LEMBAGA KEMAJUAN TANAH PERSEKUTUAN

FEDERAL LAND DEVELOPMENT AUTHORITY

MALAYSIA

THE JENGKA TRIANGLE REPORT

APPENDICES

TIPPETTS-ABBETT-McCARTHY-STRATTON

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APPENDICES

Table of Contents

1/ Appendix numbers correspond to Chapter numbers in the report.

APPENDIX 2

CLIMATE

APPENDIX 2-1

RAINFALL DATA

Table 1 - Mean Monthly And Mean Annual Rainfall 1/

Station	Months												Mean Annual	Adjusted Mean Annual 2/	Records Commenced	Number of Years of missing or incomplete records 3/	Years of records covered in probability analysis 4/	DID Station Number
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.						
Sg. Jempol	10	5	8	9	8	4	4	6	6	10	12	13	90	83	1924	18	-	P.A. 16
Sg. Sentul	10	5	7	9	9	5	4	5	7	10	12	12	94	91	1925	20	25	P.A. 32
Maran	10	5	7	8	8	5	5	6	8	11	9	12	94	97	1912	9	40	P.A. 6
Sg. Tekam	9	6	7	9	8	5	4	6	7	10	11	11	94	96	1912	16	38	P.A. 92
Kg. Awah	11	4	8	10	9	5	4	5	6	7	6	8	82	82	1950	12	7	P.A.117
Temerloh	9	6	6	9	6	4	6	4	5	9	9	9	84	84	1924	29	-	P.A. 79
Sg. Tekal	7	5	6	8	8	5	6	5	8	11	10	9	88	88	1947	2	-	P.A. 46
Average	10	5	7	9	8	5	5	5	7	10	10	10	90	89				

1/ All data are means of all records to 1964 inclusive.

2/ The mean annual rainfall data for Sg. Jempol, Sg. Sentul, Maran and Sg. Tekam were adjusted to allow for small changes in station regime which were detected by means of a double mass plot analysis.

3/ No records exist for any station for the war years 1941-1945 inclusive. Apart from this, all stations have missing years, months or days. This is not an abnormal condition for hydrological data obtained from remote areas and the accuracy of the mean annual and mean monthly tables were not materially affected, except for the station at Kampong Awah.

4/ See page 2-2 and figure 2-2 in text. Rainfall station records at Mentekab covering a 32 year period were also analysed.

APPENDIX 2-1

Table 2 - Extreme Monthly and Annual Rainfall 1/

Station		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Extreme Annual	Station No.
Sg. Jempol 2/	Lowest	00	0.6	0.7	0.2	1.7	0.4	00	00	2.0	3.1	3.9	1.1	51	P.A. 16
	Highest	33	16	20	25	19	11	13	15	13	19	23	36	122	
Sg. Sentul 2/	Lowest	1.0	0.4	0.7	0.5	2.5	0.8	00	00	0.6	4.1	5.1	2.5	51	P.A. 32
	Highest	29	14	16	22	16	10	19	14	19	19	24	33	136	
Maran	Lowest	1.3	0.2	1.1	1.0	2.4	0.6	0.1	0.2	2.8	3.3	2.5	1.8	63	P.A. 6
	Highest	21	19	18	17	18	9	11	19	15	20	18	30	134	
Sg. Tekam	Lowest	1.4	0.7	1.4	2.1	1.1	0.5	0.6	2.3	0.3	3.2	4.5	2.5	61	P.A. 92
	Highest	19	20	22	20	21	13	13	12	16	23	22	23	145	
Kg. Awah	Lowest	1.1	1.2	0.5	0.5	1.0	1.5	0.4	0.7	1.3	0.5	0.5	1.5	53	P.A.117
	Highest	16	8	11	19	18	10	10	9	10	13	23	18	124	
Temerloh	Lowest	4.0	2.0	3.2	3.9	3.0	1.5	2.0	0.8	3.4	4.4	3.7	4.8	71	P.A. 79
	Highest	19	15	14	14	15	6	10	8	10	12	17	19	90	
Sg. Tekal	Lowest	1.5	2.0	3.3	4.0	3.8	1.2	1.7	2.7	4.8	6.8	5.4	2.8	63	P.A. 46
	Highest	13	9	12	16	13	12	12	10	15	15	16	17	101	

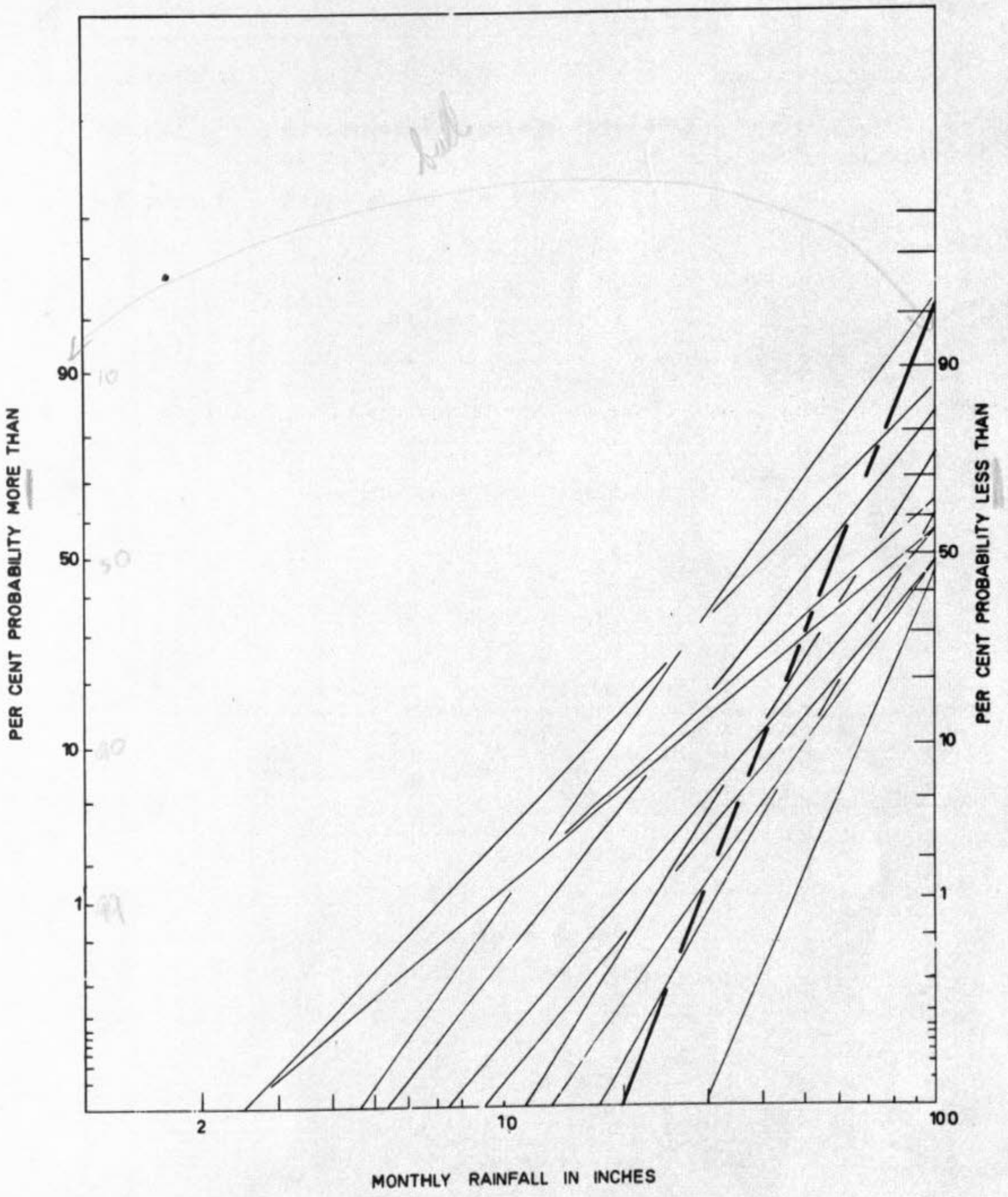
Months: Jan. to Dec.

1/ Includes all records up to 1964. See table 1, columns 16 and 17.

2/ The rainfall station in the Sg. Jempol catchment record some low monthly values which lie well outside the range of statistical prediction based upon geometrically normal frequency distribution. These records may or may not be correct. They should not be discounted for the project areas bordering the Jerantut-Maran road. Outside these areas the rainfall is less extreme and the Sg. Tekam data will give reliable rainfall figures for general application within the other parts of the Jengka Triangle.

APPENDIX 2-1

FIGURE 1 - PROBABLE MINIMUM MONTHLY RAINFALLS FOR PARTICULAR MONTHS 1/



1/ Based on Sg. Tekam rain gauge records and on data supplied by the Rubber Research Institute

APPENDIX 3

GEOLOGY AND GEOMORPHOLOGY

APPENDIX 3-1

LANDFORMS - REPRESENTATION OF SLOPES AND STREAMS ON TOPOGRAPHIC MAPS

An investigation was made of the reliability of using the 1:25,000 topographic map for the determination of slopes. Comparisons were made between slopes as obtained from the contour spacing on the map and from three other sources of data: the accurate survey of F.L.D.A. Ulu Jempol following forest clearance; slope profile surveys along portions of six rentis lines; and slope classes as recorded in the field over a sample area of 25 square miles. With the exception of hills and ridges that are both high and steep, for which the contours are a reliable guide, it was found that the topographic map substantially underestimates slope steepness and that the amount of this underestimate varies widely as between different samples, so that it is not possible to apply a constant correction factor. Taking as an example the proportion of land above 12^{o}, the extent to which the topographic map underestimates this for small areas, varies between 0 per cent and 50 per cent. For landform classes over more extensive areas, land shown by analysis of the topographic map to belong to class C_3 (0^{o} - 12^{o} slopes) is found by field survey to belong to class C_4 (0^{o} - $18\frac{1}{2}^{o}$ slopes) in about 25 per cent of cases; conversely, however, land shown by map analysis as C_4 is found to be correct in over 90 per cent of cases. Thus the map underestimates steepness both for individual slopes and for the predominant slopes over larger areas.

The map contours are based mainly on air photograph interpretation. The height of the forest trees is greater than the depth of most valleys in Jengka, and the trees tend to be taller in valley floors than on interfluve crests. This latter feature can be seen clearly along the margin between cleared land and forest; where a valley crosses the margin perpendicularly its steepness as seen in the top of the tree canopy is considerably less than as seen on the ground. Consequently air photograph interpretation, and contouring based partly on this, may be expected to underestimate slope steepness. A further reason is that many of the smaller stream valleys are not shown on the map (see below); hence the increased slope steepness resulting from dissection by these valleys is also omitted.

A comparison between the number of valleys crossed during field survey of rentis lines and the number shown on the topographic map indicates that the map underestimates valley frequency. To obtain the best estimate of actual valley frequency add 35 per cent to the number of streams shown crossing a given line on the map. If all inflections of contours indicative of valleys are also included, the mean amount to be added to the count of valleys from the map is 23 per cent. However, for sample lines 5 miles in length, the standard error on the latter mean is 18 per cent; hence the amount to be added to the number of valleys shown on the map for any given 5 mile line will commonly vary from 0 per cent to 50 per cent.

With respect to drainage density, the length of stream channel per unit area, Eyles (1966, see reference in Chapter 3) has shown that for Malayan topographic maps in general the actual drainage density (D) is related to the drainage density as shown on the maps (d) by the equation

$$D = 2.12d - 0.43$$

where D and d are measured in miles of drainage channel per square mile of area. Eyles' method was to obtain true drainage density from air photographs of cleared land, on which all drainage lines can be seen. This same method was applied to recently cleared land on the Ulu Jempol, Bukit Tajau and Sungai Nerek FLDA Schemes, and to Chenor Estate. Substantially lower correction factors than Eyles' were obtained. If the results from these sample areas are of general application, to obtain the best estimate of the length of drainage channel within a given area, using the 1:25,000 Jengka Triangle map series, add between 25 per cent and 33 per cent to the length as measured from the map.

SLOPE ANGLE FREQUENCY

The data on the proportion of land area lying between selected values of slope angle, as given in Table 1, may be supplemented for the class of Rolling land (Class C_3) by the proportions at each single-degree angle, using data obtained from slope profile surveys. For the other landform classes the surveyed sample is insufficiently large to permit accurate values for individual angles to be obtained.

Figure 1 shows the proportion of the ground surface at each single-degree angle for C_3 land. Gentle slopes are considerably more extensive than nearly level land; there is a rapid fall in slope frequency between 9° and 12°, and a small percentage at all angles up to over 35°. Figure 2 shows the same values plotted cumulatively. The percentage of land in the C_3 class that exceeds, or is less than, any given angle can be read off from this curve.

APPENDIX 3-1

Table 1 - Estimated Percentage Frequency of Slopes

Landform Class	$0^\circ - 2^\circ$ Valley Floor	$0^\circ - 2^\circ$ Slope Crest	$2\frac{1}{2}^\circ - 6^\circ$	$6\frac{1}{2}^\circ - 12^\circ$	$12\frac{1}{2}^\circ - 18^\circ$	$18\frac{1}{2}^\circ - 35^\circ$	Over 35°
C_1 (P)	100	0	0	0	0	0	0
C_1	98	0	2	0	0	0	0
C_2 (T)	90	0	6	1	1	1	1
C_2	20	20	50	10	0	0	0
C_3	5	10	40	35	7	3	0
C_4	4	5	10	35	35	10	1
C_5	2	2	5	10	30	50	1
C_6	1	2	5	10	20	60	2
C_6 (L)	0	2	5	10	13	50	20

Probable error - Classes C_2, C_3, C_4 : $\pm$ 5%
Classes C_2(T), C_5, C_6 : $\pm$ 10%
Class C_6 (L) : $\pm$ 20%

APPENDIX 3

Figure 1

SLOPE ANGLE FREQUENCY

Figure 1-A

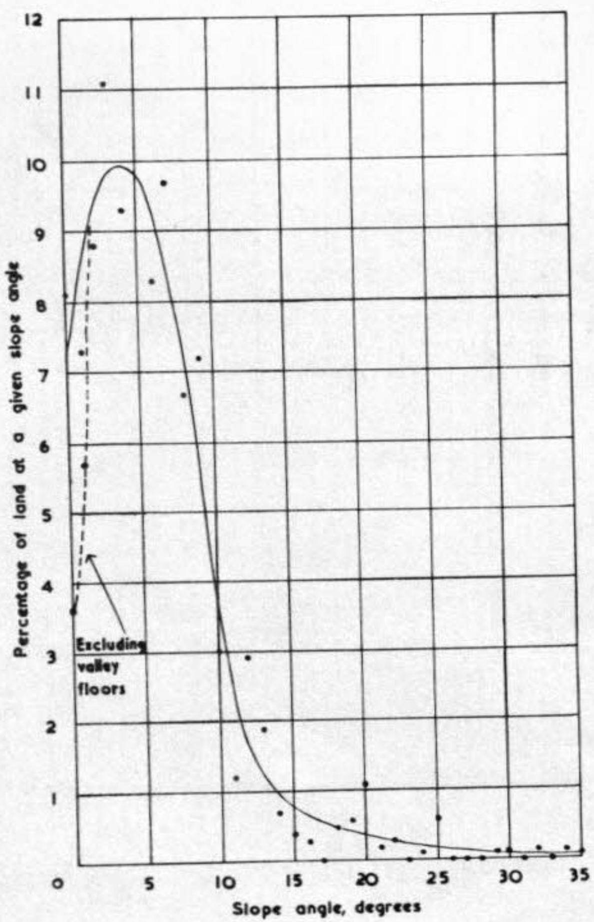
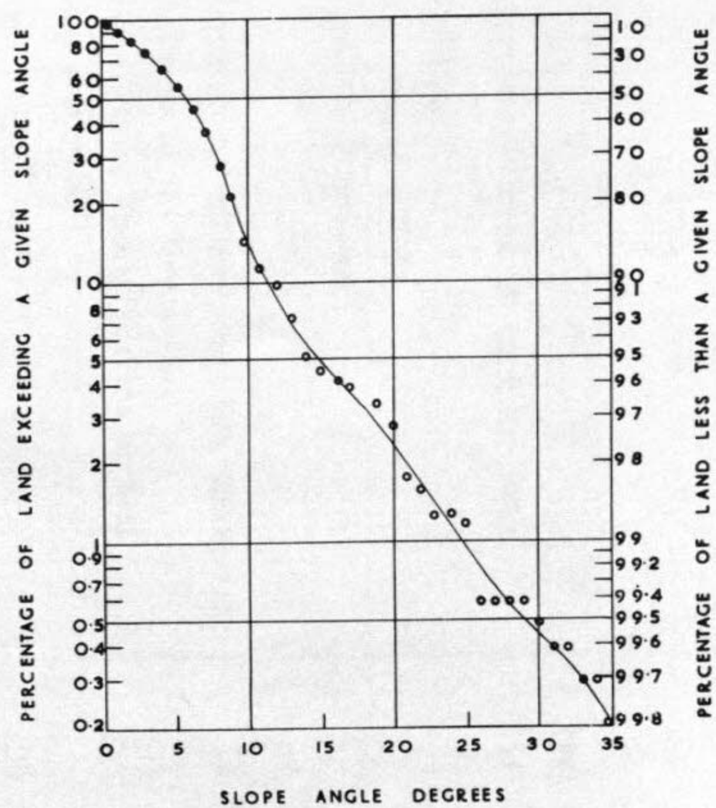


Figure 1-B



APPENDIX 4

SOILS

APPENDIX 4-1

SOILS AND LAND CLASSIFICATION OF THE TEKAM AREA

That part of the Tekam Forest Reserve within which the soil survey was carried out is indicated in Figure 4-1 of the report. The survey methods and the procedure for identifying each soil series were the same as those employed in the Jengka Triangle.

The area surveyed, in contrast to Jengka, contains smaller proportions of steeper land. Table 1 indicates the acreages and percentages of each slope class found to occur. Their location is shown in Figure 4-1. More than 93 per cent of land surveyed falls into slope classes of up to 12°. This high percentage of undulating and rolling land will facilitate planning for agricultural development. The small areas of steep land are scattered through the area; the periphery of the area is characterized by a sharply defined line of steep hills with slopes exceeding 18°.

Soil Series and Distribution

The range of soil series identified and their characteristics were the same as those encountered in Jengka. Their distribution was less intricate and the need to map soil complexes occurred less frequently. A generalized soil map of the area appears as Figure 3-5. Detailed presentation of the soils appears at the 1:63,360 scale in the Map Annexure. Soil maps of the area at 1:25,000 scale have been submitted separately from this report. The acreage and percentage area of each series is shown in Table 2.

The Segamat and Munchong series are the predominant series occupying 21.1 per cent and 26.5 per cent of the land respectively. They are found entirely in the central and eastern sectors of Tekam and each series usually occurs as an extensive unit. In a few instances, particularly in the south and southeast, Munchong was found in complex with Malacca series.

Table 1

LANDFORMS

Slope Class	Area (acres)	Percent.
$C1_P$	NIL	-
C1	3,723	9.2
$C2_T$	NIL	-
C2	21,782	54.0
C3	12,336	30.6
C4	1,937	4.8
C5	444	1.1
C6	25	0.3
$C6_L$	NIL	-
Total	40,247	100.0

Table 2

SOIL SERIES

	Area (acres)	Percent.
Segamat	10,668	26.5
Munchong	8,497	21.1
Durian	2,708	6.7
Batu Anam	2,018	5.0
Malacca	3,274	8.2
Tavy	205	0.5
Bungor	1,389	3.4
Serdang	4,472	11.1
Kuala Brang	42	0.2
Kedah	1,353	3.4
Jempol	238	0.6
Telemong	2,919	7.2
Akob	1,935	4.8
River Alluvium	529	1.3
Total	40,247	100.0

Durian series is limited in distribution and was found in small units, usually on the periphery of the surveyed area. The greatest proportion was encountered in the southwest corner where in isolated instances it was found in complex with Batu Anam. The latter series is confined almost entirely to the west, close to the Sungei Siam.

Individually small areas of Malacca series were encountered throughout the area but the greater number lie in the southeast corner, where Malacca occurs as the dominant series in a Malacca/Munchong complex.

Tavy was insignificant in its occurrence and appears as small isolated areas in the southeast corner. Bungor series also is of minor importance, and was encountered only in small areas in the northwest extremity.

The Serdang series comprising 11.1 per cent of the area lies predominantly in a discontinuous belt from north to south along the western edge of the area. Small units occur in a few cases to the east and south. Characteristically, Serdang also occurs in complex with Kedah and Kuala Brang on the steeper foothills of the northern border. In only two instances were the latter series found to occur individually. Neither is significant in its area of distribution.

The distribution of Telemong series is associated with the river pattern of the whole area. Thus bands of varying width adjacent to the Sungei Tekam, Galong and Siam intersect the whole area from north to south, converging towards a central point on the southern boundary.

The Akob series is present in all of the valley flows throughout Tekam but also occurs as more extensive areas in the west. Smaller areas of River Alluvium also occur in narrow belts along the more important streams of the northwest and southeast.

Land Classification

The land classification system devised for the Jengka Triangle was used for classifying the land of the Tekam area, (Table 3). By virtue of the flatter terrain and the occurrence of large areas of soil with few limitations for agricultural development nearly 50 per cent of the land falls into Class II. A further 20 per cent falls into Class IIW.

Figure 9-1 depicts the boundaries of the land classes and the crop suitability ascribed to each. The pattern which emerges clearly demonstrates the high proportion of land in the area which is suitable for planned agricultural development.

Table 3

LAND CLASSIFICATION

Land Class	Area (acres)	Percent.
I	NIL	-
IIa	NIL	-
IIb	8,270	20.5
IIc	8,784	21.8
IId	615	1.5
IIe	2,294	5.7
IIW	7,768	19.3
IIIa	12,014	29.8
IIIb	NIL	-
IV	305	0.8
V	197	0.6
Total	40,247	100.0

APPENDIX 4-2

LATERITE

Laterite horizons are important in land classification insofar as they act as a limiting horizon for root development. The factors bearing on this are the physical nature of the laterite, its thickness, and the depth of overlying soil.

Most of the laterite in Jengka is of the nodular type; it is formed of hard, sub-angular to sub-rounded concretions, typically one tenth to half inch diameter, not cemented together or only very weakly cemented. Ironstone pebbles and boulders, originating as iron-indurated rock, are occasionally found, but are not common. Analyses show that in thick laterite horizons, as in the Malacca and Tavy series, concretionary gravel and stones form 65 - 80 per cent of the total soil volume. Under forest a few roots penetrate between the concretions, and oil palm roots have also been observed to do so to a limited extent; but because of the high proportion of concretionary material, laterite of this type is regarded as a limiting horizon because of the reduction in soil volume with its effects on moisture holding and nutrient capacity.

A second type of horizon consists of concretions set in a matrix of clay. The proportion of concretionary material is typically 30 - 60 per cent. This horizon is commonly found in Durian series profiles. It restricts, but does not prevent, root penetration.

Massive laterite, as found in the Malacca series in Malacca State, has only been recorded in Jengka in the south-east. Here, associated with the swamps of tributaries of the River Jempol, massive boulders with a honeycomb structure and bog iron ore with a laminar structure have been recorded. The Malacca series in this area may prove to have more serious limitations than in other areas; this has been taken into account in making crop recommendations.

With respect to the thickness of the laterite horizon, 15 out of 19 pits in Malacca and Tavy series show 24 - 48 inches; in two pits, after penetrating 48 inches of laterite the base of the horizon had not been reached. In the Durian series thicknesses varied from 3 to 18 inches. Below laterite horizons weathered shale, in which iron staining has caused mottled or variegated colours, is usually found.

These observations support the suggestion of Leamy (1966b), that in soil series definitions, the specification for minimum thickness for a petric (laterite) horizon should be 18 inches. On this criterion the Malacca and Tavy series have laterite horizons but the Durian series does not.

Variations in the thickness of laterite over distances of the order of quarter mile are frequent, giving rise to soil complexes of the Malacca, Tavy and Durian series.

The depth of soil overlying laterite horizons may range from four inches to over six feet; most frequently it is between 8 and 18 inches. This depth may vary considerably over short distances (in one soil pit exposure a change from 10 to 23 inches occurred). In north Jengka such variations give rise to Munchong-Malacca complexes; a soil depth over laterite of 24 inches has been taken as the dividing criterion between these two series.

The laterite of Jengka shows no systematic relation to relief. In particular, the feature commonly reported from other tropical regions, laterite cappings to flat hill or interfluve crusts, is not found. In areas with non-incised valleys a tendency for laterite to be more frequent, or closer to the surface, within 50 yards of the valley floor margins was noted in places.

There is a definite tendency for laterite to be more abundant in zones adjacent to Segamat soils.

Such a relation could possibly be due to inter-bedding of iron-rich andesite with shales in these zones, but it has not been possible to obtain geological confirmation of this.

An anomalous feature is that Segamat soil derived from rock with a higher iron content have laterite horizons less frequently than do Durian and Munchong.

There is no evidence that much of the laterite in Jengka is relict, that is formed under environmental conditions different from those of the present. Two facts point rather to an origin during the present cycle of pedogenesis; the existence of a continuous transition, from scattered concretions, via a thin horizon of concretions in a clay matrix, to thicker horizons composed mainly of concretions; and the absence of hill-cappings of laterite. An exception is the massive laterite in the south-east, which may be relict from a time when swamps were more extensive.

APPENDIX 4-3

PROFILE DESCRIPTIONS, ANALYTICAL DATA AND SERIES KEY.

Soil profile and site descriptions follow. These have been selected as representative of the soil series as developed in Jengka and Tekam, but are not necessarily typical in all respects of the same series as found in other parts of Malaya. Analytical data for the profiles described are given in Table 1. Textural properties of the series are shown in Figure 1 of Appendix 4-4. Table 2 gives a field key to the identification of soil series; it is applicable only to the Jengka Triangle and the surveyed area of the Tekam Forest Reserve. Details of analytical methods are given following the profile descriptions. Table 3 gives the whole of the analytical data and shows the variation within each series.

All the profiles described, except the Akob series, were under primary Dipterocarp rain forest.

APPENDIX 4-3

Table 1 - Analyses of Soil Series

Series and Pit No.	Depth (ins.)	Percentages: Clay	Silt	Fine Sand	Coarse Sand	On original sample: Gravel %	Stones %	pH	Percentages: Organic Matter	Carbon	Nitrogen	C/N Ratio	Easily Sol. ppm: N/10 NaOH P	Organic P
Segamat	0-3	77	8	10	2	NIL	NIL	3.6	5.55	3.22	0.38	8.47	131	107
PE 5/24	3-8	87	4	9	2	"	"	4.3	2.40	1.39	0.17	8.17	68	59
	8-26	91	4	7	1	"	"	4.7	1.14	0.66	0.08	8.25	53	37
	26-72	91	4	7	1	"	"	5.1	0.66	0.38	0.04	9.50	-	-
Munchong	0-2½	91	4	4	2	NIL	NIL	3.6	5.48	3.18	0.32	9.93	88	69
L_3C 3/57	2½-10	97	4	2	1	"	"	4.7	1.29	0.75	0.17	4.30	48	40
	10-14	98	4	2	1	"	"	4.5	1.83	1.06	0.10	10.6	36	-
	14-40	97	2	2	1	"	"	4.3	2.21	1.28	0.13	9.84	37	-
	40-60	99	4	2	Trace	"	"	5.2	0.53	0.31	0.04	7.75	30	-
Durian	0-2	62	18	12	8	NIL	NIL	4.3	6.72	3.90	0.31	12.6	86	58
D 2/50	2-7	67	17	11	5	"	"	4.5	1.53	0.89	0.12	7.4	64	65
	7-24	75	13	8	3	"	"	4.5	0.75	0.44	0.07	6.3	46	45
	24-36	80	12	5	2	"	"	4.6	0.43	0.25	0.07	3.6	27	-
	36-60	-	-	-	-	-	-	-	-	-	-	-	-	-
Batu Anam	0-2	43	22	32	2	NIL	NIL	4.4	4.10	2.38	0.21	11.33	32	29
EE 4/58	2-6	42	23	30	1	"	"	4.4	1.57	0.91	0.12	7.58	29	16
	6-13	53	22	25	1	"	"	4.5	0.52	0.30	0.11	2.73	19	11
	13-27	63	19	20	1	"	"	4.6	0.41	0.24	0.07	3.42	18	-
	27-44	67	23	12	1	"	"	4.6	0.36	0.21	0.06	3.51	17	-
Malacca	0-1½	41	17	33	8	1.14	NIL	4.8	5.72	3.32	0.15	22.13	53	19
K'W 0/0	1½-9	60	14	26	3	2.63	"	4.5	1.81	1.05	0.07	15.00	28	10
	9-43	73	8	16	7	43.80	31.28	5.0	1.17	0.68	0.06	11.33	27	-
	43-72	81	9	12	4	11.09	4.26	5.3	0.44	0.26	0.05	5.20	23	-

APPENDIX 4-3

Table 1 - Analyses of Soil Series (Contd.)

Series and Pit No.	C. E. C. me/100 g	Exchangeable Cations me/100 g				Saturation %	6 N HCl Soluble				
		K	Ca	Mg	Total		P (ppm)	Fe_2O_3 %	K me/100 g	Ca me/100 g	Mg me/100 g
Segamat PE 5/24	19.00	0.60	0.52	0.89	2.11	11	510	14.16	0.91	3.89	6.91
	11.92	0.34	0.16	0.32	0.86	7	410	14.22	0.68	3.57	4.02
	9.33	0.30	0.21	0.16	0.69	7	360	14.50	0.49	3.08	3.21
	7.26	0.31	0.16	0.32	0.81	11	-	-	-	-	-
Munchong L_3C 3/57	22.9	0.14	0.47	0.36	1.05	4	1,015	15.8	0.52	2.76	4.50
	10.0	0.02	0.10	0.05	0.24	2	840	15.0	0.52	3.24	1.13
	11.7	0.02	0.16	0.05	0.28	2	735	14.8	0.52	2.27	1.29
	12.5	0.02	0.16	0.05	0.28	2	-	-	-	-	-
	7.15	0.02	0.16	0.05	0.28	4	-	-	-	-	-
Durian D 2/50	20.5	0.29	0.37	0.46	1.25	6	140	1.33	2.37	2.36	3.04
	11.4	0.11	0.10	0.20	0.48	4	160	1.47	2.97	2.52	3.04
	11.1	0.09	0.16	0.10	0.46	4	140	1.57	3.02	3.84	3.04
	12.4	0.07	0.10	0.10	0.36	3	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-
Batu Anam EE 4/58	12.1	0.20	0.26	0.37	0.83	7	133	1.19	3.38	4.54	3.22
	7.08	0.09	0.16	0.10	0.35	5	106	1.33	3.74	4.05	3.54
	7.95	0.04	0.16	0.05	0.25	3	93	1.54	4.42	3.73	4.34
	7.95	0.02	0.36	0.10	0.48	6	38	2.14	5.36	-	-
	8.12	0.02	0.16	0.05	0.23	3	-	-	-	-	-
Malacca K'W 0/0	16.72	0.31	0.63	1.21	2.23	13	136	5.36	3.74	5.51	5.30
	12.24	0.09	0.05	0.31	0.59	5	144	7.82	5.04	3.73	6.75
	13.27	0.05	0.05	0.31	0.61	5	122	12.92	7.28	3.73	7.55
	12.41	0.05	0.16	0.10	0.41	3	-	-	-	-	-

(Contd.)

APPENDIX 4-3

Table 1 - Analyses of Soil Series (Contd.)

