report of about the same amount, but the winch lorries are at present working along rough trails and (probably) at low yield densities of around 15 FD tons per acre compared to the 20 FD tons assumed here. It is also not clear what transport distances are included in these quotes.

The traditional San Tai Wong system is also stated to have the disadvantages of not being able to use the all-purpose equipment intensively and of leaving a significant volume of merchantable timber in the jungle because it is too heavy or too large to be handled by the lorries or is on rougher terrain inaccessible to them. (Charnell Report 1967)

The skidder system costs as calculated here total workout about $31 per FD ton when the capital expenditure is depreciated on a straight-line basis and about $36 per FD ton when interest is charged at the rate of 10 percent per annum (See Table II). The total number of workers employed at full production would be about 310 made up as follows;

	Number of employees
Quarry and road construction	30
Felling, bucking and loading	145
Log transport and main landing	35
'Planning' (mapping, cruising and laying out)	25
Finance Department (share attributable to logging)	10 (half the total)
Cooks, carpenters, first aid, personnel and general administration	20
Repair and Maintenance shop	45
Total employees	310

Very little published information is available on logging costs with which the costs in this report can be compared. The only sources available for West Malaysia are the Charnell, 1967 report and the Tams/Huntings report on Jengka.

Logging costs are summarised in Appendix 7 of the Charnell, 1967 report as follows;

	Costs in $ per FD ton		
Year	1	2	3
Direct	20.5	18.0	16.8
Indirect	11.0	8.8	8.3
Depreciation	9.3	6.5	5.7
Total in mill yard excluding royalties	40.8	33.3	30.8
Less contingencies included in costs	(3.7)	(3.1)	(2.9)
Total cost excluding contingencies	37.1	30.2	27.9

Logging costs were given in the Tams/Huntings report (Appendix 10-11) as follows;

Year	Cost (excluding contingencies and royalties) - $ per FD ton
1968	33
1969	23
1970	22
1971	20
1972	18

These costs did not however include depreciation which represented an additional 15 percent or between $3 and $5 per FD ton.

The Tams/Huntings and Charnell costs are therefore between about $28 and $32 per FD ton. The estimated costs of the skidder system as estimated in this section are about $31 per FD ton. The costs of the San Tai Wong or lorry winch system are uncertain but loggers in West Malaysia give costs of between $26 and $29 per FD ton.

It is most unlikely that a valid comparison of the two systems on a commercial scale and with yields of about 20 FD tons per acre can be made before 1973 the year when equipment has to be first ordered. Therefore on the basis of current performance and in view of the yield of timber to be extracted the skidder system is proposed and has been costed into the project.

APPENDIX J

THE COSTS OF SAWMILLING

1. INTRODUCTION

The estimates of sawmilling costs used in this project are based on observations and discussions in local recently-established mills using fully-automatic headrigs and ponyrigs. They are estimates of best-practice techniques in a mill which achieves a consistently high level of throughput.

The costs however exclude the costs of transporting finished products to export points or to domestic consumers. Where equipment is mentioned specifically, it is not particularly recommended, but given in order to clarify the assumptions.

The sawmill is assumed to have an annual capacity of about 65,000 FD tons input which is equivalent to about 51,000 cubic tons (about 21,000 FBM) of sawn timber output. The output in the first operating year (1975) is assumed to be about 26,000 cubic tons with the full capacity level of 51,000 cubic tons being achieved in 1976. The mill is assumed to saw for 12 hours a day on 280 days of the year with 2 shifts being worked. The mill is expected to convert a high proportion of the log input into export timber, the remainder being sold locally (Appendix G).

The output of medium hardwoods is assumed to be nearly half the total output from the sawmill; it is assumed that the sawing rates for light and heavy hardwoods are 10 percent faster and slower respectively. The conversion rate from FD tons of logs to cubic tons of rough sawn timber is assumed to average 60 percent, although the rate is likely to vary between species. Major defects have been allowed for in the log inventory.

2. CAPITAL COSTS

The estimates are based on the following system:

- logs would be delivered from the main landing by mobile log loaders (Appendix I) and transferred to the sawmill storage deck;

- the main breakdown system would be one or two headrigs with automatic carriages and log turners;

- cants would then be transferred to pony-rigs and band mills for further remanufacture;

- side lumber would be moved to edgers and pre-grading tables;

- as much refuse as possible would either be chipped or directed to the steam generating plant.