Series and Pit No.	Depth (ins.)	Percentages				On original sample		pH	Percentages			C/N Ratio	Easily Sol. ppm	
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stones %		Organic Matter	Carbon	Nitrogen		N/10 NaOH P	Organic P
Tavy J_2N 0/0	0-2	28	13	42	22	NIL	NIL	4.5	6.17	3.58	0.22	16.27	42	40
	2-20	24	12	44	25	"	"	5.0	0.74	0.43	0.09	4.77	30	12
	20-26	37	14	39	23	1.1	"	5.0	0.59	0.34	0.05	6.80	28	-
	26-40	39	10	41	23	45.1	"	4.8	0.41	0.24	0.03	8.00	24	-
	40-72	37	8	38	21	4.67	"	4.6	0.21	0.12	0.03	4.00	21	-
Bungor UB 4/74	0-3	40	19	31	12	NIL	NIL	4.8	1.83	1.06	0.10	10.60	38	24
	3-15	51	16	24	10	"	"	4.6	0.48	0.28	0.06	4.66	22	19
	15-27	53	16	23	9	0.73	"	4.4	0.28	0.16	0.06	2.66	17	-
	27-43	57	18	21	8	2.95	"	4.5	0.21	0.12	0.05	2.40	16	-
	43-70	65	12	17	7	3.38	7.41	4.6	0.21	0.12	0.03	4.00	14	-
Serdang SB 4/77	0-3	20	12	52	18	NIL	NIL	3.8	2.69	1.56	0.08	19.50	28	21
	3-17	26	12	52	14	"	"	4.3	0.81	0.47	0.06	7.83	23	7
	17-43	3[illegible]	12	47	15	"	"	4.5	0.38	0.22	0.04	5.50	21	-
	43-70	32	12	47	15	"	"	4.7	0.10	0.06	0.02	3.00	21	-
Kedah DB 4/57	1-5	35	18	33	15	NIL	NIL	3.6	4.12	2.39	0.15	15.93	50	48
	5-16	38	19	30	14	0.49	"	4.4	0.53	0.31	0.05	6.20	21	12
Jempol JL 0/5	0-2	39	10	45	9	NIL	NIL	4.0	1.67	0.97	0.19	5.10	38	23
	2-14	41	12	43	9	"	"	4.2	1.57	0.91	0.08	11.37	32	7
	14-72	53	10	34	6	2.1	0.8	4.7	0.57	0.33	0.04	8.25	23	-
	72-75	62	12	26	5	31.6	30.6	4.9	0.41	0.24	0.03	8.00	22	-
Telemong JA 0/20	0-2	22	6	56	20	NIL	NIL	4.3	2.41	1.40	0.14	10.0	65	65
	2-17	18	6	56	24	"	"	4.5	0.52	0.30	0.03	10.0	44	33
	17-72	15	8	51	30	"	"	4.8	0.10	0.06	0.01	6.0	43	-
Akob Y'E 3/12	0-3	Muck	Muck	Muck	Muck	NIL	NIL	7.9	23.12	13.41	1.65	8.13	117	99
	3-15	84	4	6	2	"	"	5.3	2.50	1.45	0.06	24.17	39	21
	15-36	80	12	5	3	"	"	5.8	0.76	0.45	0.03	15.00	30	-

(Contd.)

APPENDIX 4-3

Table 1 - Analyses of Soil Series (Contd.)

Series and Pit No.	C. E. C. me/100 g	Exchangeable Cations me/100 g: K	Ca	Mg	Total	Saturation %	6 N HCl Soluble: P (ppm)	Fe_2O_3 %	K me/100 g	Ca me/100 g	Mg me/100 g
Tavy J_2W 0/0	19.31	0.28	1.10	0.94	2.34	12	118	1.00	2.55	3.24	4.82
	5.34	0.05	0.16	0.16	0.38	7	91	1.89	1.61	3.57	2.73
	5.69	0.07	0.16	0.26	0.51	9	-	-	-	-	-
	7.59	0.04	0.26	0.42	0.74	10	-	-	-	-	-
	6.21	NIL	0.26	0.26	0.54	9	-	-	-	-	-
Bungor UE 4/74	9.33	0.12	0.57	0.42	1.05	11	70	1.72	2.05	2.08	4.64
	7.95	0.07	0.26	0.05	0.38	5	50	2.33	2.52	3.89	3.04
	8.25	0.02	0.16	0.10	0.28	3	50	2.33	2.39	5.51	1.44
	8.64	0.02	0.16	0.05	0.23	3	-	-	-	-	-
	10.19	0.02	0.21	0.10	0.33	3	-	-	-	-	-
Serdang SE 4/77	10.71	0.09	0.50	0.31	0.90	8	98	1.07	1.12	3.56	4.48
	7.78	0.04	0.21	0.16	0.41	5	55	1.36	1.51	3.73	1.28
	7.26	0.04	0.10	0.10	0.24	3	50	1.72	2.05	5.67	0.80
	6.39	0.02	0.16	0.10	0.28	5	-	-	-	-	-
Kedah DE 4/57	11.75	0.37	0.26	0.26	0.91	8	100	1.07	1.33	2.43	3.21
	6.22	0.32	0.21	0.05	0.60	10	50	1.64	1.69	5.19	1.77
Jempol JL 0/5	15.03	0.14	0.55	0.45	1.16	8	98	3.82	2.96	5.02	2.41
	9.85	0.05	0.16	0.10	0.33	3	76	4.62	2.96	4.38	2.57
	8.47	0.04	0.16	0.10	0.34	4	51	6.47	5.04	5.35	3.05
	9.33	0.04	0.16	0.10	0.32	3	-	-	-	-	-
Telemong JA 0/20	8.98	0.11	0.57	0.74	1.42	16	270	1.39	2.08	4.21	8.38
	4.32	0.02	0.15	0.16	0.33	8	179	1.20	2.08	3.73	3.86
	2.76	0.02	0.21	0.10	0.33	14	-	-	-	-	-
Akob Y'E 3/12	72.50	0.41	34.48	5.47	40.55	56	-	-	-	-	-
	13.30	0.09	3.90	4.26	8.31	62	156	3.04	1.51	7.78	2.89
	12.61	0.05	5.56	1.84	7.53	60	-	-	-	-	-

APPENDIX 4-3

Table 2 - Field Key to Identification of Soil Series

1a	Mottling commences above 8 in.	AKOB
1b	No mottle, or mottling commences below 8 in.	2
2a	Laterite horizon over 18 in. thick commences above 36 in.	3
3a	Soil overlying laterite a clay; no eluvial A horizon; laterite commences above 24 in.	MALACCA
3b	Soil overlying laterite a sandy clay or lighter texture; eluvial A horizon present	TAVY
2b	No laterite, or laterite horizon thinner than 18 in., or commences below 36 in.	4
4a	All horizons below 8 in. clay	5
5a	Mottling commences above 36 in.; lower horizons very stiff to auger; eluvial A horizon present	6
6a	Very pale colours; mottling commences above 18 in.; laterite never present	BATU ANAM
6b	Mottling commences 18 - 36 in.; laterite horizon less than 18 in. thick sometimes present	DURIAN
5b	No mottle, or mottling commences below 36 in.; eluvial A horizon absent or only weakly developed	7
7a	All horizons friable; soil depth exceeds 72 in.	SEGAMAT
7b	All or some horizons non-friable	8
8a	Yellowish red	MUNCHONG
8b	Reddish brown	JEMPOL
4b	At least one horizon below 8 in. sandy clay or lighter texture	9
9a	Weathered rock commences above 48 in.	10
10a	Weathered quartzite or sandstone commences above 24 in.	KEDAH
10b	Weathered quartzite or sandstone commences at 24 - 48 in.	KUALA BRANG
9b	No weathered rock above 48 in.	11

(Contd.)

Table 2 - Field Key to Identification of Soil Series (Contd.)

11a	Texture becomes progressively heavier with depth	12
12a	Above 18 in. predominantly sandy loam or sandy clay loam	SERDANG
12b	Above 18 in. predominantly sandy clay	BUNGOR
11b	No regular increase in clay with depth	TELEMONG

Mapped soil types other than soil series are excluded from the key because their range of characteristics is not precisely defined.

Their principle diagnostic features are:

Alluvial soils with mottling commencing at 8 - 60 in.	River alluvium
Shale commences above 24 in.	Lithosols
Reddish brown clay, with rock commencing at 24 - 48 in.; steep slopes	Colluvium (Jempol)
Boulders and/or quartz fragments commencing at 12 - 36 in.; steep slopes	Colluvium (miscellaneous)
Soils on lower slopes of limestone hills	Colluvium (limestone)

APPENDIX 4-3

Table 3 - Soil Analysis

(Final Mean Values as at 11.10.66)

Soil series	No. of Pits	Percentage Clay				Percentage Silt	pH			Organic matter	Carbon	Nitrogen	Soluble P	Organic P	6N HCl					Exchangeable										
															P	Fe_2O_3	K	Ca	Mg	C.E.C.	K	Ca	Na	Mg	T.E.C.	Saturation Percentage	C.E.C.	T.E.C.	Saturation Percentage	C.E.C./100g clay
		Ah	Ae	B/C	Heaviest	Mean	Ah	Ae	B/C	Ah Horizon					Mean Horizons					Ah Horizon							Lower Horizons			
Segamat	11	81	85	87	88	8	3.9	4.5	5.0	6.1	3.52	0.34	110	79	378	14.85	15.8	3.72	3.86	20.62	0.31	0.58	0.06	1.19	2.11	8	10.11	0.56	6	11.8
No. of samples		9	7	11	11	11	9	7	11	9	9	9	9	9	11	10	11	11	11	9	9	9	5	9	9	8	11	11	11	11
Munchong	2	85	89	89	91	8	4.0	4.6	4.9	6.81	3.95	0.35	54	80	173	8.51	1.12	3.58	1.72	21.30	0.34	0.21	0.13	0.70	1.37	6	8.97	4.45	6	10.3
No. of samples		2	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Durian	10	57	64	78	81	16	4.5	4.5	4.7	5.0	2.9	0.21	48	31	90	3.03	5.76	4.34	4.99	16.04	0.23	0.46	0.05	0.79	1.55	10	13.33	0.55	4	17.3
No. of samples		9	9	9	9	9	9	10	10	9	10	10	10	10	10	10	10	10	10	9	9	9	6	9	9	9	9	9	9	8
Batu Anam	4	43	57	67	70	19	4.4	4.5	4.6	4.97	2.88	0.21	55	32	54	1.63	4.56	4.19	4.42	15.05	0.17	0.42	0.06	0.55	1.16	7	10.28	0.43	4	17.5
No. of samples		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	4	4	4	4	4	4	4
Malacca	5	61	65	77	80	13	4.4	4.4	4.8	6.55	3.80	0.24	55	67	119	6.48	3.71	3.90	5.54	21.09	0.29	0.55	0.14	0.74	1.71	9	14.77	0.58	4	19.9
No. of samples		5	4	5	5	5	5	4	4	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	5	5	5	5
Tavy	8	42	45	56	61	13	4.1	4.4	4.7	6.19	3.59	0.25	48	57	91	4.19	2.68	3.92	4.43	18.16	0.31	0.41	0.03	0.79	1.61	9	9.76	0.54	6	20.1
No. of samples		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	3	8	8	8	8	8	8	7
Bungor	4	35	40	56	64	16	4.3	4.5	4.6	2.76	1.60	0.15	48	28	64	2.80	1.72	3.16	3.40	10.71	0.18	0.43	0.04	0.59	1.02	10	8.11	0.45	6	16.7
No. of samples		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4
Serdang	8	23	30	41	42	13	4.2	4.7	4.8	2.58	1.50	0.12	42	26	94	1.49	1.98	3.95	3.39	10.89	0.12	0.27	0.07	0.41	0.85	8	7.10	0.37	5	19.7
No. of samples		8	8	8	8	8	8	8	8	5	5	6	8	8	8	7	8	8	8	8	8	8	4	8	8	8	8	8	8	5
Kuala Brang	1	26	32	48	67	18	4.2	4.6	4.8	3.19	1.85	0.15	33	12	29	1.18	5.36	5.27	2.41	11.06	0.11	0.26	0.02	0.58	0.97	9	10.33	0.42	4	24.1
No. of samples		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Kedah	1	35	-	38	38	19	3.6	-	4.4	4.12	2.39	0.15	50	48	75	1.35	1.51	3.81	2.49	11.75	0.37	0.26	0.02	0.26	0.91	8	6.22	0.60	10	16.4
No. of samples		1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Jempol + Colluvium (JML)	2	28	45	48	49	14	4.1	4.5	4.7	2.05	1.19	0.10	52	20	142	4.11	2.80	3.43	8.06	9.85	0.05	0.15	-	0.26	0.46	5	9.16	0.50	6	19.9
No. of samples		1	2	2	2	2	1	2	2	1	1	1	1	1	2	2	2	2	2	1	1	1	0	1	1	1	2	2	2	2
Telemong	2	25	18	14	25	11	5.4	4.5	5.9	1.84	1.07	0.15	74	66	89	2.76	2.96	4.25	7.80	8.45	0.09	1.75	0.10	1.25	2.13	16	2.89	0.72	11	21.3
No. of samples		2	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	1	2	2	1	1
River Alluvium	2	60	62	75	77	22	4.9	4.9	4.9	4.54	2.63	0.24	77	54	186	5.24	5.15	4.85	6.78	17.66	0.34	2.10	0.11	2.07	4.62	24	12.69	0.89	8	17.6
No. of samples		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Akob	5	33	-	75	76	20	5.1	-	5.2	12.13	7.04	0.67	93	90	328	3.85	1.50	8.10	4.85	37.32	0.34	10.84	0.17	3.12	14.45	32	15.47	7.49	45	20.8
No. of samples		3	0	5	5	5	4	0	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5
Akob (sandy variant)	2	20	16	29	29	17	5.5	5.3	4.0	4.09	2.37	0.18	64	40	114	0.94	1.26	5.33	5.94	12.52	0.09	2.55	0.03	1.50	3.72	27	7.68	2.80	38	35.4
No. of samples		2	1	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Akob (swampy soil)	1	-	-	92	92	2	4.8	-	4.9	33.88	19.65	0.97	109	392	434	6.51	1.30	9.97	3.46	11.55	0.14	6.86	-	2.05	9.05	80	15.17	2.47	17	18.9
No. of samples		0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1

Segamat Series

Grid location: WA586541 Rentis location: PE 5/24

Parent material: Andesite. Relief: C_3, Rolling, 0° - 12°; broad interfluves with incised, flat-floored valleys. Site: 2° upper slope, near crest. Drainage: Free.

Depth (inches)	Horizon Nomenclature	Field Description
0 - 3	Ah	5YR 5/6 yellowish red clay, strong fine crumb structure, friable, abundant fine roots; clear boundary
3 - 8	Bti	3.5YR 5/6 red clay, strong medium blocky structure, moderate clay skins, friable, common medium roots; merging boundary
8 - 72	Bti	2.5YR 4/6 red clay, weak medium blocky structure, breaking down into weak fine crumb; very friable, floury, few roots; merging boundary
72 +	B/Cm	As above with very few weatherable minerals

Remarks: Yellowish red (5YR 5/8) and red colours occur with about equal frequency. On the site described above, the red colour near the slope crest gives place downslope to yellowish red.

Segamat differs from all other series in Jengka in its greater friability; the profile is relatively uniform with depth. Segamat and Munchong may both have the same yellowish red colour

Grid location: WA532747 Rentis location: L_3C 3/57.
Parent material: Shale. Relief: C_3, Rolling, $0^{o} - 12^{o}$; with incised, flat-floored valleys. Site: 11^{o} upper slope, convex. Drainage: Free

Depth (inches)	Horizon Nomenclature	Field Description
0 - 2½	Ah	7.5YR 5/6 strong brown clay loam, weak fine granular structure, friable, abundant fine and common medium roots; clear boundary
2½ - 14	Bt	7.5YR 5/8 strong brown clay, moderate medium blocky structure, moderate clay skins; plastic, firm; common medium roots; merging boundary
14 - 40	Bt	Colour, texture and structure as above; plastic, firm, and sticky near top, but becoming friable towards base; few roots; merging boundary
40 - 60	Bi	5YR 5/8 yellowish red clay, moderate firm medium blocky structure, no clay skins, friable, few fine roots, almost no visible minerals

Remarks: In the above profile, almost no visible rock minerals were present at 90 inches; frequently, however, minerals appear at about 60 inches. A laterite horizon is quite commonly present; it may commence at any depth below 24 inches.

Munchong is less friable than Segamat, has a deeper and more uniform profile than Durian, and is less sandy than Bungor.

Durian Series

Grid location: WA546581 Rentis location: D 2/50

Parent material: Shale Relief: C_2, undulating, $0^\circ - 6^\circ$.

Site: 3° upper slope. Drainage: Site drainage free, profile drainage slightly impeded.

Depth (inches)	Horizon Nomenclature	Field Description
0 - 2	Ah	1OYT 5/4 yellowish brown clay, with noticeable sand, moderate medium crumb structure, friable, abundant fine and common medium roots; clear boundary
2 - 7	Aej	1OYR 7/6 yellow clay, with noticeable sand, very weak medium blocky structure, friable, medium roots common; merging boundary
7 - 24	Bt	7.5YR 6/6 reddish yellow clay, with faint mottle commencing below 16 inches; weak medium to coarse angular blocky structure, very weak clay skins; plastic, firm; few medium roots
24 - 36	Btg/C	Transitional horizon; a few iron concretions present
36 - 60	Cu	Variegated colouring, grey, red, and yellowish brown, becoming with depth white with prominent red mottle; clay very firm; rare roots; lamination originating from rock structure detectable in places

Remarks: The above profile belongs to the non-lateritic variant of the Durian series. In the lateritic variant a horizon of iron concretions set in a matrix of clay occurs between the Bt and Cu horizons; the thickness of this concretionary horizon varies from 6 to 18 inches.

Durian differs from Munchong in having a shallower profile, with a weathering mottle commencing above 36 inches, and in having an eluvial A horizon. Durian has a less bright colour than Munchong, but is not as pale as Batu Anam.

Batu Anam Series

Grid location: WA616577 Rentis location: EE 4/58

Parent material: Shale Relief: C_4, Hilly, $0^\circ - 18^\circ$.

Site: 9° upper slope. Drainage: Site drainage free, profile drainage impeded.

Depth (inches)	Horizon Nomenclature	Field Description
0 - 2	Ah	10YR 6/4 light yellowish brown clay loam, weak fine crumb structure, abundant fine roots; clear boundary
2 - 6	Ae	1Y 7/6 yellow clay loam, weak medium blocky structure, friable to plastic; common medium roots; merging boundary
6 - 13	Bt	10YR 7/5 yellow clay, weak medium angular blocky structure; plastic, firm; few medium roots; merging boundary
13 - 27	Bg	As above with greyish and reddish mottle, faint near top, becoming clear towards base; very firm; few roots; merging boundary
27 - 48	Cu	10YR 8/1 white, with prominent red (2.5YR 5/8) mottle, clay; very firm; permeability slow; no roots; occasional iron concretions
48 - 60	Cu/Cu	Weathered shale, light grey

Remarks: Batu Anam is paler and shallower than Durian; these two series have the same succession of horizons except that a concretionary B horizon is never present in Batu Anam.

<u>Grid location</u>: WA422492 <u>Rentis location</u>: K'W 0/0.
<u>Parent material</u>: Ferruginous shale <u>Relief</u>: Class C_3, Rolling, $0^o - 12^o$. <u>Site</u>: 7^o middle slope. <u>Drainage</u>: Free.

Depth (inches)	Horizon Nomenclature	Field Description
0 - 1½	Ah	7.5YR 4/4 brown sandy clay, weak medium blocky structure, friable, many fine and medium roots; clear boundary
1½ - 9	AB	7.5YR 5/8 strong brown clay, moderate medium blocky structure, firm, common fine and medium roots; clear, wavy boundary
9 - 43	Bcn	Nodular laterite, concretions forming 75% of total soil mass; concretions dark red to black, hard, mainly 1/10 inch - 1/2 inch diameter, non-cemented; occasional boulders of iron-impregnated rock; plus red clay; very few fine roots; merging boundary
43 - 72	Cu	Highly-weathered shale, variegated red to yellow colours, structureless, firm but crushable, no roots

<u>Remarks</u>: Malacca differs from Tavy in that the soil overlying laterite is a clay, and there is no eluvial A horizon.

Tavy Series

Grid location: WA269429 Rentis location: J_2W 0/0

Parent material: Interbedded shale, siltstone and conglomerate.

Relief: Class C_2, Undulating, $0^o - 6^o$. Site: 4^o middle slope.

Drainage: Free

Depth (inches)	Horizon Nomenclature	Field Description
0 - 2	Ah	10YR 5/4 yellowish brown sandy loam, weak fine crumb structure, abundant roots; clear boundary
2 - 20	Ae	10YR 7/6 yellow sandy clay loam, weak fine blocky structure, friable, common fine and medium roots; merging boundary
20 - 26	Bt	10YR 6/6 brownish yellow sandy clay, weak fine blocky structure, friable, few medium roots; clear, wavy boundary
26 - 40	Bun	Nodular laterite, concretions forming 75% of total soil mass; concretions dark red to black, hard, ¼ inch - 2 inch diameter, non-cemented; few fine roots; merging boundary
40 - 72	Bg/C	Yellowish red with red and grey mottling, clay; firm, no roots; passing downwards into highly-weathered rock

Remarks: Laterite may commence at depths of between 8 and 36 inches. The soil overlying the laterite horizon is more sandy in Tavy than in Malacca; Tavy has an eluvial A horizon, and is slightly yellower than Malacca.

Bungor Series

Grid location: WA711674 Rentis location: UE 4/74.

Parent material: Siliceous shale. Relief: Rolling, $5^{\circ} - 10^{\circ}$.

Site: Lower slope. Drainage: Free to imperfect

Depth (inches)	Horizon Nomenclature	Field Description
0 - 3	Ah	10YR 7/6 sandy clay loam, medium crumb structure, loose consistency, many small roots
3 - 15	Ae	10YR 7/6 clay loam sub-angular blocky structure, friable consistency with many large and medium sized roots
15 - 27	Bt	10YR 7/6 clay loam, sub-angular blocky structure, friable consistency and traces of organic matter, weak mottlings with few roots
27 - 43	Cm	10YR 7/6 clay loam, sub-angular blocky structure, organic matter absent, medium mottling and few roots
43 - 70	Cu	Strongly mottled clay with imperfect drainage and few small roots

Remarks: Bungor is intermediate in texture between Munchong and Serdang.

Serdang Series

Grid location: WA521588 Rentis location: SE 4/77.

Parent material: Quartzitic conglomerate with interbedded shale.

Relief: Locally Class C_2, Undulating, $0^\circ - 6^\circ$, but steep ridges nearby. Site: 5° middle slope. Drainage: Free.

Depth (inches)	Horizon Nomenclature	Field Description
0 - 3	Ah	10YR 5/4 yellowish brown sandy loam, moderate medium crumb structure, loose, many roots, clear boundary
3 - 17	Ae	10YR 6/6 brownish yellow sandy clay loam, weak medium blocky structure, friable to loose, common medium roots; merging boundary
17 - 43	Bt	10YR 6/6 brownish yellow sandy clay loam, moderate medium blocky structure, weak clay skins, friable, few medium roots; merging boundary
43 - 70	BC	7.5YR 5/6 strong brown sandy clay loam, moderate medium angular blocky structure, firm, few fine roots; weathering mottle commencing towards base

Remarks: Weathered rock normally commences at between 48 and 60 inches. Similar but shallower profiles are classed as Kuala Brang or Kedah series.

Kuala Brang Series

This has similar profile characteristics to Serdang, but with weathered rock commencing at between 24 and 48 inches depth. Profiles shallower than 24 inches are classed as Kedah series.

Kedah Series

Grid location: WA617573 Rentis location: DE 4/57
Parent material: Quartzitic conglomerate. Relief: Class C_6, Very steep, $0^o - 35^o$. Site: 29^o upper slope. Drainage: Free

Depth (inches)	Horizon Nomenclature	Field Description
0 - 1	Ad/f	Mat of fine roots with partly decomposed leaves
1 - 5	Ah	7.5YR 4/2 dark brown clay loam, moderate fine crumb structure, friable, abundant fine roots; clear boundary
5 - 16	AB	10YR 7/6 yellow clay loam with few stones, weak medium blocky structure, no clay skins, friable, common fine and medium roots; sharp, irregular boundary
16 - 28	Stone line	30% quartzite boulders, 6 - 24 inches diameter; 40% smaller quartzite stones; 30% soil as above; clear boundary
28 - 50	Cu	Mottled weathered rock, crushable; with common iron concretions

Remarks: It is not known how widely stone lines occur in this series. Shallow profiles overlying shales are classed as undifferentiated lithosols.

Jempol Series

Grid location: WA369754 Rentis location: JL 0/5

Parent material: Tuff and ferruginous shale. Relief: Class C_3, Rolling, 0° - 12°. Site: 7° middle slope. Drainage: Free

Depth (inches)	Horizon Nomenclature	Field Description
0 - 2	Ah	7.5YR 5/4 brown clay, moderate fine crumb structure, friable, many fine and medium roots; clear boundary
2 - 14	Ae	5YR 5/4 reddish brown clay, moderate medium blocky structure, friable, common fine and medium roots; merging boundary
14 - 72	Bt	5YR 5/4 reddish brown clay, moderate medium blocky structure, firm, few iron concretions, common roots; merging boundary
72 - 75	Cu	Highly-weathered rock, structureless, firm, no roots

Remarks: Similar but shallower profiles, occurring on steep slopes, are classified as Colluvium (Jempol). Many different rock types are found in the C horizon of Jempol profiles.

The reddish brown colour of Jempol distinguishes it from the yellowish red of Munchong.

Grid location: WA402685 Rentis location: JA 0/20.

Parent material: Alluvium. Relief: River Terrace. Site: 0^{o}.

Drainage: Profile freely drained through sandy alluvium standing above the water table.

Depth (inches)	Horizon Nomenclature	Field Description
0 - 2	Ah	10YR 4/3 dark brown sandy loam, weak fine blocky structure, very friable, many roots; clear boundary
2 - 17	AB_1	10YR 5/3 brown sandy loam, structureless, loose, few medium roots; merging boundary
17 - 17	AB_2	10YR 6/6 brownish yellow sandy loam, becoming increasingly sandy with depth; structureless, loose, few roots; some mica present

Remarks: Mica is present in Telemong series profiles along the Rivers Pahang and Jempol, which rise outside the Jengka Triangle, but is absent from those along rivers rising within Jengka.

Profiles in which gleying commences above 60 inches are classified as undifferentiated river alluvium.

<u>Grid location</u>: WA348540 <u>Rentis location</u>: Y'E 3/12.

<u>Parent material</u>: Alluvium and colluvium, derived from Segamat series soils on valley sides. <u>Relief</u>: Class C_1, Nearly level, $0^\circ - 2^\circ$.
<u>Site</u>: 1° valley floor, 40 yards wide, lower valley sides steeply incised. <u>Drainage</u>: Poor; at time of observation, following a wet spell the water table was 2 inches below the surface.
<u>Vegetation</u>: Freshwater alluvial swamp forest.

Depth (inches)	Horizon Nomenclature	Field Description
0 - 3	AF	Dense mat of fine and medium roots, with dark brown (7.5YR 3/2) humus and some clay (muck horizon); clear boundary
3 - 15	Bg	10YR 7/1 light grey with prominent, common, yellowish red mottle, clay; too wet to observe structure; plastic; common roots; merging boundary
15 - 36	Br	Grey clay with occasional yellowish mottles, plastic, stiff

<u>Remarks</u>: Mottling usually commences at the surface, and never deeper than 8 inches. The depth at which the mottled horizon gives place to the reduced horizon is variable.

APPENDIX 4-4

SOIL PROPERTIES

Mechanical and chemical analyses are available for 305 samples from 80 soil pits. The analyses were carried out by the Soil Science Division of the Malayan Division of Agriculture; methods of analysis, and the results are given in this Appendix.

Texture

Table 1 gives mean values for mechanical analysis and for selected chemical properties of each series. Figure 1 shows the textural triangle (New Zealand Soil Survey) in which the featural ranges of the series found in Jengka have been indicated.

Most series have high to very high clay contents. In Segamat and Munchong the clay fraction amounts to 80 - 95 per cent and in all the shale-derived series the heaviest-textured horizon has over 70 per cent clay. This is accounted for by the rapid chemical weathering, and by parent material in the case of the shale-derived soils. The only series in which clay contents are substantially lower are Serdang, Kuala Brang and Kedah, derived from rocks containing quartz sand, and Telemong, formed by deposition of sandy alluvium.

Except for Munchong, the soils derived from sedimentary rocks have moderate silt (0.02 - 0.002 mm) contents, 12 - 21 per cent. Only Segamat and Munchong have the low silt contents, four to eight per cent in most profiles, that are frequently characteristic of soils of the humid tropics.

Ng (1966) found that the degree of development of an eluvial A horizon is one of the two main analytical criteria differentiating Malayan soil types, the other being iron oxide content. This is confirmed for Jengka both by field observations of texture and by mechanical analyses. Columns 3 - 5 of Table 1 show the clay percentages

APPENDIX 4-4

Table 1 - Selected Mechanical And Chemical Properties Of Soil Series

	No. of profiles	Clay %			Silt %	pH			Organic matter %	Fe_2O_3 %	Cation exchange capacity me %		Total exchangeable cation me %		Exchangeable cation saturation %		C.E.C. per 100g clay me %
Horizons / Series	-	Ah	Ae	B/C	Mean	Ah	Ae	B/C	Ah	Mean	Ah	Lower	Ah	Lower	Ah	Lower	Lower
Segamat	11	81	85	87	8	3.9	4.5	5.0	6.1	14.8	20.6	10.1	2.1	0.6	8	6	11.8
Munchong	2	85	89	89	8	4.0	4.6	4.9	6.8	8.5	21.3	9.0	1.4	0.5	6	6	10.3
Durian	9	58	65	78	15	4.5	4.5	4.7	5.0	2.9	15.5	12.3	1.4	0.5	10	4	17.3
Batu Anam	4	43	51	67	19	4.4	4.5	4.6	5.0	1.6	15.0	10.3	1.2	0.4	7	4	17.5
Malacca	5	61	65	77	13	4.4	4.4	4.8	6.5	6.5	21.1	14.8	1.7	0.6	9	4	19.9
Tavy	7	44	47	58	14	4.1	4.3	4.7	6.2	4.6	18.0	10.3	1.5	0.5	7	6	20.1
Bungor	4	35	40	56	16	4.3	4.5	4.6	2.8	2.8	10.7	8.1	1.0	0.5	10	6	16.7
Serdang	5	22	27	38	12	4.3	4.2	4.9	2.6	1.6	9.4	6.5	0.7	0.4	8	6	19.7
Kuala Brang	1	26	32	48	18	4.2	4.6	4.8	3.2	1.2	11.1	10.3	1.0	0.4	9	4	24.1
Kedah	1	35	-	38	19	3.6	-	4.4	4.1	1.3	11.7	6.2	0.9	0.6	8	10	16.4
Jempol	2	28	45	48	14	4.1	4.5	4.7	2.0	4.1	9.8	9.2	0.5	0.5	5	6	19.9
Telemong	1	22	18	15	7	4.3	4.5	4.8	2.4	1.3	9.0	3.5	1.4	0.3	16	11	21.3
Akob	5	53	-	75	20	5.1	-	5.2	12.1	3.8	37.3	15.5	14.4	7.5	32	45	20.8

Explanation of horizons Ah - humic A horizon, approximately 0-2 ins; Ae - eluvial A horizon, approximately 2-3 ins; B/C - all horizons except Ah and Ae; Mean - mean of all horizons; Lower - mean of all horizons except Ah.

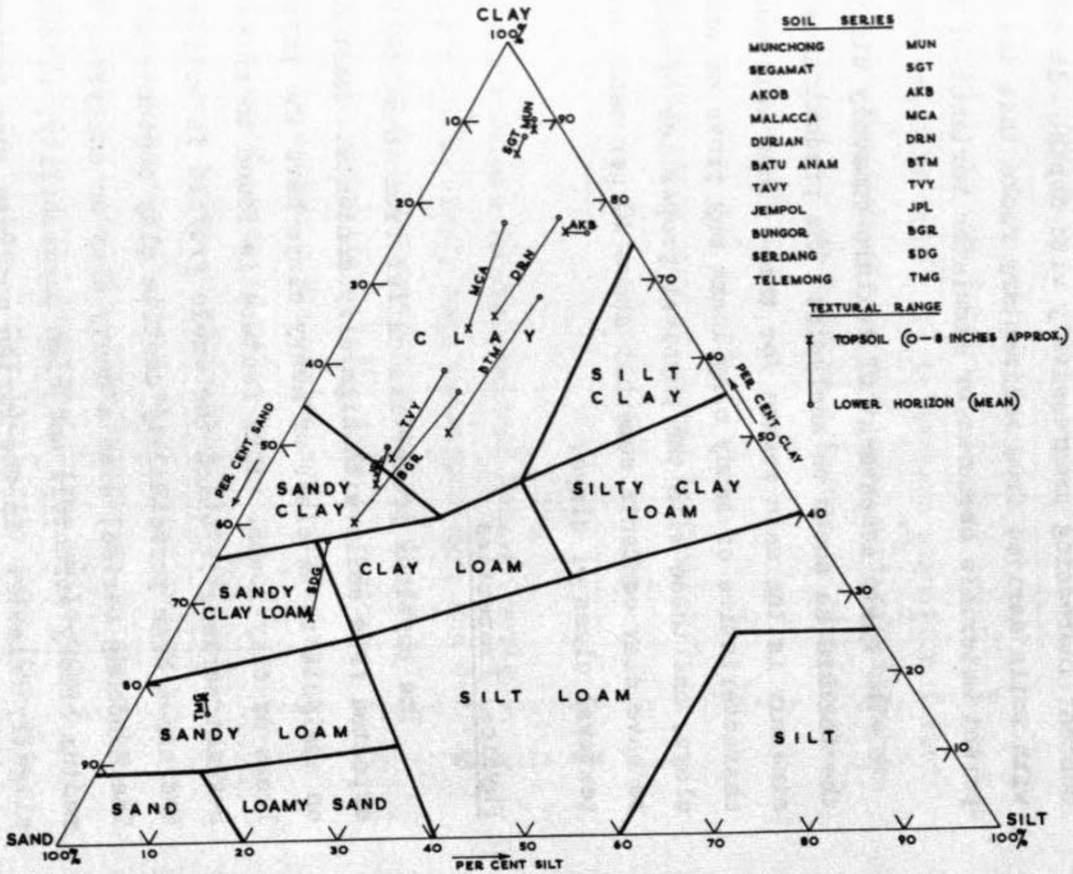
Jempol includes colluvium (Jempol). Akob excludes Akob (sandy variant) and soils of permanent swamps.
For analytical methods see Appendix 1.

APPENDIX 4-4

Figure 1

TEXTURAL TRIANGLE

(New Zealand Soil Survey)



in the surface (humic) horizon, in the horizon below this, and in the lower part of the profile. In Segamat and Munchong the eluvial horizon is absent or only very weakly developed, the surface soil being a heavy clay. In contrast there is a well-marked eluvial horizon, typically six to ten inches deep, in Durian and Batu Anam. The sandstone and quartzite-derived soils, Bungor and Serdang, also show substantial eluviation, the clay content increasing progressively with depth. It must however often happen with soils derived from sedimentary rocks that the texture of the bonded parent materials obscures or simulates horizons of clay accumulation.

The field assessment of texture commonly differs by one class from the texture as shown on analysis; the predominance of kaolinitic clay minerals is the main reason for this. Thus horizons with the field characteristics of sandy clay loams may prove on analysis to be sandy clays, and those with the physical properties of sandy clays may be found to have clay contents somewhat above 40 per cent, and so fall within the textural class of clays.

Physical Properties

The physical properties differ from those that would normally be expected from soils with high clay contents. Most horizons that are shown on analysis to be clays or heavy clays have the physical properties of loams or clay loams. This feature is found to an extreme degree in the Segamat series, in which the whole profile is well-structured, friable, and has a high permeability despite clay contents of 80 - 95 per cent. The Munchong series, also a heavy clay on analysis, has a well-developed medium blocky structure and high permeability, although it is only slightly friable. In the Durian and Batu Anam series the eluvial horizon is friable, but in the lower part of the profile the consistency becomes very firm, and extremely stiff to auger. The more sandy Bungor and Serdang series have a weak blocky structure, and are friable in the eluvial horizon, becoming moderately firm in depth.

These physical properties cannot be easily explained by the nature of the clays. Clay mineral analyses have not been carried out, but an indication is provided by the values of cation exchange capacity per 100 grams of clay for the subsoil (see last column of Table 1). All series have means of less than 25 m.e. per cent, with a combined average of 17 m.e. per cent. This indicates that clay minerals belong almost entirely to the kaolinite and illite groups.

Data given by Ng (1966), for the Munchong, Serdang and Durian series in other parts of Malaya, confirm this. It is perhaps significant that the figures for Segamat and Munchong are in the lower part of the range. The presence of active iron oxides may also be a factor in causing the stable aggregation of the Segamat series.

Soil moisture characteristics are discussed in Chapter 7.

Chemical Properties

A feature both of the Jengka Triangle and of Malayan soils in general is that soil types with widely varying morphology, and derived from different parent materials, possess a substantial degree of similarity in their chemical characteristics. This is the case particularly with respect to exchangeable cation saturation, which in many other tropical areas is of value in differentiating soil types. Exchangeable aluminium is here taken as equivalent to exchangeable hydrogen. In Jengka all series except those of alluvial origin have very low values, four to six per cent for mean base saturation in the subsoil, an indication of the high intensity of leaching. Akob soils have considerably higher saturation values; they lie partly below the water table and so are less exposed to leaching, and they may receive cations leached from higher up in the soil catena.

Soil reaction also shows considerable similarity as between all series except Akob. The soils are strongly acid, the pH values in most profiles being in the range 4.0 - 4.5 for the topsoil, rising to 4.5 - 5.0 at depth. The tendency for the profile to become less acid with at depth. The tendency for the profile to become less acid with increasing depth is most clearly marked in Segamat and Munchong, and least in Durian. Akob profiles have pH values mainly of 4.5 - 5.6, occasionally higher. The mean pH of the surface samples is 5.1, higher than for any other series.

The content of total iron oxides (= acid - extractable) is the chemical property which best differentiates the Jengka soil series; this agrees with the finding of Ng (1966) for the main soil types of Malaya. Segamat series, derived from rock rich in ferromagnesian minerals, has the highest value; the shale-derived series fall into the sequence Munchong-Durian-Batu Anam with decreasing iron oxide content; and the series with laterite, Malacca and Tavy, have higher contents (excluding concretions over 2 mm. diameter) than the corresponding non-lateritic series, Munchong and Bungor.

Levels of organic matter in the humic surface horizon are mainly five to seven per cent in the shale-derived soils and Segamat, and two to four per cent in the sandstone and quartzite-derived series. They range from 8 to 20 per cent in Akob, rising to 34 per cent in the muck horizon of one swamp soil. These levels may be expected to fall following forest clearance.

Nutrient Status

Recent agronomic studies in Malaya have shown that soil nutrient levels vary significantly with soil series. For example Rosenquist (1964), from work based on foliar analysis of both rubber and oil palm, concluded that there are differences in nutrient levels "sufficiently great to modify fertilizer requirements for the different soil series"; whilst Guha and Pushparajah (1966) demonstrated for rubber that fertilizer responses varied with soil series. Ng and Thamboo (1966) showed that large quantities of nutrients, particularly potassium and nitrogen, are removed from the soil by oil palm, and conclude that "on Malayan sedentary soils, adequate and balanced fertilizers have to be applied if the oil palm is to produce sustained high yields". Guha and Yeow (1966) consider that for slow-growing perennial crops, "available" nutrient level may not be a reliable criterion, and that reserve or slowly-available nutrients may prove to be of importance; the latter are assessed by acid extraction.

Only a general indication of nutrient status can be obtained from the sampling density of the present survey. Table 2 shows mean values for the nutrient status of each series; the small number of samples does not permit measures of variability to be obtained. The detailed results are given in Appendix 4-3; as would be expected there are wide variations within a series.

Nitrogen status is highest in Akob. The remaining series fall into three groups: Segamat and Munchong with nitrogen approximately 0.35 per cent, the other shale-derived series and the soils with laterite with a range of 0.20 - 0.25 per cent, and the sandy soils including Telemong, with 0.10 - 0.15 per cent. These levels are partly a consequence of the high organic matter status under forest, and can be expected to decrease on clearance of the vegetation.

Available phosphorus is above 30 parts per million for all series in the surface horizons, and above 40 parts per million for the shale-derived soils; Segamat and Akob have the highest values. Reserve phosphorus is at low levels for all series except Segamat, Akob and Munchong. Guha and Pushparajah (1966) found that Serdang and Batu Anam series, in areas outside Jengka, gave "consistently good responses to the application of phosphoric fertilizers" under rubber; the data suggest that this may prove to be the case with all Jengka series derived from sedimentary rocks.

Exchangeable potassium is mainly in the range 0.20 - 0.35 m.e. per cent, but is low on Serdang, Telemong and Batu Anam. Much of this is held by clay-humus particles in the humic topsoil and will fall, due to the intense leaching, if organic matter status drops after forest

Table 2 - Mean Nutrient Levels Of Soil Series

Series	No. of Profiles	A-humic horizon						Mean for all horizons			
			N/10 NaOH	Organic	Exchangeable			6N HCl soluble			
		N %	P ppm	P ppm	K me %	Ca me %	Mg me %	P ppm	K me %	Ca me %	Mg me %
Segamat	11	0.34	110	79	0.31	0.58	1.19	378	1.38	3.72	3.86
Munchong	2	0.35	54	80	0.34	1.21	0.70	173	1.12	3.58	1.72
Durian	9	0.21	46	32	0.20	0.46	0.74	90	5.43	4.39	4.59
Batu Anam	4	0.21	55	32	0.17	0.42	0.55	54	4.56	4.19	4.42
Malacca	5	0.24	55	67	0.29	0.55	0.74	119	3.71	3.90	5.54
Tavy	7	0.25	49	37	0.32	0.41	0.76	89	2.76	3.99	4.60
Bungor	4	0.15	48	28	0.18	0.43	0.39	64	1.72	3.16	3.40
Serdang	5	0.10	39	23	0.09	0.29	0.32	77	1.98	4.21	3.02
Kuala Brang	1	0.13	33	12	0.11	0.26	0.58	29	5.36	5.27	2.41
Kedah	1	0.15	50	48	0.37	0.26	0.26	75	1.51	3.81	2.49
Jempol	2	0.10	52	20	0.05	0.15	0.26	142	2.80	3.43	8.06
Telemong	1	0.14	65	65	0.11	0.57	0.74	65	2.08	3.97	6.12
Akob	5	0.67	93	90	0.34	10.84	3.12	328	1.50	8.10	4.85

Jempol includes colluvium (Jempol). Akob excludes Akob (sandy variant) and soils of permanent swamps. For analytical methods see Appendix I.

clearance. Reserve potassium levels show a tendency to be lowest on the series with deepest profiles, Segamat and Munchong, and higher on the shallower soils, Durian and Batu Anam, as a result of the continuing release of potassium by rock weathering processes. The low level on Segamat is in conformity with the potassium deficiency found for Kuantan series, also derived from basic igneous rocks, by Guha and Yeow (1966) for rubber.

Both exchangeable and reserve magnesium tend to be somewhat lower on the sandy than on the shale-derived soils and Segamat, with high exchangeable magnesium on Akob. Levels of exchangeable calcium are exceedingly low, with the marked exception of Akob.

In summary, Akob series has the highest nutrient status, and the sandy soils, Serdang, Bungor, and Kuala Brang, the lowest. The series with laterite, Malacca and Tavy, have a nutrient status generally similar to the shale-derived series, Munchong, Durian and Batu Anam, Segamat is in most respects superior to the shale-derived soils, but is low in reserve potassium.

All possible measures should be taken to maintain the organic matter status of the soils at the maximum possible level following forest clearance. If organic matter decreases the nutrient levels may fall considerably, necessitating increased expenditure on fertilizers. In general a sustained fertilizer application will be necessary on Jengka soils.

APPENDIX 4-5

EROSION STATUS

Soil Movement Under Natural Conditions

Under the existing undisturbed cover of forest the main erosion processes are soil creep, rain splash erosion, lateral eluviation, landslides, gullying, and bed and bank erosion by rivers. There is little information on the relative importance of these processes; the occurrence of each in the Triangle is as follows:

1. The displacement of rock strata by soil creep (outcrop curvature) has not been observed; stone lines, however, are found in some soils on steep slopes, and soil creep is a possible explanation of these.

2. Rain splash erosion, the dislodgement of soil particles by the impact of falling raindrops, occurs. The tree canopy does not provide complete protection, the terminal velocity of water dripping from the canopy is substantial, and leaf litter does not entirely cover the soil surface. Despite the high infiltration rates surface run-off occurs during heavy storms.

3. The transport of clay and other fine particles by water moving laterally (downslope) within the soil probably occurs; a tendency for the more sandy soil series to have a higher clay content on the lower parts of valley sides has been noted, and could be explained by this process.

4. Landslides commonly occur on the sides of road cuttings following heavy rain, and are possibly an important process under natural conditions, particularly on the deep soils of the Segamat series; vertical cliffs, 4 - 8 feet high, have occasionally been noted on steep slopes on this series.

5. Gullying acts chiefly in extending the valley heads of small streams.

6. Bed and bank erosion by streams is substantial at times of flood. Observations of river sediment load under jungle elsewhere in Malaya on granite soils (Douglas, 1966) suggest that the suspended load somewhat exceeds the dissolved load; that the net rate of soil removal from hilly catchments may be of the order of $50m^3/km^2/yr$, equivalent to the loss of an average of 1 mm thickness of soil in 20 years; and that erosion in the short periods following exceptional storms exceeds the total erosion throughout the whole of the intervening periods of lower discharge.

Erosion Status Under Agricultural Use

The frequent occurrence of rainfall of high intensity results in a potential danger of accelerated soil erosion by rain splash or gullying when the protective forest cover is cleared. All the soil series, however, have very high infiltration capacities, enabling them to absorb almost all likely rainfall without surface run-off; and in their natural state, as they would be found immediately following jungle clearance, the stable crumb structure of the humic surface horizon provides considerable resistance against dislodgement of soil particles. However, following forest clearance the force of rain splash erosion is considerably increased; and burning the dead timber destroys some of the organic matter in the topsoil and causes considerable deterioration in the structure. The organic cycle is broken, organic matter decreases, leaves and litter soon disappear and the impact of rain drops seals the surface, thus increasing run-off. Consequently it is essential that a cover crop should be established early, and maintained.

Observations on logging tracks show the potential force of erosion if soil from which the humic horizon has been removed becomes directly exposed to rain. Where disturbed soil is exposed along the margins of tracks, miniature earth pedestals are formed. These are small columns of earth, capped by stones or laterite concretions, left as residual features after the surrounding soil has been removed by splash erosion. Such pedestals are typically two to three inches high, and have fluted sides following the shape of the capping where vertically-falling rain has etched away the surrounding soil. On the surfaces of tracks the deeper soil horizons are exposed to rain. Where such tracks are no longer in use, gullies frequently develop on sloping sections. The soft weathered shale that forms the lower horizon of the Durian series is particularly subject to such gullying. These processes are consequent upon the considerable soil disturbance involved in constructing tracks; they illustrate the potential erosion danger under poor soil management.

APPENDIX 4-6

SOIL CATENAS

A marked feature of the soils of Jengka is the relatively limited variation in soil characteristics on upper and lower parts of the slope. In this respect it contrasts with, for example, the typical situation in tropical savanna climates, in which regularly-repeated catenas of three or more series are found. One of the main reasons for the restricted development of catenas is the incised nature of many of the valleys; this causes conditions of free site drainage to extend close to the valley-floor margins. Consequently the soil catena in Jengka frequently contains only two series: a freely drained series extending from the interfluve crust down to the valley-floor margin, and Akob series in the level valley-floor; the transition may take place over as little as two yards.

In addition to the above, the following catenas have been observed, although not investigated in detail:

1. A colour change in Segamat series from red on the interfluve crest passing successively downslope into yellowish red and reddish yellow (Munsell hues 2.5YR, 5YR and 7.5YR). This is found only in certain locations; frequently the red colouration continues down to the incised lower part of the valley side.

2. Where the valleys are not incised, Durian series on the upper slopes may pass downslope into Batu Anam series, due to poorer site drainage on the lower part of the valley side.

3. In steeply-sloping country the soil tends to become deeper downslope, giving a Kedah-Kuala Brang-Serdang catena. Whilst this represents average conditions, individual slopes frequently show irregular variations in soil depth.

4. In areas of sandy soils the texture may become heavier on the lower parts of valley sides.

APPENDIX 5

FORESTS

APPENDIX 5-1

LIST AND DESCRIPTION OF SPECIES WITH SUGGESTED USES

GROUP	VERNACULAR NAME	SCIENTIFIC NAME	DESCRIPTION	SUGGESTED USES
1.	Merbau	Intsia palembanica	Large tree - a good heavy hardwood	Heavy construction, flooring.
2.	Buey	Diospyros spp.	Rare and of small size	Furniture.
	Kayu Arang	" "	Small tree of no present commercial significance	Turnery
	Kekatong	Cynometra inaequifolia	Medium size. Not presently popular	Sleepers, heavy construction.
	Keranji	Dialium spp.	Medium size. Not presently popular	Flooring, panelling, tool handles.
	Membatu	Shorea guiso	Large tree	Flooring, heavy construction.
	Merbatu	Parinari spp.	Medium size. Rarely taken	General construction.
	Pelawan	Tristania spp.	Medium to large tree. Rarely taken	Flooring, construction, tool handles.
	Penaga	Mesua ferrea	Small to medium size	Heavy construction, tool handles.
	Resak	Vatica spp.	Medium size. Larger trees are taken in fellings	Heavy construction, boat building.
	Tembusu Hutan	Fragraea gigantea	Large tree with very durable timber	Flooring, heavy construction.
4.	Balau	Shorea spp.)	With exception of Giam, trees of large size	Heavy construction, heavy duty flooring and in the case of Giam, suitable for boat building.
	Giam	Hopea spp.)		
	Sengkawang	Shorea spp.)		
5.	Kempas	Koompassia malaccensis	Large tree of good form. Not durable in contact with ground but takes preservatives easily	Sleepers, flooring, core veneer, panelling.
6.	Keruing	Dipterocarpus spp.	Large tree of good form. Commercially popular for timber. Eight species were recorded.	Sleepers, flooring, general construction.
7.	Mengkulang	Heritiera spp.	Medium to large size	Plywood, flooring, furniture, panelling.
8.	Kelat	Eugenia spp.	Small to medium size. Rarely taken	Sleepers, general construction.
9.	Berangan	Castanopsis spp.	Small to medium size. Rarely taken	General construction.
	Jelawai	Terminalia spp.	Medium to large size. Rarely taken	Veneer, furniture, general construction.
	Kamap	Strombosia rotundifolia	Small to medium size. Rarely taken	General construction.
	Kasai	Pometia spp.	Medium to large size. Rarely taken	Sleepers flooring, tool handles, general construction.
	Keladan	Dryobalanops oblongifolia	Medium to large tree, taken wherever found	Flooring and general construction.
	Keledang	Artocarpus spp.	Medium to large tree. Popular amongst Chinese coffin makers	Flooring, panelling, hewn coffins.
	Kulim	Scorodocarpus borneensis	Small to medium size. Seldom taken	Marine piling, general construction.

Cont'd

APPENDIX 5-1

GROUP	VERNACULAR NAME	SCIENTIFIC NAME	DESCRIPTION	SUGGESTED USES
9.	Meransi	Carallia spp.	Small to medium size. Seldom taken.	Sliced veneer, cabinet making
	Mempening	Lithocarpus & Quercus spp.	Small to medium size. Seldon taken.	Sliced veneer, general construction.
	Minyak Berok	Xanthophyllum spp.	Medium to large size. Seldom taken.	Gereral construction, joinery, tool handles.
	Pauh Kijang	Irvingia malayana	Medium to large tree. Rarely taken.	General construction.
	Perah	Elateriospermum tapos	Small to medium size. Of no present commercial significance.	Core veneer, general construction.
	Petaling	Ochanostachys amentacea	Small to medium size. Rarely taken.	General construction.
	Rengas	Melanorrhoea spp. Gluta spp.	Medium size tree, seldom taken because of an irritant sap in the tree.	Furniture, cabinet making, decorative panelling and veneer.
	Simpoh	Dillenia spp.	Medium to large tree normally taken in fellings.	Sleepers, general construction, sliced veneer.
	Temponek	Artocarpus rigidus	Medium to large size. Not very popular.	Furniture, cabinet making, veneer.
	Tualang	Koompassia excelsa	Large buttressed tree of good form but seldom taken at present because of the susceptibility of the timber to splitting.	Sleepers, veneer, panelling, flooring.
10.	Bintangor	Calophyllum spp.	Medium to large tree. Larger trees are taken in fellings.	Light construction, flooring, panelling, core veneer.
11.	Durian	Durio spp.	Medium to large size. Larger trees are taken in fellings.	Core veneer and light construction.
	Punggai	Coelostegia griffithii	Medium to large tree. Heavily buttressed. Un-common and rarely taken.	Core veneer and light construction.
12.	Jelutong	Dyera costulata	Large tree of good form. A popular timber but liable to serious defect in trees tapped for latex.	Plywood, moulding, pattern making.
13.	Meranti Melantai	Shorea macroptera		
14.	Meranti Rambai Daun	Shorea acuminata		
15.	Meranti Sarang Punai	Shorea parvifolia		
16.	Meranti Tembaga	Shorea leprosula	Large trees of good form in the Red Meranti group - the most important group of general utility timbers in the country.	Plywood, furniture, joinery, cabinet making, panelling, general construction.
17.	Seraya	Shorea curtisii		
18.	Meranti Batu	Shorea dasyphylla		
	Meranti Kepong	Shorea ovalis		
	Meranti Langgong	Shorea lepidota		
	Nemesu	Shorea pauciflora		
19.	Meranti Pa' ang	Shorea bracteolata	Medium to large size tree of the White Meranti group.	Plywood, general construction,
20.	Mersawa	Anisoptera spp.	Large tree.	Plywood, flooring, general construction.
21.	Meranti Kuning	Shorea spp.	Medium to large trees of the Yellow Meranti group, rather susceptible to defect especially in over-mature trees.	Plywood, joinery, general construction.
22.	Nyatoh	Palaquium spp.	Medium to large trees, some species of which are taken in fellings.	Plywood, furniture, joinery, panelling.

Cont'd

GROUP	VERNACULAR NAME	SCIENTIFIC NAME	DESCRIPTION	SUGGESTED USES
23.	Sepetir	Sindora spp.	Large tree of good form providing good figured heartwood	Furniture, decorative panelling, plywood.
24.	Kedondong	Burseraceae spp.	Medium to large tree not commonly taken in fellings	Plywood, general construction.
	Mata Ulat	Lophopetalum spp.	Medium to large tree not commonly taken in fellings	Veneer, general construction.
	Melunak	Pentace spp.	Medium to large tree with timber resembling Red Meranti. Larger trees are taken in fellings	Plywood, furniture, joinery.
25.	Medang	Lauraceae spp.	Medium to large tree some species of which are taken, but mostly not	Plywood, light construction.
	Penarahan	Myristica spp.	Small to medium size trees not popular and only occasionally taken	Plywood, light construction.
	Sesendok	Endospermum malaccense	Small to medium size and rarely taken. Timber is subject to mould during seasoning. Normally common in secondary forest	Plywood, light construction.
26.	Ara Berteh	Paratocarpus spp.	Medium to large size. Taken in fellings	Core veneer.
	Geronggang	Cratoxylon arborescens	Small to medium size tree normally found in wet situations. Larger trees are taken	Plywood, furniture, joinery.
	Karas	Aquilaria malaccensis	Trees of medium size and of no present commercial importance	Light construction.
	Kembang Semangkok	Scaphium spp.	Medium size tree of poor form. Rarely taken in present fellings. The timber has a high silica content	Plywood.
	Kungkur	Pithecellobium spp.	Medium size and of sporadic occurrence. Rarely taken in fellings	Plywood, furniture, joinery.
	Machang	Mangifera spp.	Medium to large size	Plywood, furniture, veneer cabinet work.
	Mempisang	Anonaceae spp.	Generally of small to medium size, of no present commercial significance	Sliced veneer, light construction.
	Merawan	Hopea spp.	Medium to large size trees, the larger stems being taken in present fellings	Plywood, furniture, light construction.
	Pelong	Pentaspadon spp.	Medium size tree of good form and, though not popular is taken in growing quantities	Core veneer, flooring, light construction.
	Petai	Parkia speciosa	Medium size tree more prized for its edible fruit than for its timber	Plywood, light construction.
	Petai Kerayong	Parkia javanica	Large tree of good form but not commonly worked for timber although reputed to be easy to saw and to peel	Plywood, light construction.
	Pulai	Alstonia spp.	Medium to large size with high buttresses, but little used for timber.	Core veneer, moulding, pattern making.
	Terentang	Campnosperma spp.	Medium to large tree of good form	Plywood, match boxes, light construction.

APPENDIX 5-2

JENGKA SINGLE ENTRY VOLUME TABLE

Volumes in cubic feet based on height/girth data obtained from Jengka Forest Reserve

Species Groups	Girth Classes 1/									
	4'	5'	6'	7'	8'	9'	10'	11'	12'	13' +
1	34	62	98	146	191	243	305	385	460	540
2	40	71	120	166	231	310	383	463	551	646
4	42	71	113	156	218	276	350	430	521	610
5	97	138	185	242	308	383	462	548	640	740
6	100	136	182	230	301	386	465	552	635	718
7	60	97	140	195	260	334	420	518	605	700
8 & 9	59	93	137	191	257	336	418	500	590	680
10 & 11	59	93	137	191	257	336	418	500	590	680
12	74	116	167	226	296	370	448	540	636	732
13	76	110	154	207	269	330	405	487	570	658
14	72	111	158	213	277	342	418	492	574	662
15	88	115	170	229	302	393	499	593	696	807
16	87	126	175	230	300	370	450	545	645	750
17	70	110	162	228	300	376	475	590	700	814
18	97	125	166	220	286	348	441	550	646	747
19	60	97	140	195	260	334	420	518	605	700
20 - 23	74	116	167	226	296	370	448	540	636	732
24	60	97	140	195	260	336	420	518	605	700
25 & 26	59	93	137	191	257	334	418	500	590	680

1/ Girth Classes are of completed unit type entitled by lower limit of each class.

APPENDIX 5-3

STAND TABLES - JENGKA FOREST RESERVE

Table 1 - Northeast Quadrant (No. of stems per 100 acres)

Girth Class		Heavy Hardwoods 1&4	2	Total	Medium Hardwoods 5	6	7	8-9	Total	Light Hardwoods 10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	MS	20.2	58.7	78.9	34.1	70.3	20.5	575.4	700.3	14.2	11.0	150.0	21.0	12.3	28.1	7.1	517.2	760.9
	E%	17	18	14	22	13	32	7	6	42	33	16	50	36	35	60	5	4
	RME	16.8	48.2	68.2	26.9	61.3	14.0	540.8	658.8	8.4	7.5	126.6	10.7	8.0	18.5	2.9	496.3	737.3
7'-9'	MS	12.6	11.5	24.1	29.9	61.9	15.5	54.0	161.3	4.7	3.1	71.3	4.7	6.3	4.2	2.9	47.5	144.7
	E%	54	34	29	24	22	36	20	12	58	53	14	55	41	83	88	26	15
	RME	5.8	7.7	17.3	23.0	48.8	10.0	43.7	143.3	2.0	1.5	61.6	2.1	3.7	0.8	0.4	35.2	123.8
10'+	MS	2.9	2.4	5.3	11.0	22.0	1.3	26.2	60.5	1.3	4.7	19.1	2.9	3.1	0.8	0.5	4.5	36.9
	E%	92	82	70	49	27	76	36	21	183	52	23	61	94	128	157	86	24
	RME	0.3	0.4	1.6	5.7	16.2	0.3	16.9	47.9	-1.1	2.3	14.9	1.1	0.2	-0.2	-0.3	0.6	28.2
Total 7' and over	MS	15.5	13.9	29.4	40.9	83.9	16.8	80.2	221.8	6.0	7.8	90.4	7.6	9.4	5.0	3.4	52.0	181.6
	E%	51	27	29	23	20	32	21	12	67	45	11	44	32	70	78	26	15
	RME	7.7	10.3	20.9	31.7	67.8	11.5	64.1	195.9	2.1	4.4	80.6	4.3	6.5	1.5	0.8	38.9	155.8
Total 4' and over	MS	35.7	72.6	108.3	75.0	154.2	37.3	655.6	922.1	20.2	18.8	240.4	28.6	21.7	33.1	10.5	569.2	942.5
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

MS denotes Mean Stand
E% denotes Error per cent
RME denotes Reliable Minimum Estimate
NA denotes Not Available

APPENDIX 5-3

STAND TABLES - JENGKA FOREST RESERVE

Table 2 - Southeast Quadrant (No. of stems per 100 acres)

Girth Class		Heavy Hardwoods 1&4	2	Total	Medium Hardwoods 5	6	7	8-9	Total	Light Hardwoods 10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	MS	48.5	46.5	95.0	46.7	99.7	20.8	420.3	587.5	11.2	16.6	176.3	17.7	12.2	20.5	13.8	520.5	788.8
	E%	30	18	19	22	14	11	8	8	37	16	13	67	41	30	20	8	8
	RME	34.4	38.4	77.3	36.6	86.4	18.6	389.8	545.5	7.1	14.1	155.1	6.0	7.2	14.6	11.1	481.1	730.1
7'-9'	MS	20.5	6.5	27.0	24.9	66.2	6.2	29.3	126.6	1.0	3.6	59.4	2.3	5.5	2.1	2.9	32.2	109.0
	E%	44	38	35	29	23	35	31	15	83	43	17	59	63	82	98	17	10
	RME	11.5	4.1	17.7	17.8	51.0	4.1	20.5	107.7	0.2	2.1	49.8	1.0	2.1	0.4	0.1	26.8	99.0
10'+	MS	3.4	0.5	3.9	4.2	20.5	0.3	13.5	38.5	0.3	6.0	11.4	2.1	2.9	0.5	0.5	2.3	26.0
	E%	86	159	62	66	23	225	22	11	230	41	21	41	115	160	156	105	19
	RME	0.5	-0.3	1.5	1.4	15.9	-0.3	10.6	34.3	-0.3	3.5	9.1	1.2	-0.4	-0.3	-0.3	-0.1	21.1
Total 7' and over	MS	23.9	7.0	30.9	29.1	86.7	6.5	42.8	165.1	1.3	9.6	70.8	4.4	8.4	2.6	3.4	34.5	135.0
	E%	45	37	34	26	18	37	20	12	105	30	15	38	68	66	98	18	8
	RME	13.3	4.5	20.5	21.7	71.8	4.1	34.5	146.0	-0.1	6.8	60.8	2.8	2.7	0.9	0.1	28.6	125.4
Total 4' and over	MS	72.4	53.5	125.9	75.8	186.4	27.3	463.1	752.6	12.5	26.2	247.1	22.1	20.6	23.1	17.2	555.0	923.8
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

APPENDIX 5-3

STAND TABLES - JENGKA FOREST RESERVE

Table 3 - Northwest Quadrant (No. of stems per 100 acres)