The cost of the manufacturing equipment has not been specified in detail, but total equipment costs are expected to be about $45-$55 per ton of output. Further capital costs to be added are the costs of installation, buildings, power plant and working capital (that is the stocks of logs and finished products held before use or sale). Working capital is directly included in the financial analysis by allowing for the time lags in cash flows (see Part I). The costs of the power plant and installation costs in the cash flows would be about 15 percent of the total equipment costs. The cost of equipment and the power plant would therefore be approximately $50-$65 per ton of output, or between $2.5 million and $3.5 million. The cost is assumed to be $3 million. To this, the cost of site preparation, and buildings, and design expenses need to be added.

These are expected to total between $0.8 and $1.2 million; this includes the cost of buildings for all processing facilities including drying, pressure treatment and mouldings. The total equipment and buildings cost is therefore assumed to be about $4.0 million, with some 25 percent of the cost being incurred in 1973 and most of the rest being spent in 1974 (see Table J.1).

3. OPERATING COSTS

The sawmilling labour assumed to be required for an annual production output of about 50,000 cubic tons is as follows:

	Average number per shift	Total
Buckers, headrig operators, ponyrig operators, resawyers, edgermen, sawdoctors, foremen and tallymen	50	100
Stacking, grading, lifting and bundling labour	35	70
Sawmill administration and management, marketing of processed products and share of employees in finance, personnel and processing repair departments		50
T o t a l		220

This is equivalent to 200-250 cubic tons of output per worker per annum. This compares with an output per worker of about 400 cubic tons assumed in the Gardiner Report (1968) and an average of about 100-120 achieved in West Malaysia in 1968 (Table 283 and 289 of Department of Statistics, 1968).

The average annual cost of this labour and the other annual sawmill operating costs are summarised below:

	Number employed	Average Annual Cost		Total Annual Cost
		Thousand dollars	Unit	Thousand dollars
Buckers, headrig operators, etc	100	3.0	Employee	300
Stacking, grading, lifting and bundling labour	70	2.5	Employee	175
Sawmill administration & management, marketing, share of finance, etc.	50	8.0	Employee	400
Sub-total				875
Maintenance of buildings (2½%)		–	–	30
Machinery repairs		–	–	100
Power and other utilities		$ 5	Cubic ton of output	255
Office expenses, rent, insurance, and others		–	–	120
				1,380

Total operating costs are therefore likely to be about $1.4 million per annum at full capacity production, equivalent to $27 per cubic ton of capacity output.

4. SUMMARY AND COMPARISON

In addition to the above costs, there would probably be a large expenditure on training in the first two years. The sawmill manager might be an expatriate but it should be possible to fill the other posts with Malaysian personnel after suitable training programmes. Some 20 of the sawmill employees would receive some off-site training, but despite this it might be necessary to employ saw-doctors and possibly a few other personnel from overseas for a limited period of say two to three years. The total cost of this training and additional labour would be at least $400,000 and could be as much as $500,000. The cost is assumed to be spread over three and a half years from mid-1972 to the end of 1975 at the rate of $130,000 per annum.

The total costs of sawmilling (Table J.1) excludes the costs of export marketing, and the costs of transporting the products sold Part I of this volume.

The total costs for this project are compared below with those in the Gardiner report and with the Manufacturing Census for 1968:

	Cost per ton of output($)	
	with no interest	including interest at 10 percent p.a.
This report	35	43
Gardiner, 1968		
- capital	5-6 [1]	-
- operating	26-27 [2]	-
- total	31-33	-
Manufacturing Census, 1968	30 [3]	

(1) Depreciated over 15 years and including the estimated costs of buildings and power plant attributable to sawmilling. The output capacity is 41,700 cubic tons per annum (see p.98, Gardiner 1968).

(2) See page 50 of Gardiner, 1968.

(3) Seems to exclude depreciation; about 2/3rds of this cost consisted of salaries and wages (see Department of Statistics, 1968)

The costs in this report are therefore slightly higher than those in other available and comparable sources, but this is mainly due to the heavy training element in the costs.

TABLE J.1   Costs of Sawmilling

Input/Output	1972	1973	1974	1975	1976-1989	Total	Discounted at 10%p.a. [1]	Cost Per Cubic Ton of Output ($) Total	At a 10% p.a. discount rate
Thousand FD Tons Input	-	-	-	43	85	1233	503	-	-
Thousand Cubic Tons Output	-	-	-	26	51	740	302	-	-
Costs ($ million p.a.)						($ mn)	($ mn)		
- Equipment	-	0.50	2.00	-	-	2.50	2.11	3.4	7.0
- Installation of equipment and power facilities	-	-	0.40	0.10	-	0.50	0.41	0.7	1.4
- Site preparation, design expenses and cost of buildings	-	0.50	0.50	-	-	1.00	0.87	1.4	2.9
- Cost of equipment and buildings	-	1.00	2.90	0.10	-	4.00	3.38	5.4	11.2
- Labour and management, costs (including training costs)	0.15	0.25	0.41	0.67	0.88	13.80	6.09	8.6	20.2
- Maintenance and repair costs	-	-	-	0.13	0.13	1.95	0.82	2.6	2.7
- Power and utilities	-	-	0.05	0.15	0.26	3.84	1.59	5.1	5.2
- Office and miscellaneous expenses	0.05	0.05	0.12	0.12	0.12	2.02	0.95	2.7	3.1
- Total Costs	0.20	1.30	3.48	1.17	1.39	25.61	12.83	34.6	42.5 [2]

(1) 1972 has the factor 1.00.

(2) does not sum due to rounding.

APPENDIX   K

THE COSTS OF KILN-DRYING, PRESSURE TREATMENT, AND MOULDINGS

1. KILN-DRYING

In recent years probably less than one-tenth of exported timber and an even smaller proportion of domestic sales has been kiln-dried (Appendix O). In the Johor Tengah project it is assumed that about 16,000 to 17,000 cubic tons of sawn timber would be high-temperature kiln dried.

The costs of this kiln-drying are shown in Table K.1. The cost of the kiln and associated equipment such as steam-producing facilities is estimated to be about $70 per ton of capacity. Estimates of capital costs from actual operations in Johor State agree with those in the Gardiner (1968). The cost of the equipment for the capacity in Johor Tengah of about 16-17,000 cubic tons per annum, is therefore estimated at about $1.1 million. One quarter of this cost is assumed to be incurred in 1973 and the remainder in 1974.

The total annual operating costs are shown in Table K.1 to be about $0.21 million per annum, equivalent to $12-$13 per ton of high-temperature dried timber. The total cost, after including the capital cost depreciated over 15 years on a straight line basis, is $17-$18 per cubic ton.

2. PRESSURE TREATMENT COSTS

There are various methods of wood preservation in practice. Probably the most common form of preservation is that of painting, the purpose of which is to prevent access of the weather, but this type of preservation does not usually afford any protection against dry rot, insect, bacterial or fungal attack. The best means of preserving timber against these attacks is by impregnating it with various salt solutions and anti-fungal agents. The two most common processes in use in West Malaysia are the "Tanalith" and "Celcure" processes.

In the Johor Tengah project, the capacity of the pressure treating facilities would be about 7,000 cubic tons per annum, or about 600 tons a month. The most of this timber would be sold for use in housing. FLDA specifies that "all timber except the Heavy Hardwoods shall be vacuum/pressure impregnated with an approved wood preservative to a minimum dry salt retention of 0.35 pound per cubic foot" (FLDA, 1970). For the purpose of calculating the pressure treatment costs, it is assumed that the whole of the treated timber would be impregnated to this specification, since at least 4,000 tons per annum would be sold for use in housing.

The plant would be designed to operate the 'full cell' process whereby the air is removed under vacuum and the preservative is forced into the wood under pressure, using a pressure of about 200 pounds per square inch. The annual output of 7,000 tons require two retorts of 6 feet internal diameter by 42 feet long, each having a capacity of about 560 cubic feet per charge. The cost of the equipment, including storage and mixing tanks and installation costs, would be between $0.20 million and $0.30 million. The capital cost of about $70 per cubic ton (Gardiner Report 1968) is thought to be too high. Quotations given to the South East Johor Project indicate likely capital costs, including costs of installation, of between $20 and $50 per ton output capacity. The capital costs assumed for this project are equivalent to $35-$40 ton output capacity. About a quarter of the costs are assumed to be incurred in 1973, the rest in 1974.