Girth Class		Heavy Hardwoods			Medium Hardwoods					Light Hardwoods								Total
		1&4	2	Total	5	6	7	8-9	Total	10-11	12	13-18	19-20	21	22	23	24-26	
4'-6'	MS	91.9	65.8	157.7	68.8	93.1	30.4	382.8	575.1	15.5	9.4	231.8	16.4	8.2	41.0	19.3	541.1	882.7
	E%	19	30	16	10	40	25	12	12	47	42	11	27	59	30	33	13	9
	RME	74.8	46.6	134	62.1	56.1	23.1	339.4	510.7	8.3	5.5	206.8	12.0	3.4	28.8	13.0	472.6	804.8
7'-9'	MS	26.6	5.9	32.5	33.7	49.5	8.5	30.7	122.4	1.2	3.2	63.2	6.7	2.3	4.4	4.4	30.7	116.1
	E%	34	46	25	30	21	37	26	17	140	74	27	55	106	94	64	33	20
	RME	17.7	3.2	24.7	23.6	39.3	5.4	22.9	102.6	-0.5	0.9	46.3	3.1	-0.1	0.3	1.6	20.7	93.5
10'+	MS	4.7	0.9	5.6	5.6	22.5	0.3	7.0	35.4	0.3	3.2	11.7	2.0	0.6	0.3	0.9	1.8	20.8
	E%	102	134	92	31	37	236	42	32	222	77	74	109	163	230	77	104	54
	RME	-0.1	-0.3	0.5	3.9	14.3	-0.4	4.1	24.1	-0.4	0.8	3.2	-0.2	-0.4	-0.4	0.2	-0.1	9.7
Total 7' and over	MS	31.3	6.8	38.1	39.3	72.0	8.8	37.7	157.8	1.5	6.4	74.9	8.7	2.9	4.7	5.3	32.5	136.9
	E%	28	46	23	23	20	38	25	13	118	68	29	56	108	88	57	31	22
	RME	22.6	3.7	29.5	30.2	58.1	5.5	28.5	137.3	-0.3	2.1	53.6	3.9	-0.2	0.6	2.3	22.7	108.0
Total 4' and over	MS	123.2	72.6	195.8	108.1	165.1	39.2	420.5	732.9	7.0	15.8	306.7	25.1	11.1	45.7	24.6	573.6	1019.6
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

APPENDIX 5-3

STAND TABLES - JENGKA FOREST RESERVE

Table 4 - Southwest Quadrant (No. of stems per 100 acres)

Girth Class		Heavy Hardwoods			Medium Hardwoods					Light Hardwoods								
		1&4	2	Total	5	6	7	8-9	Total	10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	MS	46.0	55.9	101.9	50.0	59.8	33.5	408.3	551.6	6.6	10.5	242.6	26.3	7.9	25.6	10.5	432.0	762.0
	E%	31	28	26	19	24	30	14	10	79	45	20	48	96	66	28	15	13
	RME	32.0	40.5	76.0	40.9	45.8	23.8	354.9	497.8	1.4	5.8	195.0	13.9	0.3	8.8	7.6	369.6	668.5
7'-9'	MS	19.1	2.6	21.7	32.2	34.2	9.9	36.2	112.5	0.7	3.3	88.8	3.3	2.6	3.3	2.6	28.3	132.9
	E%	52	83	41	33	26	70	32	22	245	55	17	139	146	74	93	26	13
	RME	9.3	0.5	13.0	21.7	25.6	3.0	24.8	88.7	-1.0	1.5	74.0	-1.3	-1.2	0.9	0.2	21.1	115.9
10'+	MS	4.6	0.7	5.3	4.6	7.2	0.7	10.5	23.0	-	2.0	18.4	0.7	1.3	-	1.3	0.7	24.4
	E%	63	225.	80	104	56	245	44	26	-	84	59	242	150	-	196	225	50
	RME	1.7	-0.8	1.1	-0.2	3.2	-1.0	5.9	17.1	-	0.3	7.7	-0.9	-0.7	-	-1.3	-0.8	12.2
Total 7' and over	MS	23.7	3.3	27.0	36.8	41.4	10.6	46.7	135.5	0.7	5.3	107.2	4.0	3.9	3.3	3.9	29.0	157.3
	E%	43	71	33	39	30	78	31	21	245	49	15	93	116	74	101	29	9
	RME	13.7	1.0	18.1	22.8	29.2	2.4	32.5	107.3	-1.0	2.7	91.4	0.3	-0.6	0.9	-0.04	20.6	144.3
Total 4' and over	MS	69.7	59.2	128.9	86.8	101.2	44.1	455.0	687.1	7.3	15.8	349.8	30.3	11.8	28.9	14.4	461.0	919.3
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

APPENDIX 5-3

STAND TABLES - JENGKA FOREST RESERVE

Table 5 - All Four Quadrants (No. of stems per 100 acres)

Girth Classes		Heavy Hardwoods 1&4	2	Total	Medium Hardwoods 5	6	7	8-9	Total	Light Hardwoods 10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	MS	51.4	56.6	108.0	49.3	84.2	24.8	455.6	613.9	12.7	12.2	141.4	19.4	10.6	29.0	12.9	514.4	802.6
	E%	13	11	8	9	12	11	4	4	22	13	7	24	22	17	17	5	4
	RME	44.9	50.6	99.4	45.2	74.1	22.1	438.2	590.9	10.0	10.6	179.9	14.8	8.4	24.3	10.8	492.7	774.8
7'-9'	MS	19.6	7.4	27.0	29.7	56.5	10.1	38.0	134.3	2.1	3.3	67.6	4.4	4.5	3.5	3.3	35.9	124.6
	E%	20.0	20	15	13	11	19	12	7	42	26	9	30	31	42	39	13	7
	RME	15.7	6.0	23.2	25.9	50.3	8.2	33.7	125.4	1.2	2.5	61.9	3.	3.1	2.0	2.0	31.5	116.0
10'+	MS	3.7	1.2	4.9	6.7	19.9	0.6	15.2	42.4	0.6	4.4	14.7	2.1	2.1	0.5	0.7	2.6	27.7
	E%	43	56	36	27	15	63	19	11	127	27	19	37	59	83	61	52	15
	RME	2.1	0.5	3.2	4.9	17.0	0.2	12.4	37.9	-0.1	3.2	12.0	1.4	0.9	0.1	0.3	1.3	23.6
Total 7' and over	MS	23.3	8.6	31.9	36.4	76.4	10.7	53.2	176.7	2.7	7.7	82.3	6.5	6.6	4.0	4.0	38.5	152.3
	E%	19	17	14	12	10	19	11	6	17	22	9	25	30	37	37	13	7
	RME	19.0	7.1	27.6	32.2	69.4	8.8	47.6	166.2	1.5	6.1	75.6	4.9	4.7	2.5	2.5	33.9	141.7
Total 4' and over	MS	74.7	65.2	139.9	85.7	160.6	35.5	508.8	790.6	15.4	19.9	273.7	25.9	17.2	33.0	16.9	552.9	954.9
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

APPENDIX 5-4

VOLUME TABLES - JENGKA FOREST RESERVE

Table 1 - Northeast Quadrant (Cubic feet per acre)

Girth Class		Heavy Hardwoods 1&4	2	Total	Medium Hardwoods 5	6	7	8-9	Total	Light Hardwoods 10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	MV	14.4	38.6	53.0	49.8	96.6	20.9	459.5	626.8	12.0	11.0	179.7	21.3	15.1	25.6	7.9	412.6	685.2
	E%	22	20	16	24	13	34	7	7	46	31	16	49	41	34	65	5	4
	RME	11.4	30.9	44.8	38.0	84.1	13.9	430.9	588.8	6.5	7.7	152.2	10.9	9.0	17.1	2.8	395.2	660.8
7'-9'	MV	23.5	24.1	47.6	86.8	180.8	37.0	122.8	427.4	11.4	9.6	192.0	12.5	18.3	11.4	8.2	107.0	370.4
	E%	54	29	28	24	20	33	18	11	67	49	15	55	38	81	90	28	15
	RME	11.0	17.3	34.5	66.5	145.0	25.1	100.9	381.4	3.8	4.9	163.6	5.6	11.5	2.2	0.9	78.1	315.8
10'+	MV	12.7	11.1	23.8	60.8	121.5	5.8	145.6	333.7	7.0	25.6	109.3	16.5	17.3	4.3	2.8	24.6	207.4
	E%	97	82	71	50	27	79	36	22	186	55	24	63	93	132	160	84	25
	RME	0.5	2.0	7.0	30.8	89.5	1.3	94.2	260.7	-6.0	11.7	83.3	6.3	1.4	-1.3	-1.7	4.1	156.4
Total 7' and over	MV	36.2	35.2	71.4	147.6	302.3	42.8	268.4	761.1	18.4	35.2	301.3	29.0	35.6	15.7	11.0	131.6	577.8
	E%	54	29	33	27	18	27	23	14	91	46	12	45	39	67	78	29	16
	RME	16.8	25.3	47.8	108.5	248.7	31.5	206.8	657.7	1.8	19.1	266.6	16.2	21.8	5.2	2.4	93.9	486.3
Total 4' and over	MV	50.6	73.8	124.4	197.4	398.9	63.7	727.9	1387.9	30.4	46.2	481.0	50.3	50.7	41.3	18.9	544.2	1263.0
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	E.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

MV denotes Mean Volume
RME denotes Reliable Minimum Estimate
E% denotes Error percent
NA denotes Not Available

APPENDIX 5-4

VOLUME TABLES - JENGKA FOREST RESERVE

Table 2 - Southeast Quadrant (Cubic feet per acre)

Girth Class		Heavy Hardwoods 1&4	2	Total	Medium Hardwoods 5	6	7	8-9	Total	Light Hardwoods 10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	NV	31.9	29.4	61.3	66.0	138.2	20.5	332.3	557.0	9.1	17.7	205.3	17.5	15.1	20.0	13.7	411.2	709.6
	E%	29	16	48	23	15	11	8	8	46	19	13	67	42	33	24	9	9
	RME	22.9	25.0	50.9	51.3	118.3	18.4	308.1	514.4	5.0	14.5	178.7	5.8	8.9	13.6	10.5	378.0	652.8
7'-9'	MV	40.3	13.1	53.4	71.7	192.7	15.3	66.8	346.5	2.3	10.9	155.0	5.6	14.1	5.6	8.5	69.3	271.3
	E%	43	37	33	30	24	39	31	17	95	53	17	61	62	75	106	19	11
	RME	23.2	8.4	36.1	50.5	147.4	9.4	46.4	290.0	0.1	5.2	128.9	2.2	5.4	1.4	-0.4	56.5	242.4
10'+	MV	15.9	2.6	18.5	23.9	120.7	1.1	78.8	224.5	1.1	36.5	63.7	12.5	17.7	2.8	3.6	10.9	148.8
	E%	82	160	58	58	25	225	22	12	230	46	19	40	124	162	157	106	21
	RME	3.0	-1.6	7.9	10.2	91.4	-1.4	62.3	198.9	-1.4	20.1	52.2	7.5	-4.2	-1.7	-2.0	-0.6	118.5
Total 7' and over	MV	56.2	15.7	71.9	95.6	313.4	16.4	145.6	571.0	3.4	47.4	218.7	18.1	31.8	8.4	12.1	80.2	420.1
	E%	46	47	32	25	17	40	15	11	128	34	13	37	85	68	110	22	9
	RME	30.7	8.5	49.5	72.2	261.7	9.9	124.2	512.6	-1.0	31.4	191.9	11.5	5.0	2.8	-1.1	63.1	383.3
Total 4' and over	MV	88.1	45.1	133.2	161.6	451.6	36.9	477.9	1128.0	12.5	65.1	424.0	35.6	46.9	28.4	25.8	491.4	1129.7
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

APPENDIX 5-4

VOLUME TABLES - JENGKA FOREST RESERVE

Table 3 - Northwest Quadrant (Cubic feet per acre)

Girth Class		Heavy Hardwoods 1&4	2	Total	Medium Hardwoods 5	6	7	8-9	Total	Light Hardwoods 10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	MV	59.0	39.5	98.5	95.3	126.4	30.3	295.7	547.7	11.7	9.5	263.8	17.7	9.2	38.6	19.8	420.7	791.0
	E%	19	27	15	10	40	27	13	14	53	41	12	29	61	30	35	12	8
	RME	48.3	28.9	84.1	85.8	76.5	22.2	260.0	473.7	5.5	5.7	232.5	12.6	3.6	27.1	13.0	370.3	732.3
7'-9'	MV	52.0	12.2	64.2	96.1	142.9	18.9	70.7	328.6	2.2	9.6	161.3	17.4	6.7	11.6	11.6	65.4	285.8
	E%	36	40	26	30	22	34	26	16	140	80	28	59	102	98	65	35	21
	RME	33.4	7.3	48.1	67.6	112.9	12.5	52.6	277.7	-0.9	2.0	117.4	7.3	-0.1	0.3	4.1	43.0	228.0
10'+	MV	19.4	3.4	22.8	30.7	128.7	2.0	37.4	198.8	1.2	17.4	65.5	13.6	3.2	1.6	4.5	8.2	115.2
	E%	101	134	91	34	38	236	39	32	222	82	73	108	165	230	96	104	54
	RME	-0.1	-1.1	2.3	20.5	81.1	-2.8	23.1	135.8	-1.5	3.6	18.3	-1.1	-2.1	-2.1	0.2	-0.3	53.2
Total 7' and over	MV	71.4	5.6	87.0	126.8	271.6	20.9	108.1	527.4	3.4	27.0	226.8	31.0	9.9	13.2	16.1	73.6	401.1
	E%	30	47	27	19	23	42	25	14	116	71	33	63	109	88	59	29	26
	RME	50.1	8.3	63.9	103.8	211.8	12 2	81.5	458.8	-0.5	7.9	152.9	11.6	-0.9	1.6	6.7	52.3	300.1
Total 4' and over	MV	130.4	55.1	185.5	222.1	398.0	51.2	403.8	1075.1	15.1	36.5	490.6	48.7	19.1	51.8	35.9	494.3	1192.0
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

APPENDIX 5-4

VOLUME TABLES - JENGKA FOREST RESERVE

Table 4 - Southwest Quadrant (Cubic feet per acre)

Girth Class		Heavy Hardwoods 1&4	2	Total	Medium Hardwoods 5	6	7	8-9	Total	Light Hardwoods 10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	MV	29.9	36.6	66.5	69.4	86.9	34.5	319.8	510.6	5.3	10.1	293.5	25.3	9.4	24.5	11.0	347.1	726.2
	E%	34	28	28	20	25	42	17	13	93	60	20	54	92	79	39	15	14
	RME	19.8	26.5	48.0	55.9	65.3	20.1	265.7	448.5	0.4	4.1	236.4	11.8	0.8	5.2	6.8	298.5	631.7
7'-9'	MV	40.3	4.8	45.1	90.6	92.2	24.6	82.8	290.1	1.3	8.9	238.3	8.2	7.4	8.8	6.4	64.1	343.4
	E%	55	90	45	35	20	75	32	21	245	45	19	138	137	78	85	31	13
	RME	18.2	0.5	24.9	59.2	74.1	6.2	56.8	231.3	-1.8	5.0	194.9	-3.1	-2.7	2.0	1.0	44.5	300.5
10'+	MV	23.0	3.6	26.6	23.7	39.3	2.8	52.4	118.1	-	10.0	98.7	2.9	7.1	-	9.0	3.3	131.0
	E%	67	225	83	108	53	245	42	24	-	74	60	242	152	-	197	225	50
	RME	7.7	-4.5	4.6	-1.8	18.7	-4.0	30.6	90.3	-.	2.6	39.7	-4.2	-3.7	-	-8.6	-4.1	65.7
Total 7' and over	MV	63.3	8.4	71.7	114.3	131.5	27.4	135.2	408.2	1.3	18.9	337.0	11.[illegible]	14.5	8.8	15.4	67.4	474.4
	E%	37	98	35	46	27	88	32	20	245	47	19	88	111	78	125	39	12
	RME	40.3	0.2	46.8	62.7	96.7	3.5	92.5	329.9	-1.8	10.1	273.8	1.4	-1.5	2.0	-3.7	41.3	421.6
Total 4' and over	MV	93.2	45.0	138.2	183.7	218.4	61.9	455.0	918.8	6.6	29.0	630.5	36.4	23.9	33.3	26.4	414.5	1200.6
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

APPENDIX 5-4

VOLUME TABLES - JENGKA FOREST RESERVE

Table 5 - All Four Quadrants (Cubic feet per acre)

Girth Class		Heavy Hardwoods			Medium Hardwoods					Light Hardwoods								
		1&4	2	Total	5	6	7	8-9	Total	10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	MV	33.7	35.8	69.5	69.5	116.2	25.0	359.3	570.0	10.2	12.6	224.1	19.6	12.8	27.3	13.3	406.5	726.4
	E%	13	11	8	9	12	13.00	5	5	24	14	7	24	23	17	18	5	4
	RME	29.5	32.2	64.0	63.5	102.4	21.9	344.8	545.5	7.8	10.9	210.2	15.0	9.9	22.8	10.9	389.7	702.1
7'-9'	MV	38.4	15.2	53.6	85.2	163.5	23.9	86.7	359.3	4.9	9.9	178.0	11.2	12.6	9.4	9.0	79.0	314.0
	E%	20	18	14	13	11	19	12	7	48	29	9	31	30	42	42	14	8
	RME	30.7	12.6	46.1	74.2	145.7	19.6	77.1	335.1	2.6	7.1	162.3	7.8	8.9	5.4	5.3	68.6	291.1
10'+	MV	16.7	5.5	22.2	36.8	113.3	3.0	84.6	237.7	2.8	24.8	82.2	12.9	12.4	2.6	4.2	13.4	155.3
	E%	42	56	35	27	15	67	19	12	134	28	19	38	62	85	66	52	16
	RME	9.8	2.4	14.5	27.1	96.6	1.0	69.1	211.4	-0.9	18.0	67.2	8.1	4.7	0.4	1.5	6.5	132.0
Total 7' and over	MV	55.1	20.7	75.8	122.0	276.8	26.9	171.3	597.0	7.7	34.7	260.2	24.1	25.0	12.0	13.2	92.4	469.3
	E%	19	19	15	13	10	18	12	7	63	23	9	26	36	37	40	14	9
	RME	44.7	16.8	65.0	107.4	251.4	22.2	151.9	559.5	2.9	26.9	237.5	17.8	16.0	7.6	8.0	79.6	431.6
Total 4' and over	MV	88.8	56.5	145.3	191.5	393.0	51.9	530.6	1167.0	17.9	47.3	484.3	43.7	37.8	39.3	26.5	498.9	1195.7
	E%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	RME	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX 5-5

JENGKA FOREST RESERVE

Percentage composition of Groups by species exclusive of all defective trees

BLOCKS FROM WHICH DATA OBTAINED	GROUP	SPECIES	GROUPED GIRTH CLASSES			
			4'-6'	7'-9'	10'& over	Total
N. E. QUADRANT : BLOCKS 1, 2, 3, 4, 9 & 10. S. E. " " " 13 & 14. N. W. " " " 22, 23, 26 & 27. S. W. " " " 32 & 33.		<u>HEAVY HARDWOODS</u>				
	1 & 4	Balau	56.5	51.6	54.5	55.2
		Merbau	22.4	25.3	36.4	23.5
		Giam	18.0	20.9	9.1	18.5
		Sengkawang	3.1	2.2	-	2.8
		%	100.0	100.0	100.0	100.0
	2	Keranji	42.2	43.5	14.3	41.9
		Merbatu	25.2	13.0	-	23.4
		Kekatong	10.7	19.6	-	11.5
		Membatu	6.3	19.6	85.7	9.1
		Kayu Arang & Buey	6.6	-	-	5.7
		Tembusu	3.8	4.3	-	3.8
		Resak	2.5	-	-	2.2
		Penaga	2.2	-	-	1.9
		Pelawan	0.5	-	-	0.5
		%	100.0	100.0	100.0	100.0
		<u>MEDIUM HARDWOODS</u>				
	8 & 9	Kelat	30.0	15.4	-	28.0
		Perah	26.3	8.4	-	24.2
		Minyak Berok	7.7	6.6	3.9	7.5
		Tualang	2.9	22.4	71.4	6.3
		Kasai	6.3	5.1	-	6.0
		Temponek	2.9	6.5	2.6	3.2
		Meransi	3.3	0.9	-	3.0
		Petaling	2.6	0.5	-	2.4
		Keladan	1.8	6.1	9.1	2.4
		Pauh Kijang	1.5	6.5	2.6	1.9
		Mempening	2.1	-	-	1.9
		Simpoh	1.6	6.1	1.3	1.9
		Berangan	1.6	1.4	1.3	1.6
		Keledang	1.0	5.2	3.9	1.4
		Rengas	1.1	0.9	2.6	1.1
		Jelawai	0.7	4.2	-	1.0
		Kamap	0.1	-	-	0.1
		Kulim	0.1	-	-	0.1
		Others	6.4	3.8	1.3	6.0
		%	100.0	100.0	100.0	100.0

(Contd.)

APPENDIX 5-5

JENGKA FOREST RESERVE

Percentage composition of Groups by species exclusive of all defective trees (Contd.)

BLOCKS FROM WHICH DATA OBTAINED	GROUP	SPECIES		GROUPED GIRTH CLASSES			
				4'-6'	7'-9'	10'& over	Total
N. E. QUADRANT : BLOCKS 1, 2, 3, 4, 9 & 10. S. E. " : " 13 & 14. N. W. " : " 22, 23, 26 & 27. S. W. " : " 32 & 33.	10 & 11	**LIGHT HARDWOODS**					
		Durian		47.0	66.7	100.0	54.1
		Bintangor		51.5	33.3	-	44.7
		Punggai		1.5	-	-	1.2
			%	100.0	100.0	100.0	100.0
	13 - 18	Meranti Tembaga		21.9	23.3	10.2	21.6
		" Melantai		20.7	10.5	2.3	17.1
		" Sarang Punai		18.2	10.3	4.5	15.4
		" Kepong		10.7	11.8	20.4	11.6
		" Rambai Daun		10.3	14.3	17.1	11.6
		Nemesu		8.7	16.5	18.2	11.2
		Meranti Langgong		7.3	9.3	13.6	8.2
		Seraya		2.0	3.8	11.4	3.0
		Meranti Batu		0.2	0.2	2.3	0.3
			%	100.0	100.0	100.0	100.0
	19 & 20	Mersawa		51.4	71.4	90.0	57.2
		Meranti Pa'ang		36.4	14.3	10.0	31.2
		" Pipit		12.2	14.3	-	11.6
			%	100.0	100.0	100.0	100.0
	24 - 26	Kedondong		32.3	38.9	-	32.7
		Merawan		8.9	5.2	-	8.6
		Penarahan		7.6	5.2	-	7.4
		Kembang Semangkok		7.3	8.8	-	7.4
		Medang		7.5	4.1	11.1	7.3
		Nempisang		6.4	4.2	11.1	6.3
		Mata Ulat		4.7	7.3	11.1	4.9
		Pelong		3.6	7.8	11.1	3.9
		Machang		2.4	3.1	11.1	2.5
		Terap		2.0	1.6	11.1	2.0
		Sesendok		2.1	1.6	-	2.0
		Kungkur		1.2	0.5	-	1.2
		Karas		0.9	1.0	-	0.9
		Petai & Petai Kerayong		0.9	0.5	22.[illegible]	0.9
		Ara Berteh		0.5	1.0	-	0.5
		Terentang		0.4	1.5	-	0.5
		Pulai		0.3	3.6	11.1	0.5
		Melunak		0.4	1.0	-	0.4
		Geronggang		0.3	-	-	0.3
		Others		10.3	3.1	-	9.8
			%	100.0	100.0	100.0	100.0

APPENDIX 5-6

STATISTICAL RESULTS OF JENGKA FOREST INVENTORY SAMPLING

Area Sampled

Approximately 146 square miles (39,000 ha.) of "productuve" lowland dipterocarp forest in the "Jengka triangle" development area.

Design

Stratified random 2-per-block with a systematic constraint, employing chain-wide strips running parallel east and west from a central north-south base-line. Contiguous blocks were first defined, separately east and west of the base-line, each 2 miles (160 chains) wide north-south and from half to four miles long east-west depending on the extent of the forest, covering the whole unexploited area. There were 33 blocks in all, subdivided for analysis into four quadrants, NE with 10 blocks, SE with 9, SW with 6 and NW with 8 blocks.

Strips were randomised along the north-south base-line two in each block, but with the constraint that only six positions were possible in each block, but with the constraint that only six positions were possible in each block, namely the six previously cleared soil-survey rentis lines which had been laid out at one-third mile intervals.

The theoretical effect of this restriction will be to over-estimate sampling errors and therefore to depress the lower confidence limit and to create the possibility of bias if coincident systematic variation should occur in the forest. In practice these effects can be ignored firstly because there was no evidence that wider spacing led to greater deviations and secondly because strip length averaged 7½ times minimum spacing. Since the strips always extended to the east and west limits of each block, the sampling fraction was constant at 1.25% over the whole area.

Observations in each strip consisted of the numbers of stems of 26 different species-groups separately in each of ten girth-classes running from 4' up to 13', the latter including all larger sizes. For analysis, observations were converted to the two parameters stems per acre and volume per acre. The latter was obtained from single-entry volume tables derived from standard Malayan dual-entry tables by the inventory authority, using height-girth curves obtained from the Jengka area itself.

Sampling errors at 95% probability were calculated for stems and volume per acre of the 26 species groups or combinations of them, separately by four major size-classes, in all a total of 72 "populations". Because the required parameters were ratios and sample units differed greatly in size, the "combined ratio estimate" (Cochran 1964, p. 169) was used.

Results: The relation between population density and sampling errors.

As expected, sampling errors were inversely proportional to population density, as is clearly shown in the attached graph. What was expected was the very clear logarithmic relation between the two and the small variation in slope between the four sectors.

The function: $\text{Log.}E = k - b \times \text{Log.}N$

where E = sampling error percent

and N = number of stems per acre

was clearly applicable to all quadrants, with b varying non-significantly from .36 to .50, and the value .42 applying to both westerly quadrants and to the combined analysis. K was inversely related to the number of strips employed, but with only four samples the relation could not be quantified. The two most reliable equations were:

$$\text{Log. }E = 8.8 - .42 \times \text{Log. }N \text{ for 66 strips}$$

$$\text{Log. }E = 23 - .42 \times \text{Log. }N \text{ for 14 strips}$$

The first of these should be widely applicable to lowland dipterocarp forest sampled in the way described, with any number of strips from about 50 to 100. The percentage of the sample is almost immaterial, the critical factor being the number and size of sample units and the nature of variation in the forest.

The range of sampling errors rather than their trend is set out in the attached table. It brings out clearly the dependence of sampling errors on the regularity or otherwise of a species' occurrence. Thus an evenly distributed species or group averaging 1 stem per acre may be safely quantified by a sample of less than 20 strips to within 20% but a more irregularly grouped species may cause sampling errors up to 40%.

Also clear is the fact that even exceptionally ill-distributed species averaging over 0.3 stems per acre were quantified within $\pm$ 20% by a sufficiently large sample - in this case of 66 strips. The results of the latter sample are considerably superior to those of Guyana, Sierra Leone, Uganda and elsewhere inventories of forest of 100 to 200 square miles at around 1% were found to estimate timber tree populations to within 20% only if mean stocking exceeded 2 per acre; in the present case success by the 20% criterion has been achieved over the whole area for populations down to 0.3/acre (though individual sectors only for those exceeding 3/acre). The better performance can probably be attributed to the well-known greater uniformity of the lowland Malayan forests.

As indicated before, under these conditions and dimensions of forest and sample, the estimate of approximately $\underline{\text{Log. E\%}} = \underline{9 - 0.4 \text{ Log. N}}$ is likely to provide safe predictions for the future.

JENGKA SAMPLE OF 1965 - 1966

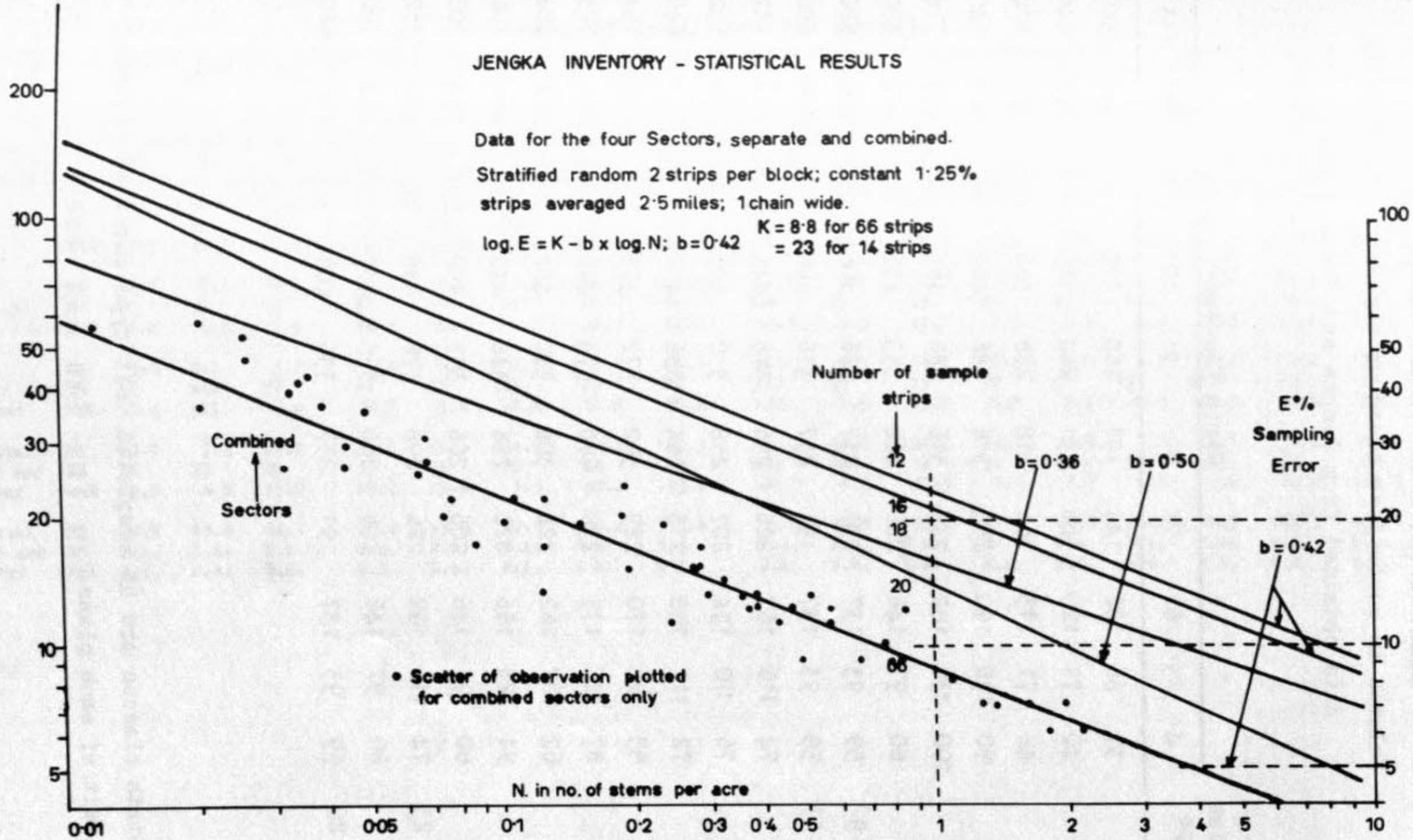
TABLE OF STATISTICAL RESULTS

Population frequency in number of stems per acre	No.of strips	E% according to species distribution: Least variable	Mean	Most variable
0.1	12 - 20 66	15 - 30 15	46 20	70 - 90 30
0.3	12 - 20 66	10 - 25 10	32 13	40 - 60 17
1.0	12 - 20 66	9 - 20 7	20 9	20 - 40 11
3.0	12 - 20 66	7 - 12 5	12 5.5	12 - 30 6
10.0	12 - 20 66	4 - 8 3	8 3.5	8 - 14 4

Range of sampling errors found and size of sample concerned

H. C. DAWKINS
Oxford
July 4, 1966

APPENDIX 5-6


JENGKA INVENTORY - STATISTICAL RESULTS
Data for the four Sectors, separate and combined.
Stratified random 2 strips per block; constant 1·25% strips averaged 2·5 miles; 1 chain wide.
log. E = K - b x log. N; b = 0·42
K = 8·8 for 66 strips
= 23 for 14 strips
Number of sample strips
12
16
18
20
66
b = 0·36
b = 0·50
b = 0·42
E%
Sampling Error
Combined
Sectors
• Scatter of observation plotted for combined sectors only
N. in no. of stems per acre
200
100
50
40
30
20
10
5
0·01
0·05
0·1
0·2
0·3
0·4
0·5
1
2
3
4
5
10

APPENDIX 5-7

TEKAM SINGLE ENTRY VOLUME TABLE

Volumes in cubic feet based on combined height/girth data obtained from Jengka and Tekam areas.