The costs are given in detail in Table K.2. Total operating costs are assumed to be about $30 per cubic ton. If the capital costs are depreciated over 15 years on a straight line basis, the total costs are $33 per cubic ton compared to an average charge for pressure treatment of $45 per cubic ton.

TABLE K.1   Kiln-drying Costs

Output capacity		— 16-17,000 cubic tons/annum
Capital cost (including ancillary equipment and installation cost)		— $1.1 million
No. of shifts per day		— 2

Operating Costs	$ per cubic ton	$000 p.a.
Fuel	0.8	12.8
Maintenance and repairs	1.2	19.2

Labour	Number employed	Annual Cost per employee ($000)	
Labourer & lift truck operators	20	3.0	60.0
Kiln operators & storemen	20	2.5	50.0
Foremen and Manager (1)	5	14.0	70.0
Total operating cost (Thousand dollars per annum)			212
Average operating cost per cubic ton ($)			13

(1) The cost of financial and general administration and domestic marketing is included in the sawmill costs.

The cost of labour employed on repairs is included in "maintenance and repair costs".

TABLE K.2   Pressure Treatment Costs

Output Capacity		— 7,000 cubic tons per annum
Capital Cost (including installation costs)		— $0.25 million

Operating Costs	$ per cubic ton	Thousand dollars per annum
Maintenance and repairs	0.6	4.2
Electricity & water	1.0	7.0
Salts (Tanalith at $1.1 per lb. — 0.35 lbs/cu. ft retention)	19.3	135.1

Labour	Number employed	Annual Costs per employee (Thousand Dollars)	
Labourers and operators	10	2.5	25.0
Supervision/ Management	3	12.0	36.0
Other expenses (Insurance, etc.)			2.7
Total operating costs per annum ($ Thousand)			210
Operating costs per cubic ton ($)			30

The total costs of pressure treatment in this report are very different from those contained in the Gardiner 1968 report. The latter gave capital costs of about $4-$5 per ton compared to the $2-$3 per ton in this Appendix, but the biggest difference is in the operating costs. The Gardiner report gave total operating costs (Gardiner) of about $12-$13 per ton compared to the $30 per ton in this report. The difference occurs in the assumptions about the cost of preservatives. It has been assumed that all project timber which is pressure-treated would be treated with 'Tanalith' CT106 wood preservative (although this is not necessarily recommended) at a dry salt retention of 0.35 pounds/cubic foot and a cost delivered in Malaysia, of about $600 per drum of 250 kilograms, or about $1.1 per pound. Therefore the preservative cost per ton of 50 cubic feet would be about $19 (Table K.2).

3. MOULDING COSTS

The costs of mouldings are shown in Table K.3. Total operating costs are estimated to be $0.15 million per annum equivalent to $20 per ton of mouldings. If the capital costs are depreciated over a period of 15 years, the total cost per ton of mouldings is about $25

TABLE K.3   Moulding Costs

Output Capacity			— 7,000 tons of moulding per annum(1)
Capital Cost			— $0.54 million

Operating Costs[2]	Number employed	$ Thousand per annum	$/ton of mouldings
Packing, maintenance, power supplies	42		6.0
Production labour	22	66	9.4
Supervision, administration	3	33	4.7
	141		20.1

(1) From an input of about 11,000 tons of kiln-dried sawn timber per annum (66 percent conversion rate). The assumed average moulding size is 2 inches x 1 inch and for an input of 11,000 tons per annum., four Wadkin PJ machines would be required. The cost of each machine, together with ancillary equipment would be about $90,000 delivered to site in Malaysia. Building and installation costs for four machines would be between $150,000 and $200,000.

(2) Excluding transport costs.

APPENDIX   L

WILDLIFE

A record was kept of all evidence of the larger mammals encountered during the soil survey of Tanjong Penggerang. Most of the peninsula is either logged or secondary forest and has suffered disturbance from Man, and big game is not common. No evidence was found for the presence of Seladang (Bos gaurus), the Sumatran Rhinoceros (Didermocerus sumatrensis) or Tapir (Tapirus indicus).

Evidence of Elephant (Elephas maximus) was encountered very commonly, in the form of droppings or footprints, throughout the peninsula in jungle areas, even to the east of the lower reaches of the Sungei Sedili Kechil and the extreme south near Bukit Pelali and Telok Punggai. However the number of animals is believed to be small, since the herds travel widely and their droppings remain visible for many weeks. The herds are probably very small, and the evidence generally indicated solitary individuals. One was seen at Mile 26 on Baseline A on May 27th 1970.

The Tiger (Panthera tigris) is probably rare in the peninsula. One was seen by Survey Parties near the Sungei Mupor headwaters on November 26th, 1969, and footprints were encountered in three or four localities. Like the elephant, the tiger is reputed to wander widely, and the number of individuals is likely to be very slow.

The claw marks on trees of the Malayan Sun Bear (Helarctos Malayanus) were seen at some half-dozen localities, and a pair were seen on rentis AE6 on November 28th, 1969.

The four species of deer, the Sambhur (Cervus unicolor), Barking Deer (Muntiacus muntjak), and Larger and Lesser Mouse-deer (Tragulus napu and Tragulus javanicus) are generally common in the peninsula, even in areas accessible to hunters. Evidence of pig was seen quite commonly, but numbers are not large; they are believed to be the Common Wild Pig (Sus scrofa), not the Bearded Pig (Sus barbatus), although the latter may also be present.

Smaller mammals are very difficult to observe and identify, many being both nocturnal and arboreal. Amongst the larger birds, it is of interest to note that the Great Argus Pheasant (Argusianus argus), and three species of Hornbill, the Black (Anthracoceros malayanus), the Bushy-crested (Anorrhinus galeritus) and the Rhinoceros Hornbill (Buceros rhinoceros) are still generally common.

All mammal and bird records have been entered on the returns of the Zoological Survey, School of Biological Sciences, University of Malaya, those of birds being fairly thorough.

Much of the big game will be lost when the forest is cleared for agriculture or other development, and it is unlikely that the remaining forested areas will be sufficiently large to support either elephant or tiger. These two, together with pig, may however be troublesome in the initial stages of development. Deer will survive in the forested areas only if hunting is rigorously controlled, but with the opening up of the peninsula, poaching may be severe. The jungle avifauna will of course be destroyed, being totally unable to adapt to clearance, but the remaining forested areas should be capable of holding an almost representative avifauna, which may even become concentrated as the birds are progressively driven back as clearance proceeds. Such a process is believed to have accounted for the rather concentrated avifauna and longlist of species in the small area of logged forest that remains near Kampong Roscote, north of Johor Baharu. For the reasons suggested, it becomes increasingly important that remaining forests are protected for scientific and aesthetic purposes as well as recreation.

APPENDIX M

Bevan, Fleming & Gray   1966   'Planting Techniques for Oil Palm
                                   in Malaysia'

Charnell   1968   'Jengka Triangle Timber Extraction   Prepared for Canadian Trans-
                                  Study - West Malaysia'   oceanic Technical Services
                                                                         Ltd. (Cantrans) by Charnell
                                                                         International Consultants
                                                                         Ltd., Vancouver, Canada.

Department of Statistics 1967 & 'West Malaysia - Annual Statistics   Department of Statistics,KL.
                         1969   of External Trade, 1967 & 1969'

Department of Statistics 1968   'Census of Manufacturing Industries-   Department of Statistics,K.L.
                                  West Malaysia, 1968'

Gardiner   1968   'A Proposal for a Forest Products   Prepared for Canadian Trans-
                                  Manufacturing Complex in the   oceanic Technical Services
                                  "Jengka Triangle" Area, Malaya'   Ltd. by S.G. Gardiner Engine-
                                                                         ering Services Ltd.

IBRD   1970   'Second Jengka Triangle Project -   IBRD/IDA, Report No. PA-31a,
                                  Malaysia'

Leamy & Panton   1966   Soil Survey Manual for Malaysian   Department of Agriculture
                                  Conditions.
Holtum   1924   Card, Bull.S.S. 3 pp. 245-257

Stevens   1968   'Conservation of Wild Life in
                                  West Malaysia'

Economic Planning Unit   1968   'Land Capability Classification
                                  Report for State of Johor'

Peel J.D.   1960   'The practicability of Manufactu-   Part III of Pulp and Paper
                                  ring Fibreboard in Selangor'   Manufacture in Malaya -
                                                                         J.D. Peel.