Species Groups	Girth Classes 1/									
	4'	5'	6'	7'	8'	9'	10'	11'	12'	13' +
1	37	66	106	146	191	260	320	388	461	540
2	40	71	120	166	231	294	383	463	551	646
4	42	71	113	166	218	276	362	438	521	610
5	90	138	190	255	316	386	462	548	640	740
6	100	136	182	242	316	386	465	552	635	718
7	60	97	146	206	266	353	432	518	614	700
8 & 9	59	93	137	191	257	336	408	510	590	680
10 & 11	59	93	137	191	257	336	408	510	590	680
12	74	116	167	226	296	376	448	548	636	732
13	76	110	154	207	258	330	395	468	548	632
14	72	111	158	213	264	336	402	476	554	640
15	83	122	170	229	302	372	473	562	659	764
16	87	126	175	230	296	374	448	534	620	723
17	62	107	162	228	306	380	481	574	676	786
18	94	125	166	220	286	348	441	522	611	706
19	60	97	146	206	266	353	432	518	614	700
20 - 23	74	116	167	226	296	376	448	548	636	732
24	60	97	146	206	266	353	432	518	614	700
25 & 26	59	93	137	191	257	336	408	510	590	680

1/ Girth classes are of completed unit type entitled by lower limit of each class.

APPENDIX 5-8

STAND TABLES - TEKAM FOREST RESERVE

(No. of stems per 100 acres)

Girth Class		Heavy Hardwoods 1&4	2	Total	Medium Hardwoods 5	6	7	8-9	Total	Light Hardwoods 10-11	12	13-18	19-20	21	22	23	24-26	Total
4'-6'	MS	17.0	56.5	73.5	41.9	55.7	17.9	466.8	582.3	8.7	21.1	164.6	28.1	12.1	25.7	6.8	446.0	713.1
	E%	30	18	13	18	20	28	9	7	35	24	9	31	35	42	29	6	5
	RME	11.9	46.4	63.9	34.7	44.8	13.1	428.8	542.1	5.7	16.2	149.9	19.6	8.0	15.0	4.9	419.8	681.2
7'-9'	MS	10.7	7.3	18.0	30.5	32.5	4.4	34.7	102.1	1.0	9.7	72.0	10.9	7.3	2.7	2.9	29.1	135.6
	E%	40	39	25	20	23	61	29	14	108	46	15	33	47	85	58	36	13
	RME	6.4	4.5	13.5	24.6	25.1	1.7	24.7	87.9	-0.1	5.3	61.7	7.4	3.9	0.4	1.2	18.8	118.5
10' and over	MS	3.2	nil	3.2	3.4	5.6	0.5	17.7	27.2	nil	4.1	18.4	2.4	4.6	0.5	1.2	2.2	133.4
	E%	57	nil	57	81	45	215	29	26	nil	63	19	78	43	153	113	79	16
	RME	1.4	nil	1.4	0.7	3.1	-0.6	12.6	20.2	nil	1.5	15.0	0.5	2.7	-0.3	-0.2	0.5	28.2
Total 7' and over	MS	13.9	7.3	21.2	33.9	38.1	4.9	52.4	129.3	1.0	13.8	90.4	13.3	11.9	3.2	4.1	31.3	169.0
	E%	36	39	25	15	24	70	24	12	108	40	14	31	36	83	56	34	12
	RME	8.9	4.5	15.9	29.2	29.0	1.5	40.2	113.7	-0.1	8.4	77.9	9.2	7.7	0.6	1.8	21.0	149.3
Total 4' and over	MS	30.9	63.8	94.7	75.8	93.8	22.8	519.2	711.6	9.7	34.9	255.0	41.4	24.0	28.9	10.9	477.3	882.1
	E%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	RME	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

APPENDIX 5-9

VOLUME TABLES - TEKAM FOREST RESERVE

(Cubic Feet Per Acre)

GIRTH CLASSES		HEAVY HARDWOOD			MEDIUM HARDWOOD					LIGHT HARDWOOD								
		1 & 4	2	TOTAL	5	6	7	8 & 9	TOTAL	10&11	12	13-18	19&20	21	22	23	24-26	TOTAL
4' - 6'	M.V.	12.4	38.0	50.4	59.4	76.3	18.6	370.4	524.7	6.9	21.9	205.2	27.1	14.9	24.6	7.6	354.6	662.8
	E %	32	18	13	18	21	30	9	8	41	19	9	30	33	42	33	6	5
	R.M.E.	8.5	31.5	44.1	49.2	60.4	13.1	337.2	484.5	4.1	17.8	187.9	19.0	10.0	14.3	5.2	334.0	632.2
7 - 9'	M.V.	19.2	13.3	32.5	88.3	94.4	11.5	80.6	274.8	2.0	26.9	194.0	28.4	20.1	6.9	8.3	64.5	351.1
	E %	39	41	26	18	23	61	27	13	109	46	16	30	47	83	54	35	13
	R.M.E.	11.7	8.0	24.3	72.7	72.9	4.5	59.3	240.4	-0.2	14.5	164.1	19.9	10.7	1.2	3.9	42.4	306.8
10' & OVER	M.V.	13.6	NIL	13.6	18.9	30.3	2.3	104.2	155.7	NIL	24.4	102.3	13.5	27.1	2.2	7.3	11.7	188.5
	E %	51	NIL	51	82	47	215	29	27	NIL	66	21	79	45	153	113	80	16
	R.M.E.	6.8	NIL	6.8	3.5	16.3	-2.6	74.1	113.9	NIL	8.4	81.6	2.9	14.9	-1.2	-0.9	2.4	159.2
TOTAL 7' & OVER	M.V.	32.8	13.3	46.1	107.2	124.7	13.8	184.8	430.5	2.0	51.3	296.3	41.9	47.2	9.1	15.6	76.2	539.6
	E %	32	41	26	13	26	78	22	13	109	44	15	34	37	83	63	32	12
	R.M.E.	22.3	8.0	34.2	93.6	93.2	3.1	144.3	376.0	-0.2	29.2	252.8	27.6	29.8	1.6	5.9	52.5	476.9
TOTAL 4' & OVER	M.V.	45.2	51.3	96.5	166.6	201.0	32.4	555.2	955.2	8.9	73.2	501.5	69.0	62.1	33.7	23.2	430.8	1202.4
	E %	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	R.M.E.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	F.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

APPENDIX 5-10

TEKAM FOREST RESERVE

Percentage Composition of Groups by species exclusive of all defective trees

BLOCKS FROM WHICH DATA OBTAINED	GROUP	SPECIES	GROUPED GIRTH CLASSES			
			4'-6'	7'-9'	10' & over	Total
BLOCKS 37, 40, 43, 45 and 47		**HEAVY HARDWOODS**				
	1 & 4	Merbau	90.3	90.9	100.0	91.1
		Balau	9.7	9.1	-	8.9
		Sengkawang	-	-	-	-
		Giam	-	-	-	-
		%	100.0	100.0	100.0	100.0
	2	Keranji	40.7	42.9	-	40.9
		Kekatong	17.3	28.6	-	18.2
		Merbatu	12.3	14.2	-	12.5
		Membatu	12.4	14.3	-	12.5
		Kayu Arang & Buey	7.4	-	-	6.8
		Tembusu	3.7	-	-	3.4
		Resak	3.7	-	-	3.4
		Penaga	2.5	-	-	2.3
		Pelawan	-	-	-	-
		%	100.0	100.0	-.	100.0
		MEDIUM HARDWOODS				
	8 & 9	Perah	24.2	7.5	-	21.7
		Kelat	23.7	8.7	-	21.4
		Tualang	3.4	33.8	81.5	9.1
		Minyak Berok	8.8	6.2	-	8.3
		Kasai	8.1	7.5	-	7.7
		Simpoh	3.4	6.3	3.7	3.7
		Keladan	3.1	8.8	-	3.6
		Temponek	3.5	3.7	3.7	3.6
		Meransi	3.5	-	-	3.0
		Petaling	3.1	-	-	2.7
		Mempaning	2.8	1.2	-	2.5
		Jelawai	2.2	3.8	-	2.3
		Pauh Kijang	1.8	5.0	-	2.0
		Berangan	1.9	-	-	1.7
		Keledang	0.9	2.5	3.7	1.1
		Rengas	0.9	2.5	-	1.0
		Kulim	-	-	-	-
		Kamap	-	-	-	-
		Others	4.7	2.5	7.4	4.6
		%	100.0	100.0	100.0	100.0

(Contd.)

APPENDIX 5-10

TEKAM FOREST RESERVE

Percentage Composition of Groups by species exclusive of all defective trees (Contd.)

BLOCKS FROM WHICH DATA OBTAINED	GROUP	SPECIES	GROUPED GIRTH CLASSES			
			4'-6'	7'-9'	10' & over	Total
BLOCKS 37, 40, 43, 45 and 47	10 & 11	LIGHT HARDWOODS				
		Durian	42.9	100.0	-	52.9
		Bintangor	57.1	-	-	47.1
		Punggai	-	-	-	-
		%	100.0	100.0	-	100.0
	13 - 18	Meranti Tembaga	27.6	25.4	39.1	27.6
		Meranti Sarang Punai	19.5	15.1	8.7	17.7
		Meranti Langgong	15.6	18.2	13.1	16.2
		Meranti Kepong	14.9	12.7	21.7	14.7
		Meranti Melantai	12.4	15.9	-	12.7
		Nemesu	9.4	12.7	17.4	10.7
		Meranti Rambai Daun	0.3	-	-	0.2
		Meranti Batu	0.3	-	-	0.2
		Seraya	-	-	-	-
		%	100.0	100.0	100.0	100.0
	19 & 20	Meranti Pa'ang	55.3	33.3	20.0	48.4
		Meranti Pipit	29.8	33.3	20.0	29.7
		Mersawa	14.9	33.4	60.0	21.9
		%	100.0	100.0	100.0	100.0
	24 - 26	Kendondong	27.8	42.9	-	28.3
		Medang	11.6	-	-	10.9
		Penarahan	11.3	-	-	10.7
		Kembang Semangkok	6.4	8.6	-	6.5
		Sesendok	4.8	-	-	4.5
		Mempisang	4.3	-	-	4.1
		Kerawan	3.7	2.9	-	3.7
		Mata Ulat	3.0	5.7	16.7	3.2
		Machang	2.8	2.9	50.0	3.2
		Pelong	2.5	14.3	-	3.1
		Petai & Petai Kerayong	2.1	5.7	-	2.3
		Pulai	2.1	2.8	16.6	2.2
		Terap	1.8	5.7	16.7	2.1
		Karas	1.6	-	-	1.5
		Ara Berteh	1.3	-	-	1.3
		Kungkur	0.9	5.7	-	1.1
		Terentang	0.8	-	-	0.7
		Geronggang	0.2	-	-	0.1
		Melunak	-	-	-	-
		Others	11.0	2.8	-	10.5
		%	100.0	100.0	100.0	100.0

APPENDIX 6

VEGETATION

APPENDIX 6-1

BOTANICAL CHECK LIST

Below are given lists of grasses, sedges, and leguminous plants collected within the Jengka Triangle in the course of the soil survey. These provide potential for the development of pasture resources. An estimate of the palatability to cattle is given for each species. Species lists for the main grassland association are also given.

Species	Habitat	Habit	Annual or Perennial	Palatability
	GRASSES OF THE JENGKA TRIANGLE			
Acroceras sparsum	Forest fringe	Stooling	P	Medium
Axonopus compressus	Road fringe clearing	Creeping	P	Good
Brachiaris paspaloides	Swamp fringe	Creeping	P	Medium
Centotheca lappacea	Forest fringe	Stooling	P	Low
Chrysopogon aciculatus	Road fringe & clearing	Creeping	P	Good
Coelorachis glandulosa	River bank	Stooling	P	Medium
Cymbopogon citratus	Cultivated in gardens	Stooling	P	Low
Cymbopogon nardus	Cultivated in gardens	Stooling	P	Low
Cynodon dactylon	Dryland	Creeping	P	Good
Dactyloctenium aeggyptum	Road fringe	Creeping	A	Medium
Digitaria longiflora	Dryland	Creeping	P	Good
Digitaria marginata	Dryland	Creeping	P	Good

Species	Habitat	Habit	Annual or Perennial	Palatability
Dimeria glabra	Road fringe	Stooling	P	Medium
Echinochloa colona	Dryland	Stooling	A	Good
Eleusine indica	Dryland	Stooling	A	Medium
Eragrostis amabilis	Road fringe	Stooling	A	Medium
Eragrostis elegantula	Clearings, wetland	Stooling	P	Medium
Eragrostis elongata	Clearings	Stooling	P	Medium
Eragrostis unioloides	Wetland	Stooling	P	Medium
Hymenachne myurus	Ricefield, swamp	Creeping	P	Good
Imperata cylindrica	Dryland, fire climax	Rhizomatous Stooling	P	Medium (young)
Isachne globosa	Open swamp, ricefield	Creeping	P	Good
Isachne rigida	In road ditch	Creeping	P	Medium
Leersia hexandra	Swamp, ricefield	Creeping	P	Good
Leptochloa chinensis	Dryland	Rhizomatous Stooling	A	Medium
Lophatherum gracile	In forest & fringe	Stooling	P	Medium
Panicum amplixicaule	Ricefield, river fringe	Stooling	P	Good
Panicum nodosum	Forest fringe	Creeping	P	Medium
Panicum repens	Ricefield, swamp	Creeping	P	Good
Panicum sarmentosum	Forest fringe & clearings	Creeping	P	Medium
Panicum pilipes	Forest fringe	Creeping	P	Medium
Panicum frigonum	Forest fringe	Creeping	P	Medium
Paspalum commersonii	Dryland & wetland	Stooling	P	Good

Species	Habitat	Habit	Annual or Perennial	Palatability
Paspalum conjugatum	Dryland, forest clearing	Creeping	P	Medium
Pennisetum purpureum	Introduced, planted	Stooling	P	Good
Pogonatherum saccharoideum	Road cuttings	Stooling	P	Low
Sacciolepis indicus	Swamp, ricefield	Creeping	P	Good
Sacharrum arudineceum	River bank	Stooling	P	Low
Setaria geniculata	Road side	Stooling	A	Good
Sporobolus diander	Road fringe clearings	Stooling	A	Medium
Sporobolus indica	Road fringe	Stooling	P	Medium
Themeda villosa	River bank	Stooling	P	Low

SEDGES OF THE JENGKA TRIANGLE

Cyperus aromaticus	Swamp	Creeping		Medium
Cyperus cyperinus	Swamp	Stooling		Low
Cyperus distans	Swamp	Stooling		Low
Cyperus elatus	Swamp	Stooling		Low
Cyperus iria	Swamp	Stooling		Low
Cyperus kyllingia	Ricefield	Creeping		Low
Cyperus pennatus	Ricefield	Stooling		Low
Cyperus pulcherrimus	Swamp	Stooling		Low
Cyperus zollingeri	Dryland	Stooling		Low
Eriocaulon sexangulare	Ricefield	Stooling		Low
Fimbristylis diphylla	Swamp	Stooling		Low

Species	Habitat	Habit	Palatability
Fimbristylis globulosa	Swamp	Stooling	Medium
Fimbristylis lerrugines	Swamp	Stooling	Low
Fimbristylis miliacea	Swamp	Stooling	Medium
Fimbristylis pavciflora	Swamp	Stooling	Low
Fimbristylis spathacea	Swamp	Stooling	Low
Fimbristylis trichophylla	Ricefield	Stooling	Low
Fuirema umbelata	Ricefield	Stooling	Low
Hypolythrum latifolium	Swamp forest	Stooling	Low
Rhynchospore aurea	Paya	Stooling	Low
Scleria laevis	Forest fringe	Stooling	Low
Scirpus grassus	Swamp	Stooling	Low
Scirpus mucronatus	Ricefield	Stooling	Low

LEGUMES OF THE JENGKA TRIANGLE

Calapogonium mucinoides	Oil palm estate	Creeper	Browsed
Canavalia microcarpa	Village clearing, forest fringe	Creeper	Non-palatable
Cassia alata	Road fringe, jungle	Shrub	Non-palatable
Cassia occidentalis	Village clearing, village fringe	Shrub	Non-palatable
Cassia tora	Ricefield fringe padang	Shrub	Non-palatable
Centrosema pubescens	Oil palm estate	Shrub	Browsed
Crotalaria striata	Roadsides and village clearing	Shrub	Browsed
Derris eliptica	Rubber estate		
Desmodium capitatum	Roadsides and village clearing	Creeper	Browsed
Desmodium heterophyllum	Roadsides and village clearing	Creeper	Palatable
Desmodium heterocarpum	Fire subclimax	Creeper	Browsed

Species	Habitat	Habit	Palatability
<u>Desmodium ovalifolium</u>	Roadsides and village clearing	Shrub	Browsed
<u>Desmodium pulchellum</u>	Village clearing	Shrub	Browsed
<u>Desmodium triflorum</u>	Roadsides and village clearing	Creeper	Palatable
<u>Easchynomene indica</u>	Fallow ricefield	Shrub	Palatable
<u>Flemingia congesta var. semialata</u>	Oil palm estate	Shrub	Non-palatable
<u>Mimosa invisa</u>	Roadsides and village clearing	Creeper	Non-palatable
<u>Mimosa pudica</u>	Roadside and village clearing	Creeper	Browsed
<u>Pueraria psoraloides</u>	Oil palm estate	Creeper	Browsed
<u>Uraria orinata</u>	Young rubber plantation, village clearing		Browsed
<u>Uraria lagopoides</u>	Fire subclimax	Creeper	Non-palatable

LEGUMES CULTIVATED IN THE JENGKA TRIANGLE

<u>Arachis hypogea</u>	Ground nut
<u>Dolichos lablab</u>	Bonaviste bean
<u>Glycine max</u>	Soya bean
<u>Phaseolus aureus</u>	Green gram
<u>Phaseolus vulgaris</u>	French bean
<u>Pachyrhyzos tuberosus</u>	Sengkuang (Malay)
<u>Psophocarpus tetragonolobus</u>	Four winged bean
<u>Stizolobium desringianum</u>	Velvet bean (white)
<u>Vigna sinensis</u>	Yardlong bean

GRASSLAND ASSOCIATIONS OF THE JENGKA TRIANGLE

Forest Clearing Association

Grasses

Paspalum conjugatum
Paspalum scrobiculatum
Echinochloa colona
Leptochloa chinensis
Eleusine indica
Digitaria marginata
Digitaria longiflora
Cynodon dactylon

Sedges

Cyperus zollingeri
Cyperus cyperimus
Cyperus iria

Forest Fringe Association

Grasses

Lophatherum gracile (deep shade)
Centhotheca lappacea (shade)
Panicum pilipes
Brachiaria paspaloides (swamp)
Panicum nodosum
Panicum trigonum

Sedges

Scleria laevis
Hypolytrum latifolium

Legume

Cassia alata

Subclimax Association

Grasses

Imperata cylindrica

Shrubs

Melastoma malabathricum

Gleictera sp.

Sedges

Scleria laevis

Legumes

Desmodium heterocarpum

Desmodium pulchelum

Uraria lagopoides

Uraria crinata

Fallow Ricefield Association

Grasses

Cryza sativa (volunteer)

Hymenachne myurus

Panicum amplexicaule

Eragrostis uniloides

Leersia hexandra

Isachne globosa

Creepers

Ipomea aquatica

Legumes

Fuirena umbellata

Cyperus elatus

Cyperus aromaticus

Cyperus pennatus

Fimbristylus diphylla

Fimbristylus globulosa

Rhynchospora aurea

Cyperus pennatus

Scirpus grassus

Neptunia oleracea

Desmodium heterocarpum

Scirpus mucronatus

Fimbristylus trichohylla

Cyperus distans

Fimbristylus pauciflora

Fimbristylus diphylla

Cyperus pulcherrimus

Fimbristylus lerrugines

Village Clearing and Roadside Association

(a) Dryland

Grasses

Chrysopogon aciculatus
Axonopus compressus
Paspalum scrobiculatum
Paspalum conjugatum
Cynodon dactylon
Sporobolus diander
Sporobolus indicus

Sedges

Fimbristylis lerrugines
Cyperus aromaticus

Legumes

Desmodium triflorum
Mimosa pudica

(b) Wetland

Grasses

Chrysopogon aciculatus
Paspalum scrobiculatum
Axonopus compressus
Cynodon dactylon
Paspalum conjugatum
Eragrostis unioloides

Sedges

Fimbristylis lerrugines
Fimbristylis miliacea
Fimbristylis pauciflora
Cyperus aromaticus
Fimbristylis globulosa
Cyperus pulcherrimus

Legumes

Mimosa pudica
Desmodium triflorum

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WYATT-SMITH, J. 1964. A preliminary vegetation map of Malaya with descriptions of the vegetation types. Journal of Tropical Geography 18, 1964, 200 - 213.

APPENDIX 7

WATER RESOURCES

APPENDIX 7-1

DISCHARGE RECORDS FOR CERTAIN STREAMS IN PERAK, SELANGOR AND PAHANG

Stream	Location of Gauge	Area in Sq.Miles	Maximum Recorded Discharge in cusecs per sq.mile	Minimum Recorded Discharge in cusecs per sq.mile	Period of Record
Batang Padang	Kampar	178	13.8	1.52[1]	1930-40
" "	Tapah	146	104.0	1.37	1914-40
Bentong	Kuala Lumpur Road	93	82.2	0.67	1931-40
Bernam	Lima Belas	422	18.2	0.73	1933-40
"	Tanjong Malim	72	139.8	0.25	1926-40
Bidor	Bidor	35	54.3	0.43	1930-40
Dong	Kpg Dong	82	29.6	1.16	1914-40
Ijok	Titi Ijok	83	26.4	0.10[2]	1915-40
"	Batu Glugor	49	23.7	0.04[2]	1934-40
Kampar	Kpg Lanjut	169	31.1	0.31	1930-40
Kinta	Batu Gajah	407	17.3	0.63[1]	1915-40
"	Ipoh	121	57.3	0.70[1]	1915-40
"	Tanjong Rambutan	95	215.0	0.37[1]	1930-40
"	Tanjong Tualang	475	16.8	1.11[1]	1915-40
Klang	Kuala Lumpur	179	62.8	0.93[1]	1910-40
"	Petaling	218	29.8	0.60[1]	1929-40
"	Puchong	268	12.6	0.70[1]	1937-40
Kurau	Pondok Tanjong	130	32.8	0.05[1]	1930-40
Langkat	Dingkil	478	10.8	0.61[1]	1930-40
"	Kajang	148	36.2	0.34[1]	1926-40
Linggi	Rahang	73	25.3	0.03	1931-40
Pari	Ipoh	105	43.6	0.20	1915-40
Perak	Iskander Bridge	3000	133.0	0.27	1915-40
Plus	Kpg Lintang	420	18.1	1.04	1936-40
Raia	Old Kelas Estate	97	21.7	0.28	1930-40
Selangor	Batang Berjuntai	600	13.7	0.15	1930-40
"	Rantau Panjang	560	25.2	0.26	1921-40
Semenyih	Bangi-Telok Dato Road	235	33.3	0.17[2]	1926-40
"	Semenyih	82	27.5	0.11[2]	1928-40
Slim	Slim Village	124	31.7	0.69	1930-40
Sungkai	Sungkai	113	74.8	1.49	1930-40

1/ Adjusted for extraction and other losses

2/ Suspect Readings not used in calculations.

APPENDIX 7-2

SOILS INFILTRATION TESTS SUMMARY

Depth in ins.	Soil moisture % of dry weight: Before test	Soil moisture % of dry weight: After test	Apparent Specific Gravity	Infiltration rate in ins./hr.	Date	Test No.	Soil Type	Volume of voids, % total volume: Capillary	Volume of voids, % total volume: Non-capillary	Volume of voids, % total volume: Total	Cover	Location	Diameter of test cyclinder	Appearance of Sample
6 - 12	-	39.7 [9]	1.2	4.9	26/4	1	Segamat	40.0	22.6 [8]	62.6	jungle	project	9.0"	Undisturbed
12 - 24	37.0 (F)	-		1.8	"	2	"	-	-	-	"	"	"	(Probably consoli- (dated by road con- (struction machinery
12 - 24	31.6	12.7 [10]		5.2	"	3	"	-	-	-	"	"	"	Undisturbed
surface	-	-		4.6	-	-	" [1]	-	-	-	"	"	"	
0 - 12	24.0	-		16.1	15/4	6	" [2]	-	-	-	young oil palm & surface cover crop	Ulu Jempol Phase II	"	Undisturbed
12 - 24	47.0 (S)	47.0 [10]		12.0	"	9	" [2]	-	-	-	"	"	"	"
0 - 12	-	37.0 [9]		2.0	"	8	" [2]	-	-	-	"	"	3.5"	Compacted
0 - 15	41.9 (F)	-		1.8	"	7	" [2]	-	-	-	"	"	"	"
6 - 12	27.7	-		15.4	25/5	4	" [3]	-	-	-	oil palm & cover	Chenor Estate	9.0"	Undisturbed
4 - 13	36.9 (F)	31.2 [8]		9.5	"	2	" [3]	-	-	-	"	"	"	"
4 - 13	40.6 (F)	31.8 [8]		3.6	"	5	"	-	-	-	"	"	"	"
3 - 10	31.6	-		25.6	24/5	1	Malacca	-	-	-	jungle	project	"	"
3 - 12	32.2	40.1 [10]		5.7	"	3	"	42.2	22.7 [8]	64.9	"	"	"	"
3 - 15	38.8	41.0 [10]		4.1	"	2	"	-	-	-	"	"	"	"
6 - 18	19.5	-		10.0(approx.)	28/4	1	Durian [4]	-	-	-	"	"	"	19% compression
4 - 9	26.4 (F)	37.2 [10]	1.35	10.0	"	6	" [5]	31.2	18.0	49.2	"	"	"	Undisturbed
9 - 21	22.3	-		2.6	"	5	" [6]	-	-	-	"	"	"	"
12 - 24	24.8	23.2	1.3	0.4	"	2	Bungor [7]	35.0	13.7	48.7			"	"
4 - 6	-	-		2.1	28/4	4	Bungor	-	-	-	jungle	project	9.0"	Undisturbed
6 - 24	25.0	40.0 [10]		2.0	27/4	1	"	-	-	-	"	"	"	"
0 - 15	12.4	-	1.5	1.6	14/4	1	Serdang	-	-	-	young oil palm and surface cover crop	Ulu Jempol Phase II	3.5"	Compacted
0 - 15	29.4 (S)	-		0.7	"	2	" [11]	-	-	-	"	"	"	"
0 - 15	17.2	-		1.6	"	3	"	-	-	-	"	"	"	"
6 - 17	34.2	-		0.4	25/5	1	Lockyang [12] Merah	-	-	-	oil palm and cover crop	Chenor Estate	9.0"	Undisturbed
8 - 12	23.9	-		5.0	29/4	1	Munchong (laterite)	-	-	-	young oil palm and surface cover crop	Ulu Jempol Phase II	"	"
15 - 21	30.3	47.0 [10]		5.0	14/4	10	Munchong	-	-	-	jungle	project	"	"
9 - 18	48.8 (S)	-	1.2	0.6	27/4	2	Munchong (clayey)	40.3	19.1 [8]	59.5	"	"	"	"
4 - 13	26.7	27.3		1.6	25/5	3	Munchong [13] (chenor)	-	-	-	oil palm & cover crop	Chenor Estate	"	"
3 - 15	35.5 (F)	-		0.2	"	4	" [14]	-	-	-	"	"	"	"
6 - 12	45.5 (S)	-	1.2	9.5	26/5	1	" [15] (but possibly Segamat)	50.0	9.5	59.5	"	"	"	"
9 - 11	-	-	1.2	4.2	"	2	" [16] (laterite)	50.0	8.3	58.3	"	"	"	"
9 - 18	53.6 [8]	-	1.2	0.8	"	3	Munchong [17] (Chenor)	48.5	11.2	59.7	"	"	"	"

1/ Casual test by P. Robinson
2/ Jungle cleared about 1961
3/ Planted 1939 - 42
4/ Friable soil, many roots
5/ Much organic debris
6/ Without ferric concretions
7/ No measurable increase beyond 0.4" infiltration
8/ Doubtful results
9/ Probably at field capacity
10/ Probably saturated
11/ Very slow gain in infiltration beyond 1 hour. Soil saturated
12/ Planted 1939 - 42
13/ Planted 1939 - 42
14/ Impermeable after first 15 minutes
15/ Planted 1962
16/ Result doubtful because of poor penetration of cylinder
17/ Planted 1939 - 42

APPENDIX 7-3

INSTALLATIONS REQUIRED FOR CONTINUING HYDROLOGICAL INVESTIGATIONS

Table 1 - List of Fixed Equipment

Rainfall Stations	Location	Full grid reference (1:63360 series L7010)	Standard grid reference (1:63360 series L7010)	Estimated cost of station establishment M$)	Remarks
Automatic rain fall recorder - Kent type	Sg Nerek	N 279200 E 577200	L 772792	1000 1/	
"	Sg Jengka	N 258000 E 558700	L 587580	1000 1/	
"	Kg Sentul	N 259000 E 283600	L 836590	600	To be paired with the existing rain guage at Kuala Sentul
"	Sg Galong	N 284600 E 575600	L 756846	1000 1/	
Manual rain guage	Sg Nerek	N 279200 E 577200	L 772792	Included in item (1) above	To be paired with item (1) above
"	Sg Jengka	N 258000 E 558700	L 587580	Included in item (2) above	To be paired with item (2) above
"	Sg Galong	N 284600 E 575600	L 756846	Included in item (4) above	To be paired with item (4) above

APPENDIX 7-3

INSTALLATIONS REQUIRED FOR CONTINUING HYDROLOGICAL INVESTIGATIONS

Table 1 - List of Fixed Equipment (Contd.)