Tams/Huntings   1967   'The Jengka Triangle Report'   Tippetts-Abbett-McCarthy-
                                                                         Stratton and Hunting Tech-
                                                                         nical Services Ltd.

Tractors Malaysia   1969   'Mechanical Landclearing Proposal'   For FLDA.

World Wood   1970   for references to wood-chip
                                                                         contracts see page 32 - Vol
                                                                         11 No. 6. 1970.
                                                                         Vol.11 page 24, No. 12, 1970
                                                                          "   11   " 27/29 " 13 1970
                                                                          "   12   " 17   "   2 1971
                                                                          "   12   " 18   "   3 1971

Wycherley P.R.   1968   'Timber of Old Rubber Trees'   Scientific Malaysian, No. 1.

Malaysian Forest Records   Numbers 23 & 24

Food & Agricultural   1961   'Timber Trends and Prospects in   Work- World Trends and Pros-
Organisation   the Asia-Pacific Region'   pects 1966.

Forestry Department   1967   'Annual Forestry Report for
                                  West Malaysia' 1967
                                 'Johor Forest Rules of 1922,
                                  Enactment 580 as amended.'
                                 'The Malayan Forester 1969'
                                 'Johor - 2nd Malaysia Plan 1970'

Loctsch & Haller   1964   For explanation of sampling
                                                                         error as applied to a forest
                                                                         inventory.

M. Dagg   1969   'Factors affecting the use of   J. EAA & Forestry No.35 p.203
                                  evaporation pan data in East
                                  Africa'

I.J. Jackson   1970   'Annual Rainfall probability and   J. EAA & Forestry No.35 p.265
                                  the binomial Distribution'

V.T. Chow	1964	'Handbook of Applied Hydrology'	
	1963	'Hydrological data for experimental agricultural watersheds in the U.S. 1956-1959'	Agric. Res. Serv. Misc. Publ. 945.
H.C. Pereira et al	1962		E. Afr. Agric. forestry J.27 p 1-131.
H.C. Pereira		'Land Use and Stream Flow'	E. Afr. Agric. & forestry J.30 p.395.
Dr. Harold L. Baker	1969	'The Role of Forestry in Land-Use in West Malaysia'	A Preliminary Report, Draft, Restricted.
Wong Yew Kwan, FRI, Forest Department	1967	'Some indications of the total volume of wood per acre in lowland diptercarp forest'	Research Pamphlet No. 53, K.L.
	1 969	'Penyata Tahunan Perhutanan di-Malaysia Barat Tahun 1966'	K.L.
D.S.P. Noakes - Malayan Forester	1937	'A yield table for meranti'	VI: 204-208
Malaysian Timber Export Industry Board	1969	'F.O.B. values by species of timber exported from W. Malaysia'	Unpublished.
Department of Statistics	1967	'Survey of Manufacturing Industries in W. Malaysia'	K.L.
F.A.O.	1967	'Forestry and Forest Industries'	
Department of Statistics	1969	'Estimates of Population for West Malaysia, 1967'	Research Paper No. 1
	1969	Straits Times	November 17th
	1969	Straits Times	October 31st
J.D. Peel, F.R.I. Kepong	1959	'The Properties of Experimental Fibreboards made from Malayan Woods'	Research Pamphlet No.24
	1968	'Johor Forest Department Report'	Unpublished
P.F. Burgess, F.R.I. Kepong	1969	'A Silvicultural System for the Hill Forests of the Malay Peninsula; preliminary conclusions'	
FAO/ECE	1963	'European timber trends and prospects'	Unasylva Vol. 17 (3)
A.J. Vincent, Malayan Forester	1961	'A Preliminary Investigation of Sampling Error assignable by forest types to commercial enumerations in lowland Dipterocarp Forest, Malaya'	
F.A.O., Forest Industries Department	1970	'An Analysis of Problem affecting the development of Forestry and Forestry Industries in West Malaysia'	FO-SF/MAL 16, Technical Report No. 1.
Forest Department	1968	'The Malayan Grading Rules for Sawn Hardwood Timber'	
S.T. MOK	1970	'Prospects for fallen utilisation of Johor's Forest Resource'	3rd Pan Malaysian Forestry Conference.
Ministry of Lands and Mines		'Annual Forestry Reports'	