Stream Gauging Stations	Location	Full grid reference (1:63360 series L7010)	Standard grid reference (1:63360 series L7010)	Estimated cost of station establishment (M$)	Remarks
Staff gauge	Sg Jempol 2/	N 267200 E 578500	L 785672	60	Established during February 1966
"	Sg Jeh 2/	N 258500 E 584500	L 845585	60	"
"	Sg Tekam 2/	N 284000 E 563800	L 638840	60	"
"	Sg Siam 2/	N 284500 E 562200	L 622845	60	"
"	Sg Kundang 2/	N 246500 E 581300	L 813465	60	"
"	Sg Galong 2/	N 284200 E 569200	L 692842	60	"
"	Sg Jengka	N 242800 E 572200 N 258600 E 558800	L 722428 L 588586	120	"
Automatic float recorder - Kent type	Sg Tekam	N 284000 E 563800	L 638840	5000	complete with gauge house, stilling well etc.
"	Sg Jempol	N 267200 E 587500	L 875672	5000	"
"	Sg Jengka	N 258000 E 558	L 587580	5000	"
			Contingencies	1920	
			Total	21,000	

1/ D.I.D. Estimate

2/ Recommended in letters GKL-407 and GKL-412

Table 2 - List of Ancillary Equipment

Experiment	No.	Cost (M$)	Remarks
Surveyors level	1	1,400	Automatic
" staff	2	320	sopwith
" tapes	2	200	100' & 300' steel
" field books etc.	-	-	as required
Current meter (Ott)	1	2,300	to be maintained by D.I.D.
Winch and cable (Ott)	1	1,200	
Wading rods	1 set	400	
Weights	1 set	400	
Counter, sounder etc.	-	800	
Long wheel base Land-rover or lorry	1	10,000	
motor cycle	1	2,000	for hydrological assistants
Tools	-	300	
Contingencies	-	2,680	
	Total	22,680	

APPENDIX 7-3

Table 3 - List of Staff

Position	Part time	Full time	Annual Salary (M$)
Hydrological assistant (who will also be a surveyor)	-	1	3,600
Rainguage readers	4	-	480
Staff guage readers	8	-	960
Driver	-	1	1,200
Labourers for stream guaging, station maintenance, and stream surveys	-	3	3,600
Contingencies			1,160
		Annual Total	11,000

APPENDIX 10

FOREST UTILISATION

APPENDIX 10-1

NETT VOLUME PER ACRE IN UNDISTURBED FOREST

JENGKA FOREST RESERVE
(cubic feet)

NORTH EAST QUADRANT

Species	Sawlogs	Veneer Logs	Total
HEAVY HARDWOODS	78.0	-	78.0
Merbau, Balau, etc.	33.1	-	33.1
Other Heavy Hardwoods	44.9	-	44.9
MEDIUM HARDWOODS	497.9	124.4	622.3
Kempas	23.5	97.6	121.1
Keruing	272.7	-	272.7
Mengkulang	18.3	23.1	41.4
Kelat	42.5	1.1	43.6
Tualang	79.4	-	79.4
Simpoh	5.0	-	5.0
Jelawai	1.4	2.6	4.0
Kasai	9.6	-	9.6
Keladan	9.6	-	9.6
Keledang	2.7	-	2.7
Temponek	9.1	-	9.1
Kulim	0.2	-	0.2
Rengas	3.2	-	3.2
Minyak Berok	14.0	-	14.0
Petaling	6.7	-	6.7
LIGHT HARDWOODS	174.9	430.8	605.7
Bintangor & Durian	9.4	7.7	17.1
Jelutong	3.0	24.4	27.4
Red Meranti	61.0	202.0	263.0
White Meranti, Mersawa	6.5	24.9	31.4
Yellow Meranti	2.9	32.4	35.3
Nyatoh	10.5	10.0	20.5
Sepetir	2.3	9.7	12.0
Kedondong	30.8	40.5	71.3
Mata Ulat	5.2	8.0	13.2
Melunak	0.5	0.7	1.2
Medang	6.4	8.6	15.0
Penarahan	6.4	7.7	14.1
Sesendok	1.8	2.2	4.0
Merawan	7.3	8.6	15.9
Kembang Semangkok	-	9.1	9.1
Mempisang	5.7	7.8	13.5
Pelong	4.6	7.5	12.1
Machang	2.7	4.5	7.2
Petai	1.5	3.7	5.2
Other Light Hardwoods	6.4	10.8	17.2
TOTAL	750.8	555.2	1306.0

APPENDIX 10-1

SOUTH EAST QUADRANT

Species	Sawlogs	Veneer Logs	Total
HEAVY HARDWOODS	85.6	-	85.6
Merbau, Balau, etc.	59.2	-	59.2
Other Heavy Hardwoods	26.4	-	26.4
MEDIUM HARDWOODS	443.9	93.8	537.7
Kempas	14.8	80.7	95.5
Keruing	307.3	-	307.3
Mengkulang	10.9	12.5	23.4
Kelat	29.9	-	29.9
Tualang	44.2	-	44.2
Simpoh	3.0	-	3.0
Jelawai	0.9	0.6	1.5
Kasai	6.5	-	6.5
Keladan	5.6	-	5.6
Keledang	3.0	-	3.0
Temponek	4.7	-	4.7
Kulim	0.2	-	0.2
Rengas	2.0	-	2.0
Minyak Berok	9.5	-	9.5
Petaling	1.4	-	1.4
LIGHT HARDWOODS	148.1	401.0	549.1
Bintangor, Durian	2.7	3.8	6.5
Jelutong	1.6	36.7	38.3
Red Meranti	49.0	184.7	233.7
White Meranti, Mersawa	4.2	18.4	22.6
Yellow Meranti	2.7	30.0	32.7
Nyatoh	6.4	5.2	11.6
Sepetir	0.7	15.2	15.9
Kedondong	31.7	26.7	58.4
Mata Ulat	5.1	8.1	13.2
Melunak	0.4	0.4	0.8
Medang	6.8	9.1	15.9
Penarahan	6.8	5.6	12.4
Sesendok	1.8	1.6	3.4
Merawan	7.7	6.4	14.1
Kembang Semangkok	-	6.1	6.1
Mempisang	5.9	8.4	14.3
Pelong	4.4	7.6	12.0
Machang	2.6	5.9	8.5
Petai	1.2	8.4	9.6
Other Light Hardwoods	6.4	12.7	19.1
TOTAL	677.6	494.8	1172.4

APPENDIX 10-1

NORTH WEST QUADRANT

Species	Sawlogs	Veneer Logs	Total
HEAVY HARDWOODS	115.0	-	115.0
Merbau, Balau, etc.	84.0	-	84.0
Other Heavy Hardwoods	31.0	-	31.0
MEDIUM HARDWOODS	382.1	129.9	512.0
Kempas	18.7	109.8	128.5
Keruing	268.2	-	268.2
Mengkulang	13.3	17.8	31.1
Kelat	18.7	-	18.7
Tualang	33.3	-	33.3
Simpoh	2.9	-	2.9
Jelawai	0.9	0.9	1.8
Kasai	6.3	-	6.3
Keledang	1.0	1.4	2.4
Temponek	4.2	-	4.2
Kulim	0.2	-	0.2
Rengas	1.3	-	1.3
Minyak Berok	8.2	-	8.2
Petaling	1.1	-	1.1
Keladan	3.8	-	3.8
LIGHT HARDWOODS	154.6	402.5	557.1
Bintangor, Durian	1.8	5.7	7.5
Jelutong	1.8	19.9	21.7
Red Meranti	55.6	214.3	269.9
White Meranti, Mersawa	3.2	29.0	32.2
Yellow Meranti	0.3	12.5	12.8
Nyatoh	8.6	14.8	23.4
Sepetir	1.7	20.3	22.0
Kedondong	32.5	30.4	62.9
Mata Ulat	5.2	5.3	10.5
Melunak	0.5	0.4	0.9
Medang	6.7	6.4	13.1
Penarahan	6.7	6.4	13.1
Sesendok	2.0	1.8	3.8
Merawan	7.9	7.2	15.1
Kembang Semangkok	-	6.9	6.9
Mempisang	5.8	5.7	11.5
Pelong	4.4	4.6	9.0
Machang	2.6	2.7	5.3
Petai	1.0	1.6	2.6
Other Light Hardwoods	6.3	6.6	12.9
TOTAL	651.7	532.4	1184.1

APPENDIX 10-1

SOUTH WEST QUADRANT

Species	Sawlogs	Veneer Logs	Total
HEAVY HARDWOODS	79.7	-	79.7
Merbau, Balau, etc.	56.8	-	56.8
Other Heavy Hardwoods	22.9	-	22.9
MEDIUM HARDWOODS	297.3	110.0	407.3
Kempas	24.4	84.9	109.3
Keruing	138.6	-	138.6
Mengkulang	17.4	22.2	39.6
Kelat	30.3	-	30.3
Tualang	41.2	-	41.2
Simpoh	3.4	-	3.4
Jelawai	0.7	1.1	1.8
Kasai	7.0	-	7.0
Keladan	14.5	-	14.5
Keledang	1.2	1.8	3.0
Temponek	4.8	-	4.8
Kulim	0.2	-	0.2
Rengas	1.6	-	1.6
Minyak Berok	9.1	-	9.1
Petaling	2.9	-	2.9
LIGHT HARDWOODS	175.3	421.8	597.1
Bintangor, Durian	1.0	2.4	3.4
Jelutong	0.3	16.3	16.6
Red Meranti	89.6	264.7	354.3
White Meranti, Mersawa	7.0	14.9	21.9
Yellow Meranti	0.4	15.4	15.8
Nyatoh	7.7	7.8	15.5
Sepetir	0.4	16.6	17.0
Kedondong	27.9	25.3	53.2
Mata Ulat	4.4	5.7	10.1
Melunak	0.5	0.3	0.8
Medang	5.4	6.9	12.3
Penarahan	5.7	4.5	10.2
Sesendok	1.7	1.5	3.2
Merawan	6.4	6.0	12.4
Kembang Semangkok	-	5.7	5.7
Mempisang	4.8	6.3	11.1
Pelong	3.9	5.2	9.1
Machang	2.2	3.7	5.9
Petai	0.6	4.2	4.8
Other Light Hardwoods	5.4	8.4	13.8
TOTAL	552.3	531.8	1084.1

APPENDIX 10-1

TEKAM AREA

Species	Sawlogs	Veneer Logs	Total
HEAVY HARDWOODS	56.0	-	56.0
Merbau, Balau, etc.	28.9	-	28.9
Other Heavy Hardwoods	27.1	-	27.1
MEDIUM HARDWOODS	358.1	102.1	460.2
Kempas	13.6	86.2	99.8
Keruing	133.9	-	133.9
Mengkulang	9.0	9.5	18.5
Kelat	45.8	-	45.8
Tualang	73.4	-	73.4
Simpoh	12.3	-	12.3
Jelawai	3.5	2.4	5.9
Kasai	18.3	-	18.3
Keladan	10.3	-	10.3
Keledang	1.7	4.0	5.7
Temponek	11.0	-	11.0
Rengas	3.0	-	3.0
Minyak Berok	18.6	-	18.6
Petaling	3.7	-	3.7
LIGHT HARDWOODS	152.5	434.5	587.0
Bintangor, Durian	2.4	2.1	4.5
Jelutong	2.2	40.5	42.7
Red Meranti	52.9	231.3	284 2
White Meranti, Mersawa	6.3	38.5	44.8
Yellow Meranti	3.8	40.1	43.9
Nyatoh	5.9	8.4	14.3
Sepetir	0.3	14.9	15.2
Kedondong	32.5	16.6	49.1
Mata Ulat	4.2	2.8	7.0
Medang	9.3	4.2	13.5
Penarahan	9.0	4.0	13.0
Sesendok	3.8	1.7	5.5
Merawan	3.7	1.7	5.4
Kembang Semangkok	-	3.7	3.7
Mempisang	3.5	1.6	5.1
Pelong	5.4	3.1	8.5
Machang	4.3	4.0	8.3
Petai	3.0	15.3	18.3
TOTAL	566.6	536.6	1103.2

APPENDIX 10-2

PLYWOOD AND VENEER SPECIES

Suitable for Face Veneer: Red Woods	White Woods	Other Colours	Suitable for Corestock Only
CURRENTLY USED SPECIES:			
Red Meranti Mengkulang Kembang Semangkok Nyatoh	White Meranti Mersawa Kedondong Petai Sesendok	Yellow Meranti Medang (greenish brown) Machang (black and yellow) Sepetir (black and brown)	Bintangor Durian
SPECIES ASSUMED TO BE USABLE:			
Penarahan Terentang Geronggang	Jelutong	Melunak (brown) Merawan (yellow-brown)	Pelong Kasai Kempas Keledang Jelawai Mata Ulat Mempisang Terap Pulai

NOTE: Only Kempas and Keledang on the above list will need steaming or boiling before they can be peeled. Such treatment will make any species easier to peel, but may increase the difficulty of chuck-holding, in softer species and in those with brittle-heart.

APPENDIX 10-3

SAWMILL LOG INPUT BY SPECIES, WEST MALAYSIA, 1965

(cubic tons)

Species	Nationwide Volume	Nationwide Percentage of total input	Pahang Volume	Pahang Percentage of total input
HEAVY HARDWOODS				
Merbau	23,308	1.5	2,362	1.0
Balau	67,592	4.4	6,086	2.6
Giam	779	0.1	152	0.1
Keranji	2,478	0.2	2	-
Merbatu	280	- 1/	-	-
Kekatong	141	-	-	-
Membatu	893	0.1	52	-
Penaga	12	-	-	-
Tembusu	211	-	4	-
Resak	2,329	0.2	386	0.2
	98,023		9,044	
MEDIUM HARDWOODS				
Kempas	56,695	3.7	5,014	2.1
Keruing	257,251	16.9	63,689	26.8
Mengkulang	36,866	2.4	11,117	4.7
Kelat	3,196	0.2	2	-
Tualang	3,117	0.2	164	0.1
Simpoh	2,838	0.2	19	-
Jelawai	276	-	8	-
Kasai	1,800	0.1	3	-
Keladan	1,133	0.1	964	0.4
Keledang	1,430	0.1	205	0.1
Kulim	793	0.1	25	-
Rengas	43	-	-	-
Petaling	28	-	-	-
	365,466		81,210	

1/ denotes less than 0.1 per cent.

APPENDIX 10-3

Species	Nationwide Volume	Nationwide Percentage of total input	Pahang Volume	Pahang Percentage of total input
LIGHT HARDWOODS				
Bintangor	8,927	0.6	238	0.1
Durian	7,027	0.5	454	0.2
Jelutong	27,368	1.8	3,813	1.6
Dark Red Meranti	222,344	14.6	38,440	16.2
Light Red Meranti	467,166	30.7	66,303	27.9
White Meranti	9,828	0.6	659	0.3
Mersawa	34,468	2.3	2,455	1.0
Yellow Meranti	51,744	3.4	4,668	2.0
Nyatoh	21,065	1.4	7,502	3.2
Sepetir	18,293	1.2	682	0.3
Kedondong	6,167	0.4	72	-
Mata Ulat	2,896	0.2	-	-
Melunak	1,375	0.1	31	-
Medang	7,287	0.5	178	0.1
Penarahan	2,192	0.1	28	-
Sesendok	1,849	0.1	-	-
Merawan	5,464	0.4	676	0.3
Kembang Semangkok	12	-	-	-
Mempisang	759	0.1	119	0.1
Pelong	858	0.1	-	-
Machang	1,287	0.1	-	-
Terap	5	-	-	-
Kungkur	164	-	3	-
Petai	78	-	-	-
Karas	44	-	-	-
Pulai	184	-	-	-
Ara Berteh	141	-	-	-
Terentang	3,323	0.2	-	-
Geronggang	5,305	0.3	36	-
	907,620		126,357	
Total:	1,371,109		216,611	

APPENDIX 10-4

OTHER FOREST PRODUCTS

A. CHARCOAL

Species in present use: Mangrove
Species being tested: Rubber and inland forest species similar to those in use at Iligan in the Philippines.
Market size, 1965-1980 (thousands of long tons):

Year	Domestic Consumption	Exports	Total
1965	224	4	228
1970	368	25	393
1975	411	40	451
1980	460	50	511

B. POLES AND PILING

Characteristics of market: Export small and declining; domestic market could be increased by acceptance of treated round power or telephone poles.
Market size, 1965-1980 (thousands of cubic tons):

Year	Domestic Consumption
1965	70
1970	80
1975	93
1980	107

C. FUELWOOD

Characteristics of market: Price too low to justify export, domestic needs generally filled by small entrepreneurs. Replacement fuels such as charcoal, Butane, and oil are now readily available. Jengka Triangle settlers would need about 20,000 cubic tons per year, easily supplied from logging waste and clearing operations.
Market size, 1965-1980 (thousand of cubic tons):

Year	Domestic Consumption
1965	900
1970	984
1975	1,138
1980	1,316

(Contd.)

D. PARTICLE BOARD

Characteristics of market: Particle board has gained rapid acceptance in Europe, the U.S., and Australia, but not yet in Malaya and Singapore. A prefabricated house that incorporates particle board is in use in other parts of the world, but has not yet been introduced into Malaysia; such a house could result in a considerable market.

Market size, 1965-1980 (millions of square feet, 3/16-inch basis):

Year	Domestic Consumption
1965	1
1970	3
1975	7
1980	13

E. FIBREBOARD

Characteristics of market: No fibreboard is manufactured in Malaya but the demand for imported fibreboard shows steady growth. Hardboard and plywood compete, but softboard or insulation board is more likely to compete with new sizes of wood wool construction boards than with plywood.

Market size, 1965-1980 (millions of square feet, 3/16-inch basis):

Year	Domestic Consumption
1965	32
1970	50
1975	67
1980	89

F. PAPER

Characteristics of market: Supplied mostly by imports, some by local production. Only newsprint has a very large market, but newsprint 1/ cannot be easily manufactured from the short-fibred species that grow in Malaya. Development of a pepar industry based on rubber wood and agricultural residues might provide exportable volumes eventually.

Market size, 1965-1980, domestic only (thousands of long tons):

1/ Newsprint is the only homogeneous class of paper shown. "Other Paper and Board", for example, includes cardboard, filter paper, containerboard, and so on.

(Contd.)

APPENDIX 10-4

Year	Total Paper	Printing and Writing	Newsprint	Other Paper and Board
1965	150 1/	-	-	-
1970	156	52	33	71
1975	213	66	39	108
1980	285	84	45	156

1/ 1965 paper consumption was not recorded by the classes shown for the other years.

APPENDIX 10-5

LOGGING EQUIPMENT LIST

Item	Number Needed
Felling	
Chainsaws.	36
Skidding	
Caterpillar D6C or equivalent, crawler tractor with integral logging arch.	10
Loading	
Caterpillar 977H track-mounted front-end loader, or equivalent.	2
Hauling	
200,000 lbs. GVW off-highway truck, Kenworth 849 or equivalent.	4
53,000 lbs. GVW highway truck, Commer CC-15 or equivalent.	8
Preload trailers for above trucks.	12
Unloading	
Log stacker, FWD, Le Tourneau, or equivalent.	1
Caterpillar 966B, wheel-mounted front-end loader, or equivalent.	1
Road construction	
Caterpillar D8H bulldozer, or equivalent.	4
Caterpillar D6C or equivalent.	2
Caterpillar 14 grader or equivalent.	1
Sheepsfoot roller.	1
Grid roller.	1
10-cubic-yard dump truck, Commer CC-15 or equivalent.	20
Caterpillar 933F track-mounted front-end bucket loader, or equivalent.	1

(Contd.)

Item	Number Needed
Quarrying	
Rock crusher capable of 200 tons per hour output.	1
Self-propelled, track-mounted drill.	1
Compressor.	1
Northwest 80D Shovel loader or equivalent.	1
Caterpillar 769 off-highway dump truck, or equivalent.	1
Caterpillar 966B or equivalent.	1
Road maintenance	
Caterpillar 12 grader or equivalent.	1
Administration	
Maintenance shop	-
Warehouse for parts	-
Land Rover or equivalent.	4
Crew busses.	2

APPENDIX 10-6

LOGGING EQUIPMENT AND OPERATING COSTS

(M$)

A. ROAD-BUILDING EQUIPMENT

	Northwest Shovel, 86D	Dump truck Cat. 769	Dump Truck Commer CC-15	Caterpillar Graders Cat. 14	Caterpillar Graders Cat. 12	Quarry Equipment [1]
Delivered cost	314,865	211,140	31,332	68,847	57,445	200,000
Tires	-	(25,200)	(3,088)	(4,914)	(4,305)	-
Salvage value	31,486	(21,110)	(3,133)	(13,770)	(11,489)	20,000
Amount for depreciation	283,379	164,830	25,111	50,163	41,651	180,000
Life in hours	15,000	12,000	15,000	12,000	12,000	20,000
Life in years	6.2	5.0	6.2	5.0	5.0	8.3
Hourly depreciation	18.89	13.74	1.67	4.18	3.47	9.00
Hourly insurance at 4%	3.04	2.11	0.24	0.69	0.57	1.81
Total hourly owning cost	21.93	15.85	1.91	4.87	4.04	10.81
Total yearly owning cost	52,632	38,040	4,584	11,688	9,696	25,944
Hourly fuel cost	4.80	4.80	0.60	2.35	1.80	2.00
Hourly lubrication cost	1.82	1.82	0.20	0.84	0.54	1.00
Hourly maintenance cost	19.87	11.00	1.67	2.51	2.78	8.10
Hourly tire cost	-	7.20	1.14	1.31	1.15	-
Hourly wages	2.76	2.76	2.55	2.76	2.76	8.87
Total hourly operating cost	29.25	27.58	6.16	9.77	9.03	19.97
Total yearly operating cost	70,200	66,192	14,784	23,448	21,672	97,928
Total hourly costs	51.18	43.43	8.07	14.64	13.07	30.78
Total yearly costs	122,832	104,232	19,368	35,136	31,368	123,872

1/ Quarry equipment includes Rock Crusher, Compressor, Drill. Wages include $2.76 per hour for a crusher operator, $3.19 per hour for a foreman-blaster, and $1.46 per hour for each of two labourers. Total Yearly Operating Costs include an estimated $50,000 for explosives, drill bits, etc.

APPENDIX 10-6

B. LOGGING EQUIPMENT

	Tractors 1/		Loaders			Le Tourneau
	Cat. D8H	Cat. D6C	Cat. 977H	Cat. 933F	Cat. 933F	Unloader F1304
Delivered cost	146,350	90,170	129,163	125,460	41,310	352,300
Tires	-	-	-	(8,568)	-	15,000
Salvage value	29,270	18,034	25,833	(25,092)	8,260	- 2/
Amount for depreciation	117,080	72,136	103,330	91,800	33,050	337,300
Life in hours	10,000	10,000	10,000	10,000	10,000	10,000
Life in years	4.2	4.2	4.2	3.3	4.2	2.5
Hourly depreciation	11.71	7.20	10.33	9.18	3.30	22.49
Hourly insurance at 4%	1.51	0.93	1.33	1.12	0.43	1.18
Total hourly owning cost	13.22	8.13	11.66	10.30	3.73	23.67
Total yearly owning cost	31,728	19,512	27,984	31,200	8,952	136,020
Hourly fuel cost	5.70	3.12	3.12	2.70	1.00	6.00
Hourly lubrication	1.35	0.90	0.65	0.60	0.43	2.00
Hourly maintenance	10.54	6.48	9.30	5.51	2.80	20.24
Hourly tire cost	-	-	-	2.44	-	4.28
Hourly wages	2.76	2.76	2.76	2.76	2.76	2.76
Total hourly operating cost	20.35	13.26	15.83	14.01	6.99	35.28
Total yearly operating cost	48,840	31,824	37,992	42,030	16,776	211,680
Total hourly costs	33.57	21.39	27.49	24.31	10.72	58.95
Total yearly costs	80,568	51,336	65,976	73,230	25,728	347,700

1/ At least one tractor will be used in the road-building operation.

2/ No salvage value can be established for Malaya at present; salvage value will depend on the market for Le Tourneau equipment in the region at the time.

APPENDIX 10-7

LOGGING TRUCK COSTS
(M$)

	Kenworth 849	Extra Trailers for KW 849	Commer CC-15	Extra Trailers for CC-15
Delivered cost	196,107	34,941	38,000	12,000
Tires	(15,000)	- 1/	(6,000)	- 1/
Salvage value	(19,610)	-	(3,800)	-
Amount for depreciation	161,497	34,941	28,200	12,000
Life in hours	15,000	-	-	-
Life in years	3.1	5.0	4.0	4.0
Yearly depreciation	52,096	6,988	7,050	3,000
Insurance at 4%	5,187	838	2,500	300
Total yearly owning cost	57,283	7,826	9,550	3,300
Tire cost per mile:				
Paved road	- 2/		0.0783	
Gravel road	0.5201		0.2734	
Dirt road	0.8306		-	
Cost per minute of driving time for:				
Fuel	0.0752		0.0376	
Lubrication	0.0218		0.0109	
Repairs	0.8569		0.1280	
Total	0.9539		0.1765	
Yearly labour cost	13,770 3/		9,600	

1/ Tires included in truck figure.

2/ Kenworth 849 is too large to travel on public highways, thus will not be used on paved roads.

3/ Night shift driver should be paid 1.25 times day shift rate.

APPENDIX 10-8

LOGGING LABOUR FORCE

Table 1 - Number of Employees

	1968	1969	1970	1971	1972	1973	1974	1975
Falling	48	72	72	72	72	72	72	72
Skidding	21	30	30	30	30	30	30	30
Loading	6	6	6	6	6	6	6	6
Hauling	18	24	24	22	20	20	20	20
Roads	47	43	32	38	35	32	40	40
Unloading	12	12	12	12	12	12	12	12
Overheads	54	54	54	54	54	54	54	54
NUMBER OF EMPLOYEES	206	241	230	234	229	226	234	234

Table 2 - Estimated Wage Rates

(M$)

	Monthly	Including Fringe	Yearly, with Bonus	Hourly
Faller	450	600	7650	3.19
Faller's Assistant	300	400	5100	2.12
Tractor Operator	390	520	6630	2.76
Tractor Operator's Assistant, or Choker-setter	300	400	5100	2.12
Truck Driver	360	480	6120	2.55
Road Labourer	270	360	3510	1.46

APPENDIX 10-9

LOGGING ADMINISTRATIVE STAFF

Position	Number	Total Annual Salary (M$)
Logging supervisor 1/	1	120,000
Road construction supervisor	1	50,000
Forest engineer	1	37,500
Surveyors	8	60,000
Side foremen	2	16,000
Falling supervisor	1	8,000
Base radio operator	1	6,000
Office manager	1	9,000
Clerks	3	18,000
Parts warehouseman	1	7,000
Master mechanic	1	50,000
Fuel station attendant	2	10,000
Draftsmen	3	25,000
Personnel manager	1	15,000
Guards	6	30,000
Total	33	461,500

1/ Foreign staff assumed initially

APPENDIX 10-10

LOGGING CAPITAL INVESTMENT

(M$ millions)

Year	Fixed Capital: Road Equipment	Fixed Capital: Skidding, Loading and Unloading Equipment	Fixed Capital: Logging Trucks	Fixed Capital: Support Facilities	Fixed Capital: Total	Working Capital	Total
1967	0.9	-	-	0.4	1.3	0.1	1.4
1968	1.2	1.4	0.7	0.2	3.5	2.5	6.0
1969	0.2	0.3	0.8	-	1.3	0.8	2.1
1970	-	-	-	-	-	-	-
1971	-	0.5	-	-	0.5	-	0.5
1972	0.5	1.0	1.0	-	2.5	-	2.5
1973	0.3	0.3	-	0.2	0.8	-	0.8
1974	0.1	-	-	-	0.1	-	0.1
1975	-	-	-	-	-	-	-
1976	0.5	1.0	1.0	-	2.5	-	2.5
1977	-	-	-	-	-	-	-
1978	-	-	-	-	-	-	-
	3.7	4.5	3.5	0.8	12.5	3.4	15.9

APPENDIX 10-11

ANNUAL LOGGING COSTS

(M$ per cubic ton)

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Felling	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60
Skidding	2.50	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
Loading	0.90	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Hauling	13.20	6.10	6.00	5.10	4.40	4.00	3.80	3.80	4.00	4.00	4.00
Road Construction	8.30	6.20	5.50	4.50	3.50	3.40	3.60	3.70	3.70	3.70	3.70
Road Maintenance	0.20	0.10	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Unloading & sorting	1.80	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
General overheads	3.90	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60
Royalties & premium	8.60	8.80	8.50	8.80	8.50	8.50	8.50	8.60	8.60	8.60	8.60
Contingencies	6.60	4.60	4.40	2.20	1.80	1.80	1.80	1.80	1.80	1.80	1.80
TOTAL	48.60	36.10	34.80	31.00	28.70	28.20	28.20	28.40	28.60	28.60	28.60

APPENDIX 10-12

SAWMILL EQUIPMENT AND PLANT

Item		Initial Cost (M$)
Sawmill equipment delivered at site		800,000
Planer		60,000
Moulding equipment		30,000
Lift trucks (2 needed)		120,000
Kilns		200,000
Drying sheds		200,000
Fire protection		50,000
Treatment plant		92,000
Wiring and piping		75,000
Site preparation		50,000
Conveyor systems		120,000
Buildings		340,000
Hog		50,000
Construction labour		400,000
Trucks (7 needed)		266,000
Equipment and facilities shared with plywood plant:		
50% of	power station	500,000
	boiler	150,000
	office building	25,000
	repair shop	60,000
	log deck and cut-off saw	65,000
Contingencies (10%)		365,000
	Total	4,018,000

APPENDIX 10-13

SAWMILL MANNING TABLE

Category	Number of men 1 shift	Number of men 3 shifts	Wages per man Per day (M$)	Wages per man Per year (M$)	Total annual wages (M$)
Sawmill Floor					
Barker operator	1	3	12	3,600	10,800
Conveyor control operator	1	3	18	5,400	16,200
Head sawyer	1	3	24	7,200	21,600
Resaw operator	1	3	9	2,700	8,100
Edger man	1	3	9	2,700	8,100
Trimmer man	1	3	9	2,700	8,100
Handymen	2	6	8	2,400	14,400
Indirect Labour					
Filer	1	3	20	6,000	18,000
Fitter	1	3	12	3,600	10,800
Clean-up	1	3	8	2,400	7,200
Maintenance					
Maintenance man	1	3	20	6,000	18,000
Electrician	1	3	20	6,000	18,000
Green Chain					
Graders	2	6	15	4,500	27,000
Pullers	4	12	8	2,400	28,800
Lift Truck Operators	2	6	9	2,700	16,200
Planing and Moulding					
Set up and knife grinder	1	1	15	4,500	4,500
Feeder	1	1	8	2,400	2,400
Grader	1	1	15	4,500	4,500
Pullers	4	4	8	2,400	9,600
Kilns					
Kiln operator	1	1	24	7,200	7,200
Helpers	2	2	8	2,400	4,800
Treatment Plant					
Operator	1	3	24	7,200	21,600
Helpers	6	18	8	2,400	43,200
Truck Drivers	7	7	16	4.800	33,600
Total	45	101			362,700

APPENDIX 10-14

SAWMILL CAPITAL INVESTMENT

(M$ Millions)

	Fixed Capital					
Year	Mill	Lift Trucks	Highway Trucks	Total	Working Capital	Total
1967	1.8	-	-	1.8	-	1.8
1968	1.8	0.1	0.1	2.0	1.5	3.5
1969	-	-	0.2	0.2	1.5	1.7
1970	-	-	-	-	-	-
1971	-	-	-	-	-	-
1972	-	0.1	-	0.1	-	0.1
1973	-	-	0.2	0.2	-	0.2
1974	-	-	-	-	-	-
1975	-	-	-	-	-	-
1976	-	-	-	-	-	-
1977	-	-	0.2	0.2	-	0.2
1978	-	-	-	-	-	-
	3.6	0.2	0.7	4.5	3.0	7.5

APPENDIX 10-15

PLYWOOD FACTORY EQUIPMENT AND PLANT

Item		Initial Cost (M$)
Veneer and panel-making equipment, delivered at site		2,200,000
Lift trucks (2 needed)		60,000
Highway trucks (5 needed)		190,000
Site preparation		50,000
Building		340,000
Construction labour		400,000
Steaming vats		100,000
Equipment and facilities shared with sawmill:		
50% of	power station	500,000
	boiler	150,000
	Office building	25,000
	repair shop	60,000
	log deck and cut-off saw	65,000
Contingencies (15%)		621,000
		4,761,000

APPENDIX 10-16

PLYWOOD FACTORY MANNING TABLE

Category	Number of men: 1 shift	Number of men: 3 shifts	Wages per man: Per day	Wages per man: Per year (M$)	Total Annual Wages (M$)
Green End					
Barker operators	1	3	12	3,600	10,800
Lathe spotters	4	8	9	2,700	21,600
Lathe operators	2	4	24	7,200	28,800
Green veneer clippers	6	12	12	3,600	43,200
Offbearers	4	8	6	1,800	14,400
Dryer and Veneer Prep.					
Dryer feeders	6	18	6	1,800	32,400
Dryer offbearers	6	18	6	1,800	32,400
Dry veneer clippers	1	3	8	2,400	7,200
Taping machine operators	2	6	8	2,400	14,400
Splicer operators	4	12	8	2,400	28,800
Patch crew	4	12	8	2,400	28,800
Graders	2	6	9	2,700	16,200
Lift truck operators	1	3	9	2,700	8,100
Gluing and Panel Mfg.					
Glue rustlers	1	3	8	2,400	7,200
Glue mixers	1	3	8	2,400	7,200
Glue spreader crew	4	12	8	2,400	28,800
Clean-up	2	6	8	2,400	14,400
Cold-press operators	1	3	9	2,700	8,100
Hot-press operators	1	3	9	2,700	8,100
Quality control	2	6	9	2,700	16,200
Sander operators	2	6	8	2,400	14,400
Panel patching	4	12	8	2,400	28,800
Panel Sizers	1	3	9	2,700	8,100
Graders	2	6	9	2,700	16,200
Export preparation	4	12	8	2,400	28,800
Lift truck operators	1	3	9	2,700	8,100
Maintenance					
Mechanics	3	7	12	3,600	25,200
Electricians	2	6	12	3,600	21,600
Parts clerk	1	1	9	2,700	2,700
Knife grinder	1	1	8	2,400	2,400
Peeler Core Sawmill					
Sawyers	4	4	9	2,700	10,800
Offbearers & stackers	6	6	8	2,400	14,400
Highway truck drivers	5	10	16	4,800	48,000
Total	91	226			606,600

APPENDIX 10-17

PLYWOOD FACTORY CAPITAL INVESTMENT
(M$ Millions)

	Fixed Capital					
Year	Factory	Lift Trucks	Highway Trucks	Total	Working Capital	Total
1967	2.2	-	-	2.2	-	2.2
1968	2.2	0.1	0.1	2.4	1.6	4.0
1969	-	-	0.2	0.2	1.6	1.8
1970	-	-	-	-	-	-
1971	-	-	-	-	-	-
1972	-	-	0.1	0.1	-	0.1
1973	-	-	0.1	0.1	-	0.1
1974	-	-	-	-	-	-
1975	-	-	-	-	-	-
1976	-	-	0.1	0.1	-	0.1
1977	-	-	0.1	0.1	-	0.1
1978	-	-	-	-	-	-
	4.4	0.1	0.7	5.2	3.2	8.4

APPENDIX 10-18

PREFABRICATION EQUIPMENT AND PLANT

(M$)

Precutting	
Building	100,000
Joinery Equipment	25,000
Site preparation	25,000
Construction labour	50,000
Lift trucks	30,000
Contingencies (10%)	23,000
Assembly	
Building	60,000
Site preparation	20,000
Construction labour	30,000
Lift trucks	30,000
Contingencies (10%)	14,000
Administration	
Office Building	10,000
Total	417,000

APPENDIX 10-19

PREFABRICATION PLANT MANNING TABLE

Category	Number of Men	Wages per man Per Day	Wages per man Per Year (M$)	Total Annual Wages (M$)
Precutting				
Machine operators	6	9	2,700	16,200
Helpers	12	8	2,400	28,800
Lift truck driver	1	9	2,700	2,700
Foreman	1	24	7,200	7,200
Assembly				
Carpenters	45	8	2,400	108,000
Foremen	5	24	7,200	36,000
Lift truck driver	1	9	2,700	2,700
Erection				
Carpenters	50	8	2,400	120,000
Foremen	5	24	7,200	36,000
Total	126			357,600

APPENDIX 10-20

PREFABRICATION PLANT CAPITAL INVESTMENT

(M$ Millions)

Year	Fixed Capital: Plant	Fixed Capital: Lift Truck	Fixed Capital: Total	Working Capital	Total
1967	0.2	-	0.2	-	0.2
1968	0.1	0.1	0.2	0.5	0.7
1969	-	-	-	0.4	0.4
1970	-	-	-	-	-
1971	-	-	-	-	-
1972	-	0.1	0.1	-	0.1
1973	-	-	-	-	-
1974	-	-	-	-	-
1975	-	-	-	-	-
1976	-	-	-	-	-
1977	-	0.1	0.1	-	0.1
	0.3	0.3	0.6	0.9	1.5

APPENDIX 10-21

ADMINISTRATIVE STAFF FOR FOREST INDUSTRY MANUFACTURING OPERATIONS

Position	Salary per annum (M$)
General Overhead	
Manager	200,000 (includes travel, housing, etc.)
Office Personnel (10)	50,000
Plywood Plant	
Manager	100,000 (includes travel, housing, etc.)
Assistant Manager	50,000 (includes travel, housing, etc.)
Quality Control Supervisor	20,000
Assistant Quality Control	16,000
Foremen (9-3 per shift)	144,000
Sales Manager	100,000 (includes travel, housing, etc.)
Salesmen (2)	100,000 (includes travel, housing, etc.)
SAWMILL	
Manager	80,000
Foremen (3)	45,000
Sales Manager	70,000
Salesmen (2)	70,000
Prefabricated House Plant	
Manager	12,000
Sales Manager	10,000
Salesman	8,000
Bookkeeper	5,000

APPENDIX 11

CROP SELECTION AND AGRICULTURAL LAND USE

(Contd.)

CROP SELECTION AND AGRICULTURAL LAND USE (Contd.)

APPENDIX 11 - 1

RICE AND SECONDARY CROPS

Rice - Market Prospects

West Malaysia has never been self sufficient in rice and local production at present accounts for about 55 per cent of consumption. Recently, development of rice production has been accelerated to lessen dependence on overseas supplies in the face of a rapidly increasing population. Although locally produced rice is supported by price and quality controls, imported rice has always commanded a premium because of its superior quality.

Demand - Consumption of rice during the period 1959 - 64 rose at an average rate of 3.7 per cent per year (Table 1). This compares with an annual population increase of about 3.1 per cent. Assuming future annual increases in rice consumption of 3.0 per cent in West Malaysia, consumption in 1970 is estimated at about 1.0 - 1.1 million tons, rising 1.5 million tons in 1980. By 1980, consumption can be expected to be increasing by about 50 - 55,000 tons a year.

Supply - Nearly half present supplies of rice are imported, mainly from Thailand and Burma. Local production is approximately 500,000 tons per year, based on about 750,000 acres of rice land. Although double cropping has been increasing rapidly in recent years it still forms an insignificant proportion of the total area and in the 1963-4 season only 50,000 acres, or about seven per cent of the total rice land was double cropped. Recent trends show increases in double cropping of 4-10,000 acres annually.

Over 550,000 acres of rice land is at present under irrigation and it should be possible to make substantial increases in the double cropped acreage.

Even with improved yields, past performance suggests a maximum annual increase in West Malaysia rice production of 6,000 tons. Large areas of new lands would have to be developed to irrigated padi, if domestic production is to keep pace with increases in local demand.

Table 1 - Rice Consumption in West Malaysia

(000 tons)

	1959	1960	1961	1962	1963	1964
Local Production	373	478	523	494	563	462
Nett Imports 1/	360	357	316	288	389	402
Apparent Consumption	733	835	839	782	925	864
% Increase per annum		14.0	-	-6.8	18.0	-6.6

Average 3.6

1/ No allowance has been made for changes in levels of stocks.

Source: Statistical Digest of Ministry of Agriculture, 1965.

Jengka Production and Future Rice Supply - It would be theoretically possible to grow rice on about 21,000 acres of land in the Jengka Triangle. This would produce about 25,000 tons of rice a year, equal to less than 2% of the estimated rice consumption in West Malaysia in 1980. Consequently production from Jengka, even if all possible rice growing areas were planted to rice, should have no effect on local rice supplies and prices.

Prices - Rice prices in the last 4-5 years have remained relatively steady, or have even tended to fall (Table 2).

Table 2 - Local and Imported Rice Prices 1961-1965

(M$ per ton)

	1961	1962	1963	1964	(Part) 1965
Import Price					
Av. c.i.f. (Milled whole)	404	450	429	409	420
Wholesale Price					
Thailand 100%	516	563	541	516	536
Local Kedah No. 1	443	486	469	453	444

The average import price for the period 1961-65 is just over $420 per ton, compared with the wholesale price for local rice of nearly $460 per ton; it is assumed that these prices will continue in the long term and remain fairly constant.

Rice - Cultivation

There is detailed and well documented information available on rice culture in West Malaysia and further studies by the Department of Agriculture are in progress. The importance which rice has achieved in smallholder farming has led to the assembly of much field experience as well.

The gross area of land suited to the cultivation of rice although extensive, mainly occupies the many valley floors and small swamps in the Triangle. Hence opportunities for extensive development are few. There will be suitable sites where individuals or small groups will grow rice as a subsidiary activity, particularly on otherwise unused land in rubber and oil palm areas. The extent to which this will be possible can only be determined when the jungle is removed and the extent of main crop planting can be assessed.

Seed and Nurseries - At present recommended rice varieties for Jengka are Serendah Kuning 60 on riverine lands and Milek Kuning elsewhere.

Maintenance - The following quantities of fertiliser are recommended in Pahang for application to rice after planting out:

Basic dressing	Sulphate of Ammonia	30 lbs. per acre
	Rock Phosphate	115 lbs. per acre
	Muriate of Potash	25 lbs. per acre

A top dressing of 55 lbs. per acre of Urea is also recommended.

Work inputs for the maintenance of rice fluctuate sharply; transplanting and harvesting make the greatest demands on available labour. Bird control and weeding create further peak labour demands. It would be in the interests of smallholders that their efforts in the main crops, rubber or oil palm, are not diverted by the attractions of traditionally important but significantly less profitable enterprise. It may be necessary to regulate the acreages allocated to settlers for rice planting.

Yields - Evidence available from existing rice areas near Jengka indicates that under trained supervisors, small areas will yield about 2,000 lbs. per acre. Double cropping would substantially increase yields and two periods in the year lend themselves to this practice; the first between April and November, the second between October and March. At present, however, the major floods experienced in December are an obstacle. If, during development in Jengka, river and stream control and maintenance reduces this risk it may be possible to introduce a system of double cropping in some areas. Nevertheless it is not expected that complex and expensive water control systems will be developed for rice growing.

Tapioca - Market Prospects

Production of tapioca is largely on a smallholder basis in West Malaysia and the area under production appears to be affected by changes in price. Production as a cash crop is estimated to be of the order of 250-350,000 tons a year.

Little information is available on future trends in demand, and it is not possible to assess accurately the acreage that could be grown in the Jengka Triangle and disposed of at ruling prices. Tapioca consumption is associated with very low income groups and therefore increases in demand as income per head rises are likely to be very low. In view of this, it is likely that acreages in Jengka which would increase total output of tapioca as a cash crop by more than 10% could only be disposed of at less than expected price levels.

1963 factory prices coincided with a period of high prices of all tapioca processed products and resulted in a price M$36 per ton of roots 'in-factory'. The 1964 unprocessed price of M$25 per ton was the lowest experienced over the last five years and was some 30 per cent below the 1963 peak and some 20 per cent below 1962 price levels. Given small acreages in Jengka it is assumed that M$25 - 36 per ton of roots will be the low - high range of in-factory prices, with an expected unprocessed price of $30 per ton.

Tapioca - Cultivation

Tapioca is tolerant of a wide range of soil conditions, although it cannot withstand water-logging. It is therefore suited to many parts of Jengka, provided that conservation measures are introduced where it is grown on steep slopes. Selected varieties are now under test and material from the more successful could be bulked for distribution in Jengka. This would be preferable to drawing supplies from less reliable sources which may only offer mixed varieties.

Maintenance - Tapioca makes heavy demands on soil nutrients. The replenishment of these losses therefore becomes an important factor to the smallholder if his land is to remain in production. Although definitive recommendations for fertiliser applications are not yet available it is estimated that a yield of 9 tons of tapioca per acre removes 130 pounds of nitrogen, 60 pounds of phosphorous and 110 pounds of potash. Confirmation of the levels of fertiliser needed for Jengka soils will be desirable.

From the smallholder viewpoint the low labour requirement is one of the advantages of growing tapioca. During the whole of its productive cycle it requires no more than 30 man/days per acre of which 12 days are employed in harvesting.

Manila Hemp - Market Prospects

World supplies of Manila hemp, which is used predominantly for manufacture of marine cordage, are dominated by production in the Philippines. Supplies from this source accounts for well over 90 per cent of world output.

Future demand for Manila hemp will be determined by the extent to which synthetic substitutes can be improved. Some technical advantages lie with both the natural and synthetic products.

World production of Manila hemp during the last 15 years has remained relatively constant at 110,000 - 130,000 tons per year, although overall demand for marine cordage has tended to rise. Future demand prospects are therefore uncertain because of competition from synthetic substitutes. Accordingly large scale increases in production are unlikely to find a ready market.

Prices - The range in Manila hemp prices due to differences in quality is greater than any year to year fluctuation. It is likely that higher quality fibres will be the most resistant to price competition from synthetics.

Malaysian hemp has commanded a relatively stable price over the period 1956 - 1963 at between M$1,300 - 1,400 per ton of fibre (Table 3). This compares well with general world prices, but applies to a very small level of output. In the last two years prices have risen substantially and in 1964 - 1965 were around M$1,500 for Malaysian fibre.

Table 3 - Prices of Manila Hemp 1956-63

(M$ per ton)

	Average of 1956-8	1959	1960	1961	1962	1963
c.i.f. Europe (converted)	920	1290	1270	955	938	1117
Malaysian Export	1305	1433	1243	1430	1390	1380

Source: F.A.O. Yearbook and Malayan Trade Statistics

However, in view of possible reduction in quality of fibre produced in Jengka and to make more allowance for the effect of competition from synthetics in the long run, the expected price has been assumed as $1,200 per ton of fibre f.o.b.

Manila Hemp Cultivation

Although a very small acreage of Manila hemp is grown in Malaysia as a whole, there are several aspects of its production which suggest its suitability as a smallholder crop. It has a wide tolerance of soil conditions provided that there is free drainage, and it can be grown on steep slopes such as are found in the agricultural areas of Jengka provided that cover crops are planted; within 18 - 24 months it has established its own ground canopy.

Establishment and Maintenance - Planting is a simple operation for which material is available to satisfy reasonable demands until supplies could be built up in Jengka. Setting out and planting absorb about eight man/days per acre.

Maintenance consists of weeding and disease control. Both make small demands upon growers' time and require a total of about 15 man/days per acre in the first year. By the third year only occasional slashing of weeds is necessary. Regular fertiliser applications are required in view of the large quantities of plant material removed at harvesting. Although a rate of about 3 cwt. per acre per annum of mixed fertiliser containing nitrogen, phosphorus and potash is used elsewhere, precise requirements for Jengka soils would need to be established.

Harvesting - For each harvesting round (every 4-5 weeks) one acre can be cut by one man, supported by three strippers who remove the crude fibre material from the cut stems. As the fibre in the standing plant does not deteriorate, harvesting intervals can be varied according to the demands of other crops or to throughput of the processing plant.

The crude material is bulky and transport is required from field to factory.

Yields of stems obtained in East Malaysia are as follows:

1st year	19	tons	per	acre	equivalent	to	0.4	tons	fibre
2nd year	63	"	"	"	"	"	6.9	"	"
3rd year	43	"	"	"	"	"	4.7	"	"
4th year	36	"	"	"	"	"	3.9	"	"
5th year	40	"	"	"	"	"	4.4	"	"

Thereafter yields decline by some 3 tons per acre per year. The early achievement of a peak yield followed by a lesser peak suggested that there may be a place for Manila hemp in an intercropping system.

Processing - Small scale fibre extraction requires only 3 operators and processes about 360 pounds of fibre per day or 4 tons per month. One machine is capable of handling the production of about 50 acres. The smallness of such a unit, which can operate independently, lends itself to use in small villages.

Freshwater Fish - Market Prospects

Fish is an important source of protein and demand is expected to rise strongly as income per head rises. An annual increase in consumption of over 6 per cent per year could be expected over the next two decades. Further evidence of the strong demand for fish is in the rapid increases in tonnages of fish landed and the firmness of retail prices over the last five years.

Most of the fish consumed in Malaysia are sea fish. Before 1958 tonnages landed remained relatively constant at around 110 - 120,000 tons annually. Between 1959 and 1964 landings rose to 192,000 tons, an average annual increase of 10 per cent, although in 1963-64 the increase in landings was reduced.

There is evidence that further increases in landings of sea fish may become progressively more difficult to achieve and local consumption of fresh water fish is expected to rise as demand outpaces the supply of sea fish. If in fact a shortage of sea fish develops Jengka in its inland situation appears particularly suited to becoming a market for fresh water fish. For an ultimate population of about 100,000 persons, consumption of fish could be of the order of 1,200 tons annually. In terms of fresh water fish, this would require some 2 - 4,000 acres of fish ponds.

In the period 1963-1964 when only a 4.5 per cent increase in tonnage landed was achieved, increases in retail prices were experienced. In view of the strength of the market, values of fish which could be produced in Jengka have been based on current retail prices. The weighted average retail price for the three recommended varieties, Tilapia sp., Lampam Jawa (Puntius javanicus), and Grass Carp (Ctenopharyngodon idellus) is at present M$0.90 per kati and will be the expected price over the planning period.

Freshwater Fish Culture

Investigations into the culture of freshwater fish are undertaken at the Tropical Fish Culture Research Station, Malacca. Sufficient information is available to warrant the introduction of fish ponds into the later phases of Jengka Development programme as a supplementary activity.

Fishpond Development - Many tributary valleys occur throughout Jengka, particularly in the northwest and southeast, these provide favourable site conditions for fish pond construction. It is estimated that in most areas there are at least 12 fishpond sites per square mile. More precise determination of the numbers of suitable sites and hence the significance of fish culture can only be established when the jungle is cleared.

Selected sites may be developed quickly by heavy equipment when it is conveniently available, or by hand excavation. Construction by hand will require approximately 200 man days per acre of pond. Total costs per acre are estimated to be approximately M$1,800. This will provide scope for group activity by smallholders and the work could conveniently be fitted into the period of primary crop maintenance when labour demand for those crops is not high.

Fish Production - A regular supply of fingerlings of hybrid Tilapia or Lampam Jawa would have to be arranged on behalf of smallholders. Grass Carp which are also suitable for stocking, may be used but as they do not breed under Malaysian conditions; fry will need to be imported from Hong Kong.

An initial application of about one ton per acre of lime will be necessary. Thereafter monthly or bi-monthly application of super phosphate will be needed at the rate of 3 - 4 cwts. per annum. These tasks will consume negligible proportions of smallholders' time.

Yields of 1200 lbs. of fish per acre per annum are now being obtained from smallholder ponds supervised by trained fisheries staff. It is reasonable to assume that similar yields will be obtained by settlers in Jengka.

Bananas - Market Prospects

The potential of bananas as a cash crop for Jengka depends almost entirely on the establishment of an efficient system of handling marketing and distribution. This is particularly critical in considering the potential of export markets. These appear to be sufficiently attractive to warrant further detailed investigation into all aspects of marketing and distribution.

Export - Demand - Japan with its rapidly rising incomes provides a large and expanding market in fruit and in particular bananas. Estimates of present banana consumption range from three quarters to one million tons annually. Based on present trends, consumption of bananas in Japan should rise by 30 - 35,000 tons a year.

In view of the large annual increase in Japan's consumption, the potential tonnage that Malaysia could export is probably substantial. Recently, for example, FLDA were offered a contract to supply up to 60,000 tons of bananas for export to Japan at an 'ex farm' price of M$55 per ton. This could be produced on 8,000 areas, using expected yield levels of 7½ tons per acre. The price offered is a low one compared with current Japanese banana import prices and probably is based on the poor past performance of Malaysian exporters in terms of fruit loss during shipment.

Domestic Demand - The demand for bananas within Malaysia is limited as far as Jengka is concerned to the urban areas in and around

Kuala Lumpur and to the Triangle proper. If present producers continue to supply the existing market adequately as they now do, the domestic market potential outside the Triangle appears insignificant.

Within the Triangle, for an ultimate population of about 100,000 persons, the total consumption of fruit can be expected to be around 4,500 tons. If 50 per cent of this is consumed as bananas, about 300 acres would be sufficient to provide for the entire population. All of this acreage can be expected to be developed by the settlers on their individual houselots.

Prices - The levels of prices now offered tend to reflect levels of efficiency in distribution and marketing rather than any other market factor. It is significant that the Japanese import price is three times the present Malaysian export price. This would suggest that there should be substantial returns to organizing an efficient system of sea transport which ensures minimum loss in terms of bad fruit. The technical problems of transporting bananas from Jengka to Japan will require a high degree of managerial efficiency, but the increased income both to the farmer and the economy should well justify it. Given this level of efficiency an f.o.b. price of $250 per ton should be feasible. Given a Japanese import price of M$470 per ton this allows M$220 per ton for losses en route and shipping charges. The expected f.o.b. price is taken as M$150 per ton which is similar to recent prices of bananas into and out of Singapore. M$100 per ton f.o.b. has been taken to demonstrate the effect of a fall in price on profitability.

Bananas - Cultivation

Although critical performance data for conditions similar to Jengka are not available, field observations and recordings were made during this study to supplement current information on which to assess the crops in the smallholder context. Bananas are grown both separately and as an intercrop, particularly with young rubber, although on a small scale.

The widespread popularity of bananas depends greatly upon their acceptance as a food and their small demands upon labour and skill. On these grounds they have a claim for inclusion in planning for Jengka.

Planting material - Suckers and corms are usually supplied from areas where bananas are cultivated extensively. As these sources include a mixture of varieties, selected material would have to be multiplied to meet Jengka demands. Three varieties of the thirty recorded in Malaysia are popular - Pisang Rastali, Pisang Mas and Pisang Embun. The two former varieties are less acceptable in overseas markets than Pisang Embun. Thus if market opportunities and marketing organisation are adequate to support expansion of banana production, a carefully controlled nursery programme would be necessary, through which growers in Jengka would be supplied with suitable export varieties.

Maintenance - Recommendations have been published in West Malaysia covering the main features of field maintenance including spacing, planting, manuring and desuckering.

These operations are estimated to occupy 86 man/days of labour per acre in the first year of production. In the second and third years however, this falls by seventy five per cent to 21 man/days per acre. In these years therefore, there is little or no competition for the smallholders' time between bananas and the main crop.

Bananas are relatively free from disease in Malaysia. Occasional instances of Panama disease have been recorded but without serious effect. More widespread and intensive cultivation might lead to more serious outbreaks.

Marketing - When large scale banana production for export markets is embarked upon considerable skill in timing and organisation of harvesting and dispatch of bunches is necessary. This type of organisation has not been required in Malaysia in the past because exports have been on a very small scale. If export markets can be tested successfully and continuous demand assured, FLDA settlement schemes afford good opportunities for developing the skilled organisation which export of bananas demands.

Yields - Evidence of yield is variable. Field observations indicate that Pisang Rastali may produce from 3 to 4½ tons per acre per year; Pisang Mas from 3 to 4½ tons and Pisang Embun, already noted the most suitable export variety, from 4½ to 9 tons.

Profitability of Rice and Secondary Crops

The profitabilities of the secondary crops discussed above have been calculated on a comparable basis to oil palm, and rubber. Most of them are annual crops or perennial crops with short periods of immaturity. However, their gross margins have been discounted at similar interest rates over a 25 year period and are shown in Table 4. The bases for these comparisons are given in Appendix 11-2.

Rice - Rice cultivation with its very high seasonal demand for labour requires about one worker per acre at harvesting time. Unless complementary seasonal employment can be found elsewhere the returns to labour from rice farming are very low indeed being 1/5 of rubber and 1/10 of oil palm, and compared with oil palms and two types of rubber. Rice cultivation, even if irrigated and double cropped, is clearly inferior to oil palm and rubber. While the area of competition of these crops is limited to lowlying or swamp land, the small additional costs of drainage for oil palm, or even rubber ($100 per acre) still leaves rice as clearly the least profitable crop.

Tapioca - With the exception of single cropped rice tapioca appears the least profitable crop at low rates of interest. However its small capital requirements make it preferable to double cropped rice at interest rates in excess of 7 per cent. However, this crop should be given low priority unless prices and yields improve substantially.

Manila Hemp - Although less profitable at the level of prices expected than bananas or fish, Manila hemp has some advantages. It is a non-perishable crop consequently it does not require a highly sophisticated system of distribution and marketing. It has a relatively simple technique of processing which would be suitable for production in small units and is a relatively simple crop to grow. Further investigation will be necessary to discover markets.

Fish - Given that the volume of output does not exceed the demand from within the Triangle and its surrounding area, fish cultivation appears highly profitable from the limited data available. If the settler constructs his own pond the activity has a high priority in terms of its contribution to development. It has a further advantage in that, being relatively labour intensive during the initial years of construction, it provides employment for unused settler labour during the years immediately prior to tapping, **or harvesting the primary crops.**

Bananas - Bananas appear highly profitable. In fact at expected price levels this crop is more profitable than oil palm. However, it is very doubtful at present whether marketing facilities are available to transport bananas in bulk to the port of shipment in condition to achieve the expected price though small quantities could be sold at the expected price level of M$150 per ton f.o.b. Being a highly perishable product, the price offered is critical. This can be seen by the substantial fall in profitability which takes place were the price to fall to the low level projected in Table 4. The key to achieving the higher price level lies in an efficient system of marketing and transportation. While it is possible that this can be achieved in the future, at present large scale development under bananas for urban markets or a port outside the Triangle is unlikely to achieve the price levels which could be obtained with small scale production.

The crop is more profitable than rubber, and even oil palm at rates of interest above 10%.

APPENDIX 11-1

Table 4 - Comparison of Crop Profitability

	Expected yield per acre per annum at maturity	Price during first year of production		Present worth of annual Gross Margin 3/ (M$) 5%	10%	15%
Oil Palms						
FLDA Smallholder 1/	9 tons FFB	M$500 per ton oil	f.o.b.	5942	3095	1658
Independent Smallholder 2/	4.5 tons FFB	M$325 per ton kernels	f.o.b.	2319	1089	472
Rubber (budgrafted)						
FLDA Smallholder 1/	1400 lbs latex d.r.c.	M¢ 53 per lb	f.o.b.	4830	2415	1259
Independent Smallholder 2/	700 lbs latex d.r.c.	M¢ 53 per lb	f.o.b.	2097	977	448
Rubber (clonal seedling)						
FLDA Smallholder 1/	1270 lbs latex d.r.c.	M¢ 53 per lb	f.o.b.	4822	2496	1355
Rice						
Double cropped	1.225 tons rice	M$ 420 per ton	c.i.f.	3638	1779	843
Single cropped	0.575 tons rice	M$ 420 per ton	c.i.f.	1884	1033	589
Tapioca	12 tons roots	M$ 30 per ton (unprocessed)		3598	2217	1504
Manila hemp	0.54 tons fibre	M$1200 per ton	f.o.b.	5510	3629	2600
Freshwater Fish 4/	1200 lbs	M¢ 67 per lb		9189	5630	3800
Bananas	7.5 tons	M$150 (expected)	f.o.b.	8192	5073	3478
		M$100 (ton)	f.o.b.	3310	2006	1342

1/ High density supervision
2/ Low density supervision
3/ Years 0-25 and discounted to date of planting for oil palms, rubber and rice; years 1-15 discounted to years of land development (year 0) for tapioca, manila hemp, freshwater fish, bananas. Factors used in discounting assume even annual flow of expenditure and income except for rice and tapioca.
4/ Ponds constructed using smallholder labour.

APPENDIX 11-2

COST AND REVENUE DATA

METHODS OF ANALYSIS

Gross Margin

Comparisons of the relative profitabilities of the range of crops selected for Jengka present a number of problems. In identifying the true contribution of each crop to development all expenditures and resources which would be made and used, irrespective of the cropping pattern chosen, must be ignored. The gross revenue earned by the crop has been established by valuing the expected yield at the price to the economy, (or to the farmer). Only those costs (termed "variable" costs) which would occur as a result of the decision to grow that particular crop have been deducted from the revenue. These again have been valued at their price to the economy (or to the farmer). Thus costs of initial land clearance, administration and infrastructure are not included. The gross revenue, less the "variable" crop cost is termed the 'gross margin' and is the contribution that the particular crop would make to all the common and overhead costs of development.

Social Pricing

The values used to compare the profitabilities of the different crops have been those which apply to the economy as a whole; these are termed the 'social' values. They have been used because Jengka is a large project, employing public funds on a large scale and represents an important part of the government's general plan for economic development. It is possible to adjust farmer incomes by subsidies and taxes should there be a dichotomy between the optimal pattern for the economy and for the farmer. To ensure the best allocation of the limited resources in the economy it is important that where possible the true economic value of the inputs, as represented by their opportunity cost, should be used. This requires analysis in terms of social cost rather than market values.

Special Assumptions

Two realistic assumptions have been made. First, that the input of farm management would be the same for each crop and consequently can be considered as an overhead cost. Second, that the input of farm labour although varying from crop to crop, has a zero value. This is because the settlers' productive capacity when used elsewhere at the margin is so low as to be insignificant to the economy. Consequently both the cost of unskilled farm labour and management have been excluded from the crop costs, and the gross margin represents the return to labour and management as well as to land and capital.

Discounting of Revenue and 'Variable' cost and Gross Margin

To take account of the widely different production cycles and patterns of both the perennial and annual crops selected, the concept of discounted cash flow has been used. In using this method the gross margins of the various crops over a 25 year period have been discounted to the date of planting. It is very difficult to allocate a precise cost of capital, in that the opportunity cost of capital to the economy as a whole (or to the farmer) is not precisely known. Consequently the gross margins have been discounted at a range of interest rates (5% 10% 15%) to reflect relative profitabilities for differing costs of capital. In evaluating the profitability of crops to the farmer an expected loan rate of interest of 7% has been used.

Oil Palm and Rubber

The following basic data are given in the tables.

Annual Revenue and Variable Cost (Tables 1, 2, 6, 7 and 11) - The revenue in all cases has been calculated by pricing the expected yield in any year during the production cycle (expected yields and prices are given in Chapter 11). Differences in price are caused by different assumptions as to the date of forest clearance (1968, 1971 and 1974).

The social price for both crops is the f.o.b. price.

The sum of the discounted revenue less costs (nett cash flows) for the 25 year period is termed the gross margins for the purposes of comparison.

Revenue, Cost and Gross Margin (Tables 3, 5, 8, 9 and 12) - The detailed make up of the revenue at social and farm prices is shown. The "variable" costs have been divided into two. Those costs which are incurred once the product leaves the farm are termed 'ex farm' costs. The 'on farm' costs (Tables 5 & 9) are those items of expenditure which are incurred up to and including harvesting. The main fluctuations in each stream of cost occur in the early years. These include the cost of setting up processing facilities which are incurred 'ex farm' in the years immediately prior to production and the initial cost of planting material, fertiliser and harvesting roads incurred 'on farm'. No 'on farm' labour has been taken into account because it is assumed that settler labour has zero opportunity cost except for the skilled labour required for planting. Nursery costs are included in the cost of planting material which is the first item of cost incurred in year 1. The discount factors used assume continuous compounding of interest and therefore provide financial equivalence between years in that income and expenditure is incurred evenly throughout the year.

Labour Requirements

Data on labour requirements for primary crops is shown in Tables 4, 10 and 13.

Other Crops

Data on rice and secondary crops is shown in Tables 14-22.

APPENDIX 11-2

Table 1 - Revenue and Variable Costs - Oil palms.

(at Social Prices discounted to date of planting)
FLDA Smallholder

Year	Revenue f.o.b.	Ex Farm Cost	On Farm Cost	Revenue Less Cost Nett Cash Flow	Present Worth of Nett Cash Flow discounted @ 5%	10%	15%
	M$ per acre						
(1971)0			106	(106)	(109)	(111)	(114)
1			198	(198)	(194)	(188)	(184)
2		300	28	(328)	(305)	(285)	(266)
3		300	46	(346)	(308)	(273)	(246)
(1975)4	288	55	81	152	128	109	93
5	554	103	81	370	296	241	196
6	823	125	81	617	469	364	284
7	864	134	81	649	474	350	260
8	901	143	81	677	467	332	237
9	915	148	81	686	453	309	213
10	927	156	81	690	435	276	186
11	918	156	81	681	409	252	157
12	909	156	81	672	383	222	134
13	900	156	81	663	358	199	113
14	891	156	81	654	340	183	98
15	882	156	81	645	316	161	84
16	873	156	81	636	299	146	70
17	864	156	81	627	282	132	63
18	855	156	81	618	266	117	56
19	846	156	81	609	250	104	49
20	846	156	81	609	237	97	43
21	837	156	81	600	222	84	36
22	837	156	81	600	210	78	30
23	837	156	81	600	198	72	24
24	828	156	81	591	189	65	24
25	828	156	81	591	177	59	18
		Gross Margin			5942	3095	1658

APPENDIX 11-2

Table 2 - Revenue and Variable Cost - Oil palms
(at Social Prices discounted to date of planting)
Independent Smallholder 1/

Year	Revenue f.o.b.	Ex Farm Cost	On Farm Cost	Revenue Less Cost Nett Cash Flow	Present Worth of Nett Cash Flow discounted @ 5%	10%	15%
	M$ per acre						
1971-0			106	106	(109)	(111)	(114)
1			198	(198)	(194)	(188)	(184)
2		150	28	(178)	(165)	(155)	(144)
3		150	46	(196)	(174)	(155)	(139)
4	144	27	81	36	30	26	22
5	277	51	81	145	116	94	77
6	412	62	81	269	204	159	124
7	432	67	81	284	207	153	114
8	451	71	81	299	206	147	105
9	458	74	81	303	200	136	94
10	464	78	81	305	192	122	82
11	459	78	81	300	180	111	69
12	455	78	81	296	169	98	59
13	450	78	81	291	157	87	49
14	466	78	81	287	149	80	43
15	441	78	81	282	138	71	37
16	437	78	81	278	131	64	31
17	432	78	81	273	123	57	27
18	428	78	81	269	116	51	24
19	423	78	81	264	108	45	21
20	423	78	81	264	103	42	18
21	419	78	81	260	96	36	16
22	419	78	81	260	91	34	13
23	419	78	81	260	91	31	10
24	414	78	81	255	82	28	10
25	414	78	81	255	77	26	8
			Gross Margin		2319	1089	472

1/ Yields 50 per cent of FLDA expected yields

APPENDIX 11-2

Table 3 - Revenue, Cost and Gross Margin
Maturity (Year 10) - Oil palms

	Social Prices		Farmer/Market Prices	
	M$ per acre/year			
REVENUE (at expected prices)				
9 tons F.F.B. yielding:-				
Oil 1.8 tons @ M$450/ton f.o.b.		810		810
Kernels 0.405 tons @ M$300/ton f.o.b.		122		122
		932		932
Less: Export duty 7½%				70
				862
COST 1. (ex farm)				
Marketing and Port Charges @ M$9.0 ton oil/kernels (farmer)	18		20	
Freight: Triangle to P. Swettenham @ M$15.0 ton oil/kernels (farmer)	29		33	
Processing:				
Recurring @ M$7 ton F.F.B.	63		63	
Capital (M$67 ton F.F.B.) 20 years @ 12% (social) - 7% (farmer)	80		56	
Transport: ex farm to Mill M$4.0 ton F.F.B. (including harvest and collection roads)	56		46	
				218
				644
2. (on farm)				
Fertilizer 0.375 tons @ M$210 ton (farmer) M$190 ton (social)	71			79
		317		
		615		565
GROSS MARGIN				
Return to Capital (Cost of clearing and Land Development), farm labour, and Management.				
GROSS MARGIN: at (M$500/ton oil)f.o.b. (M$325/ton kernels)		713		658
at (M$400/ton oil)f.o.b. (M$265/ton kernels)		510		469

APPENDIX 11-2

Table 4 - Labour Requirements - Oil palms

A <u>Labour Inputs</u>

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6-10	Year 10-25
	Man Days Per Acre						
Planting (incl. covers)	11						
Weeding	24	24	12	7	7	7	7
Pollination			3	3			
Castration		2½	2½				
Manuring, Lalang and Pests and Diseases	3	3	2½	2½	2½	2½	2½
	38	29½	20	12½	9½	9½	9½
Harvesting (average)				7	9	11½	16
	38	29½	20	19½	18½	21	25½

B <u>Peak Labour Requirements</u> 1/

	Age of Palms		
Harvesting	4 - 5 years	6 - 10 years	10 - 25 years
No. of Bunches in Peak Month	100	90	75
No. of Bunches Harvested per man day (incl. loose fruit collection + 4 chain carry)	115	57	37
Acres harvested per man:-			
Maximum of 25 days 2/ harvesting per month	29	16	12
Maximum of 12 days 2/ harvesting per month	14	8	6
Maximum of 6 days 2/ per month	7	4	3

1/ Fruit collection which comprises one half of the harvesting requirements is normally done by women or children. These figures may effectively be doubled for a settler with his wife and children.

2/ This will be determined by the number of days that transport is provided to collect fresh fruit bunches from any given holding.

Table 5 - 'On farm' cost during planting and immature period - Oil palms (M$ per acre)

		Farmer/Market Prices		Social Prices	
Year 0	(Year of Clearing)				
	Felling and Burning	84		84	
	Pruning, Reburning	83		83	
	Terracing 1/	72		72	
	Harvesting roads 2/	106	345	106	345
Year 1	(Year of Planting)				
	Plants planted in field (incl. lining)	120		120	
	Establishment of cover crops 1/	55		55	
	Fertilizer of plants and covers	15	190 +10	13	188
Year 2					
	Fertilizer 3-4 lbs. per plant	20	20 +10	18	18
Year 3					
	Fertilizer 6-7 lbs. per plant	40	40 +10	36	36
Year 4	(Onwards)				
	Fertilizer 12-15 lbs. per plant	79	79 +10	71	71

The cost of weeding (all labour) is excluded

Ex farm cost) excluding the capital element of processing is) M$18 per ton FFB at Social Prices) including the capital element of processing is) M$23 per ton FFB at Farmer Prices

1/ Best available estimates as at 1/9/66. Final estimates used for project financial analysis slightly revised

2/ Thereafter maintenance at M$10 per acre/year

APPENDIX 11-2

Table 6 - Revenue and Variable Costs - Rubber (budgrafted) at Social Prices discounted to date of planting

FLDA Smallholder

Year	Revenue f.o.b. incl. Scrap	Ex Farm Cost	On Farm Cost	Revenue Less Cost Nett Cash Flow	Present Worth of Nett Cash Flow Discounted @ 5%	10%	15%
	M$ per acre						
0 1971			26	(26)	(27)	(27)	(28)
1			109	(109)	(107)	(104)	(101)
2			44	(44)	(41)	(38)	(36)
3			44	(44)	(39)	(35)	(31)
4			44	(44)	(37)	(32)	(27)
5		110	44	(184)	(147)	(120)	(98)
6 1977	161	15	39	107	81	63	49
7	386	37	36	313	228	169	125
8	505	50	36	419	289	205	147
9	605	61	36	508	335	229	157
10	683	69	36	578	364	231	156
11	718	74	36	608	365	225	140
12	748	76	36	636	363	210	127
13	750	78	36	636	343	191	108
14	743	78	36	629	327	176	94
15	739	78	36	625	306	156	81
16	735	78	36	621	292	143	68
17	728	78	36	614	276	129	61
18	724	78	36	610	262	116	55
19	719	78	36	605	248	103	48
20	707	77	36	594	232	95	42
21	691	76	36	579	214	81	35
22	673	75	36	562	197	73	28
23	656	74	36	546	180	66	22
24	639	72	36	531	170	58	21
25	626	70	36	520	156	52	16
				Gross Margin	4830	2415	1259

Table 7 - Revenue and Variable Costs - Rubber (budgrafted)
(at Social Prices discounted to date of planting)
Independent Smallholder 1/

Year	Revenue f.o.b. incl. Scrap	Ex Farm Cost	On Farm Cost	Revenue Less Cost Nett Cash Flow	Present Worth of Nett Cash Flow Discounted @ 5%	10%	15%
	M$ per acre						
1971-0			26	(26)	(27)	(27)	(28)
1			109	(109)	(107)	(104)	(101)
2			44	(44)	(41)	(38)	(36)
3			44	(44)	(39)	(35)	(31)
4			44	(44)	(37)	(32)	(27)
5		70	44	(114)	(91)	(74)	(60)
6	80	8	39	33	25	19	15
7	193	19	36	138	101	75	55
8	253	20	36	197	136	97	69
9	303	31	36	236	156	106	73
10	342	35	36	271	171	108	73
11	359	37	36	286	172	106	66
12	374	38	36	300	171	99	60
13	375	39	36	300	162	90	51
14	372	39	36	297	154	83	45
15	370	39	36	295	145	74	38
16	368	39	36	293	138	67	32
17	364	39	36	289	130	61	29
18	362	39	36	287	123	55	26
19	360	39	36	285	117	48	23
20	354	39	36	279	109	45	20
21	346	38	36	272	101	38	16
22	337	38	36	263	92	34	13
23	328	37	36	255	84	31	10
24	320	36	36	248	79	27	10
25	313	35	36	242	73	24	7
			Gross Margin		2097	977	448

1/ Yields at 50 per cent of FLDA expected yield.

APPENDIX 11-2

Table 8 - Revenue, Cost and Gross Margin at Maturity - Rubber (budgrafted)

	Social Prices		Farm/Market Prices	
	M$ per acre/year			
REVENUE (at expected prices)				
LATEX (d.r.c.) 1,400 lbs. @ M¢ 50 lb. f.o.b.		700		700
Scrap 245 lbs.		70		70
		770		770
Less: Export duty 4%			30	
Cesses M¢ $5\frac{3}{8}$ lb.			88	118
				652
COST 1. (ex farm)				
Marketing and Port Charges @ M¢ 1.0 lb.	11		16	
@ M¢ 0.7 lb. (to farmer)	10		12	
Processing:				
Recurring @ M¢ 2.5 per lb. latex and scrap (d.r.c.)	41		41	
Capital (M$140 per acre) 20 years @ 12% (social) 7% (farmer)	19		13	
Transport of Latex ex farm (incl. Collecting stns. Harvest roads)	18		16	98
				554
2. (on farm)				
Fertilizer 320 lbs. @ M$210/ton (to farmer) M$190 per ton (social)	27		30	
Other materials (Sprays, Weedicides, etc.)	7	133	7	37
		637		517
GROSS MARGIN				
Return to Capital (Cost of Clearing and Land Development), farm labour, management and other overheads.				
GROSS MARGIN: at M¢ 55/lb. f.o.b.		706		537
at M¢ 45/lb. f.o.b.		552		443

APPENDIX 11-2

Table 9 - 'On farm' cost during planting and immature period - Rubber (budgrafted) (M$ per acre)

		Farmer/Market Prices		Social Prices	
Year 0	(Year of Clearing)				
	Felling and Burning	84			
	Pruning and Reburning	83			
	Terracing (say 2/3 land) 1/	110			
	Harvesting roads 2/	26	303		303
Year 1	(Year of Planting)				
	Budded stumps in field	36		36	
	Cover crops establishment 1/	42		42	
	Fertilizer (incl. covers) 320 lbs.	30		27	
	Weedicides and Spraying	2	110	2	107
Years 2 & 3					
	Fertilizer 320 lbs. plus cover crop	30		27	
	Weedicides, Spraying and supplying	15	45	15	42
Years 4 & 5					
	Fertilizer 320 lbs.	30		27	
	Weedicides and Spraying	15	45	15	42
Year 6					
	Fertilizer 320 lbs.	30		27	
	Weedicides and Spraying	10	40	10	37
Year 7	(Onwards)				
	Fertilizer 320 lbs.	30		27	
	Weedicides and Spraying 1/	7	37	7	34

The cost of weeding (all labour) is excluded

Ex farm cost) excluding the capital element of processing is M¢ 4.74 per lb. at Social Prices
) including the capital element of processing is M¢ 5.83 per lb. at Farmer Prices

1/ Best available estimates as at 1/9/66. Final estimates for project financial analysis slightly revised.

2/ Maintenance of roads thereafter at M$ 2 per acre.

APPENDIX 11-2

Table 10 - Labour Requirements - Rubber (budgrafted)

A. Even Labour Requirements Year	Planting (incl. covers)	Weeding	Manuring Pest and Diseases Pruning, etc.	Tapping and Collecting	Total Man Days per acre (All Non Seasonal)
	Man days per acre				
First	15	23	7	-	45
Second	-	33	12	-	45
Third	2	21	12	-	35
Fourth	-	13	12	-	25
Fifth	-	9	6	-	15
Sixth	-	5	5	23	33
Seventh (Onwards)	-	2	4	45	51

B. Peak Labour Requirements

Tapping tasks 3/ Acres per tapper per day 3-4 (360 - 480 trees).

Max. area per tapper tapping alternate Daily S_2 d_2 1/ is 6-8 acres 5/

Max. area per tapper tapping third Daily S_2 d_3 2/ is 9-12 acres.

1/ Alternate daily is currently recommended for Budgrafted rubber.

2/ Third daily tapping of Budgrafted rubber is expected to lead to reduction in yield per tree and per acre.

3/ Expert tappers are known to be able to do 5 acres per day (i.e. 600 trees at 120 trees per acre).

4/ Required in second half year only.

5/ Acreage per tapper on estates ranges from 5.5 acres on small estates to 10 acres on large estates.

APPENDIX 11-2

Table 11 - Revenue and Variable Costs - Rubber (clonal seedling) (at Social Prices discounted to date of planting)

FLDA Smallholder

Year	Revenue f.o.b. incl. Scrap	Ex Farm Cost	On Farm Cost	Revenue Less Cost Nett Cash Flow	Present Worth of Nett Cash Flow Discounted @ 5%	10%	15%
	M$ per acre						
(1971) 0			26	(26)	(27)	(27)	(28)
1			142	(142)	(139)	(135)	(132)
2			44	(44)	(41)	(38)	(36)
3			44	(44)	(39)	(35)	(31)
4		140	44	(184)	(155)	(132)	(112)
(1976) 5	134	13	44	77	62	50	41
6	353	34	39	280	213	165	129
7	466	45	36	385	281	208	154
8	595	59	36	500	345	245	175
9	663	67	36	560	370	252	174
10	694	71	36	587	370	235	158
11	689	71	36	582	349	215	134
12	685	71	36	578	329	191	116
13	680	71	36	573	309	172	97
14	675	71	36	568	295	159	85
15	670	71	36	563	276	141	73
16	666	71	36	559	263	129	61
17	661	71	36	554	249	116	55
18	656	71	36	549	236	104	49
19	652	71	36	545	223	93	44
20	647	71	36	540	211	86	38
21	637	71	36	530	196	74	32
22	624	69	36	519	182	67	26
23	605	68	36	501	165	60	20
24	589	67	36	486	156	53	19
25	579	65	36	478	143	48	14
				Gross Margin	4822	2496	1355

APPENDIX 11-2

Table 12 - Revenue, Cost and Gross Margin at Maturity (Year 10) - Rubber (clonal seedling)

	Social Prices		Farm Prices	
	M$ per acre/year			
REVENUE (at expected prices)				
1,270 lbs. @ M¢ 50 lb. f.o.b.		635		635
Scrap 230 lbs. @ M¢ 28 lb.		65		65
		700		700
Less: Export duty 4%)			28	
Cesses M¢ $5\frac{3}{8}$ lb.)			81	
				109
				591
COST 1. (ex farm)				
Marketing and Port Charges M¢ 1.0 per lb.	9		15	
Freight: Triangle to Port Swettenham @ M¢ 0.7 per lb. (to farmer)	9		10	
Processing:				
Recurring @ M¢ 2.5 per lb.	38		38	
Capital ($130 per acre) 20 years 12% (social) 7% (farmer)	18		12	
Transport of Latex ex farmer @ M¢ 1.5 per lb.	17		17	
				92
				499
2. (on farm)				
Fertilizer 320 lbs. @ M¢ 210 per ton (farmer)	27		30	
Other Materials (Sprays, Weedicides, etc.)	7	125	7	
		575		37
				462

GROSS MARGIN

Return to Capital, (Cost of clearing and Land Development), Farmer Labour, Management and Other overheads.

		Social Prices	Farm Prices
GROSS MARGIN:	at M¢ 55 lbs. f.o.b.	655	529
	at M¢ 45 lbs. f.o.b.	505	399

APPENDIX 11-2

Table 13 - Labour Requirements - Rubber (clonal seedling)

		Type of Work				Total
A.	Even Labour Requirements Year	Planting (incl. covers)	Weeding	Manuring Pest and Diseases Pruning etc.	Tapping and Collecting	Man Days Per Acre (All Non Seasonal)
				Man days per acre		
	First	15	23	7		45
	Second		33	12		45
	Third	2	21	12		35
	Fourth		13	12		25
	Fifth		5	5	15 3/	25
	Sixth (Onwards)		2	4	30	36

B. Peak Labour Requirements

Tapping Tasks 2/ Acres per Tapper Per day 1/ 3-4 (360-480 trees)

Maximum area per tapper third daily tapping S_2 d_3 is 9 - 12 acres.

1/ Alternate daily tapping is not recommended for clonal seedling due to threat of brown bust disease.

2/ Expert tappers are known to be able to do 5 acres per day (i.e. 600 trees at 120 trees per acre).

3/ Second half year only.

APPENDIX 11-2

Table 14 - Revenue and Variable Cost - Rice
(at Social Prices discounted for 25 years to date of planting)

	Year	Revenue	Ex Farm Cost	On Farm Cost	Nett Cash Flow	Present Worth of Nett Cash Flow Discounted @ 5%	10%	15%
	(M$ per acre)							
Irrigated	0			500	(500)	512	525	537
Doubled Cropped	1		411	413	(824)	807	783	766
	2		31	136	(167)	155	145	135
	3		41	136	(177)	158	140	126
	4-25		47	136	(183)	2134	1268	820
						(3766)	(2861)	(2310)
	1	138			138	133	128	124
	2	374			374	344	318	295
	3	495			495	430	380	366
	4-25	564			564	6497	3813	2442
						7404	4640	3227
				Gross Margin		3638	1779	843
Unirrigated								
Single Crop	1		186	357	(543)	632	516	505
	2		16	47	(63)	58	55	51
	3-25		20	47	(67)	838	513	348
						(1428)	(1084)	(904)
	1		138		138	134	128	124
	2		190		190	175	162	150
	3-25		243		243	3003	1827	1219
						3312	2117	1493
				Gross Margin		1884	1033	589

APPENDIX 11-2

Table 15 - Revenue, Cost and Gross Margin - Rice (double cropped)

	Social Prices		Farm Prices	
Expected c.i.f. Price in M$ per ton		420		460
Freight to Jengka in M$ per ton		8		20
Jengka Price in M$ per ton		428		480
		M$ per acre/year		
REVENUE				
Main Crop 0.875 tons padi (Rice 60%) 2nd Crop 1.162 tons padi (Rice 60%)		524		588
Broken rice, Bran, etc. M$20 per ton Padi		40		40
		564		628
COST (ex farm)				
1. Variable with Crop				
Transport ex mill M$2.0 ton rice	3		3	
Milling:				
Recurring Cost M$20 ton Padi	40		40	
Capital Cost (M$200 per ton Padi)	55		38	
Transport to Mill M$2.0 ton Padi	4		4	
				85
				543
2. (on farm) Seed	6		6	
Fertilizer and Sprays (incl. Equipment)	70		76	
Ploughing	60		60	
Irrigation:-				
Capital Cost (M$800 per acre)	102		68	
Maintenance	12	352	12	222
		212		321

GROSS MARGIN

(Return to Capital, farm labour, Management, and other overheads).

APPENDIX 11-2

Table 16 - Revenue, Cost and Gross Margin - Rice (single cropped)

		Social Prices		Farm Prices
Expected Jengka Prices M$ per ton		428		480
		M$ per acre/year		
REVENUE				
0.875 tons padi (Rice 60%)		225		252
Broken Rice and Bran M$20 ton padi		18		18
		243		270
COST (ex farm)				
1. Variable with yield	1		1	
Transport ex Mill M$2.0 ton Rice				
Milling:-				
Recurrent Costs M$20 ton padi	17		17	
Capital Cost (M$200 ton padi)	23		16	
Transport to Mill M$2.0 ton padi	2		2	
				36
				234
2. Variable with area (on farm)				
Seed	3		3	
Fertilizer and Sprays and equipment	44		48	
		90		51
		133		183

APPENDIX 11-2

Table 17 - Labour Requirements - Rice

Period (half months)	Single Crop Operation	Single Crop Man Days/acre	Double Cropped Operation	Double Cropped Man Days/acre
July 1	Nursery	1½		
Aug. 1	Ploughing	2	Nursery	1½
Sept. 1	Harrowing	2	Ploughing	2
	Transplanting) Fertilizer)	9½	-	
Oct. 1	Weeding)	7	Harrowing	
2	)		Transplanting) Fertilizer)	9½
Nov. 1,2	Weeding and Fertilizer	8	Weeding	7
Dec. 1,2	Pests	5	Weeding, Pests and Fertilizer	7
Jan. 1	Harvest	15 1/	Harvest	15 1/
2			Nursery	1½
Feb. 1	Winnow	5	Winnow and Ploughing	7
Mar. 1			Harrowing	2
2			Transplant & Fertilizer	9½
Apr. 1, 2			Weeding	7
May 1, 2			Weeding & Fertilizer	7
June 1, 2			Pests	5
July 1			Harvest	15 1/
2			Winnow	5
Annual Total		55		105

1/ Peak period requiring one man equivalent per acre, unless harvesting operations on two or more plots can be staggered over two (half month) periods. Harvesting also includes threshing.

APPENDIX 11-2

Table 18 - Revenue, Cost and Gross Margin - Tapioca

	Social Prices		Farm Prices	
	M$ per acre/year			
REVENUE (expected prices) 12 tons Roots				
(1.8 tons flour) M$240/ton		432		432
(3 tons Dry Refuse) M$ 35/ton		105		105
		537		537
COST 1. (ex farm) Variable with Yield				
Processing:				
Recurring Costs M$8/ton Roots	96		96	
Capital (M$17/ton Roots)	41		27	
Transport M$20 per ton flour	18		36	
				159
Value in factory (unprocessed)				378
Transport ex farm M$2/ton Roots				24
Value ex farm				354
2. (on farm)				
Ploughing	60		60	
Fertilizer 0.3 ton @ M$210	57		65	
		296		125
		241		229

GROSS MARGIN

Return to Capital (Cost of clearing and Land Development), farm labour, management, and other overheads.

		Social Prices	Farm Prices
GROSS MARGIN :	Yield 15 tons Roots	330	317
	Yield 9 tons Roots	151	140

APPENDIX 11-2

Table 19 - Revenue, Cost and Gross Margin [1] - Manila Hemp

	Social Prices		Farm Prices	
	M$ per acre/year			
REVENUE (at expected prices)				
0.5 tons fibre @ M$1200 f.o.b. (average 12 years)		696		696
COST 1. (ex farm) Variable with Yield				
Marketing and Port Charges) M$25 per Transport ex Jengka to Port) ton	14		14	
Processing: Capital (M$45 ton fibre)	4		3	
Recurrent) Field Transport) M$190 ton fibre	102		102	
				119
				577
2. (on farm)	77			86
Fertilizer		187		___
		509		491
		===		===

GROSS MARGIN

Return to Capital (Cost of Clearing and Land Development), farm labour, management, and other overheads.

		Social Prices	Farm Prices
GROSS MARGIN	Average Yield 0.7 tons fibre) Price M$1,500 per ton fibre) f.o.b.)	816	810
	Average Yield 0.4 tons fibre) Price M$1,000 per ton fibre) f.o.b.)	233	226

[1] Calculated on yield in year 7.

APPENDIX 11-2

Table 20 - Revenue, Cost and Gross Margin 1/ - Freshwater Fish

	Social Prices		Farm Prices
	M$ per acre/year		
REVENUE (at expected prices)			
1200 lbs. fish @ M$0.56 per lb. ($0.75 per kati)		808	808
COST 1. (ex farm)			
Variable with yield			
Marketing and distribution (say 10% revenue to farmer)	37		81
			727
2. (on farm)			
Fertilizer	40	44	
Nets (M$35 per acre) (life five years)	10	15	
Pond Construction and Water System (life 20 years) :-			
a. Materials (M$636 per acre)	80	55	
		167	114
GROSS MARGIN (a) (pond constructed with own labour)		641	
b. Labour (M$1200 per acre)		-	115
GROSS MARGIN (b) (pond constructed with own labour)		641	508
GROSS MARGIN ( ) Yield 1500 lbs/acre		840	805
Yield 700 lbs/acre		452	441

1/ Calculated in year 2

APPENDIX 11-2

Table 21 - Revenue Costs and Crops Margin [1] - Bananas

		Social Prices		Farm Prices
		M$ per acre/year		
REVENUE (at expected prices)				
7.5 tons @ M$150 per ton f.o.b. Singapore		1,125		1,125
COST 1. (ex farm) Variable with Yield				
Packing and Marketing Port Charges etc. M$11 per ton (Social) M$10 per ton (Farmer)	85		115	
Transport Triangle to Singapore M$40 per ton (Social) M$46 per ton (Farmer)	300		345	
				460
				665
2. (on farm)				
Fertilizer 0.5 tons @ M$210 per ton (to farmer)	95			105
		480		
		645		560
GROSS MARGIN				
Return to Capital (Cost of clearing and Land Development), farm labour, and management and other overheads.				
GROSS MARGIN: at High Prices M$250 per ton		1,395		1,310
at Low Prices M$100 per ton		270		185

[1] Calculated at maturity in year 2.

APPENDIX 11-2

Table 22 - Revenue and Variable Costs - Secondary Crops (at Social Prices discounted to date of planting)

	Year	Revenue	ex farm cost	on farm cost	Nett Cash Flow	Present Worth of Nett Cash Flow Discounted to date of planting @ 5%	10%	15%
				M$ per acre				
Manila Hemp	0							
	1			133	(133)	(130)	(126)	(123)
	2	372	68	113	191	177	166	155
	3	1296	237	77	982	874	776	697
	4	876	161	77	638	535	459	389
	5	732	134	77	521	417	338	276
	6	708	130	77	501	381	295	230
	7	696	127	77	492	359	265	197
	8	612	112	77	423	292	208	147
	9	540	100	77	363	239	163	112
	10	491	90	77	324	205	130	86
	11	420	78	77	265	159	98	60
	12	372	68	77	227	129	75	45
	14-25	(as above)			(133)-227	1873	782	329
				Gross Margin		5510	3629	2600
Tapioca	1-12	537	42		495	4386	3366	2673
	14-25	537	42		495	2326	975	426
						6712	4341	3099
	1		387		(387)	379	367	360
	2-12		96	117	(213)	1718	1318	1037
	14-25		96	117	(213)	1017	439	198
						3114	2124	1595
				Gross Margin		3598	2217	1504
Freshwater Fish (labour cost of pond construction - zero)						651	668	685
	0			636	(636)		(636)	(636)
	1	404		70	334	323	314	304
	2-25	808		87	721	9517	5984	4181
				Gross Margin		9189	5630	3800
Bananas M$ 150 per ton	1	562	185	250	127	124	120	118
	2-25	1125	385	95	645	8068	4953	3478
				Gross Margin		8192	5073	3478
M$ 100 per ton	1	375	185	250	(70)	(68)	(67)	(65)
	2-28	750	385	95	270	3378	2073	1407
				Gross Margin		3310	2006	1342

APPENDIX 13

SMALLHOLDINGS

APPENDIX 13-1

DETERMINATION OF SMALLHOLDING SIZE

The tables and figures set out in this appendix provide the supporting data from which the tables and figures shown in Chapter 13 of Volume II have been derived.

In particular certain figures in Chapter 13 have been plotted directly from the following:

Figure 13.1	plotted	from	table	3
13.2	"	"	"	4
13.3	"	"	"	8
13.4	"	"	"	9
13.5	"	"	appendix Figures 1 and 2	
13.8	"	"	table	10
13.9	"	"	"	11

<u>Farm incomes (Rubber and oil palms)</u>

To facilitate the calculations required to determine the interaction of holding size, farm income and repayment capacity over uneven streams of farm income and expenditure, the concept of present worth has been used throughout the analysis. Those items of revenue less cost which change per unit of land have been calculated separately from those costs which are incurred per unit of labour i.e. per settler. The former are calculated in tables showing a) the farmers gross margin and b) the return per acre to settler labour and capital. The farm gross margin is calculated in a similar way to the social gross margin. Additional costs are incurred in duties and cesses. The 'ex' farm unit costs include capital elements which earn a return of 7%. An exception is the initial cost of oil palm harvesting roads which is shown as a separate item and discounted. This is because the cost does not vary with the increase in production and therefore is more realistically considered as a single payment than an annual cost.

In Tables 1 and 2 the settler's gross margins for rubber and oil palm are shown for the 25 year period and the total capitalized (discounted) to year 1 at 7% for both rubber and oil palm. The costs of management are deducted to leave a return to agricultural labour and capital.

In Tables 6 and 7 cash expenditure on the main crop attributable to each settler is calculated similarly. This includes the cost of the settler's house, the cost of clearing the houselot and village area, the settler's income during the immature period and four levels of income during the production period. With the exception of one cash income which starts and remains constant at M$2400 throughout the repayment period, these all start at $1,200 per settler in the second year of production and rise respectively to $3,600, $2,400 and $1,800 in the 25th year after planting.

The returns to FLDA for each holding size and income level are given in Figure 1 and 2 by the interest rates at the points of intersection between settler's cash income and the return to capital and labour of different sizes of holding.

The features of investment and repayment periods of the 10 acre holdings selected are shown in Tables 10 and 11.

APPENDIX 13-1

Table 1 - Settler's Gross Margin and Return to Labour and Capital - Rubber (budgrafted)

(M$ per acre)

Year	Revenue @ f.o.b. Prices A	Duty 4% A.V. B	Cesses @ ¢ 5.375 per lb. C	Ex Farm Costs @ ¢ 5.83/lb. D	on Farm Cost E	Gross Margin A - (BCDE) F	Cost of Management G	Return to Labour and Capital H = (F - G)	Present Worth Discounted to date of planting @ 5%	7%	10%
1971-0					303 1/	(303)	322	(625)	(644)	(650)	(656)
1					112 1/	(112)	104	(216)	(221)	(219)	(215)
2					47 1/	(47)	100	(147)	(137)	(132)	(128)
3					47 1/	(47)	107	(154)	(137)	(129)	(122)
4					47 1/	(47)	100	(147)	(123)	(116)	(106)
5					47 1/	(47)	82	(129)	(103)	(95)	(84)
6	161	6	17	19	42 1/	77	73	4	3	3	2
7	386	15	43	46	39	243	73	170	124	109	92
8	505	20	57	62	39	327	70	257	177	154	126
9	605	24	70	75	39	397	70	327	216	183	147
10	683	27	79	86	39	452	70	382	241	202	153
11	718	29	84	91	39	475	70	405	243	198	150
12	748	30	87	94	39	498	70	428	244	197	141
13	750	30	88	96	39	497	67	430	232	185	129
14	743	30	88	96	39	490	67	423	220	169	118
15	739	30	88	96	39	486	67	419	205	159	105
16	735	29	88	96	39	483	67	416	196	146	96
17	728	29	88	96	39	476	67	409	184	135	86
18	724	29	88	96	39	472	67	405	174	126	77
19	719	29	88	96	39	467	67	400	164	116	68
20	707	28	88	95	39	457	67	390	152	105	62
21	691	28	86	94	39	444	67	377	137	93	52
22	673	27	85	92	39	430	67	363	127	83	47
23	656	26	83	90	39	418	67	351	116	77	42
24	639	25	82	88	39	405	67	338	108	68	37
25	626	25	80	87	39	395	67	328	98	62	33
							Alternate day tapping.		2133	1229	452
							Third day tapping (assumes 7½ per cent fall in yield of rubber).		1525	860	184

1/ Years before bearing.

APPENDIX 13-1

Table 2 - Settler's Gross Margin and Return to Labour and Capital - Oil Palms

(M$ per acre)

Year	Revenue @ f.o.b. prices A	Duty 7½% A.V. B	Ex farm cost $22 per ton FFB C	On farm cost D	Gross Margin A-(BCD) E	Cost of Manage-ment F	Return to Labour and Capital (E-F) G	Present Worth discounted to date of planting @ 5%	7%	10%
1970-0				345 1/	(345)	322	(767)	(790)	(798)	(805)
1				200 1/	(200)	104	(304)	(298)	(295)	(289)
2				30 1/	(30)	100	(130)	(121)	(117)	(113)
3				50 1/	(50)	107	(157)	(140)	(132)	(124)
4	288	22	78	89 1/	99	100	(1)	(1)	(1)	(1)
5	554	41	137	89	287	82	205	164	152	133
6	823	62	167	89	505	73	432	328	298	254
7	864	65	178	89	532	73	459	335	294	248
8	901	67	188	89	557	70	487	336	292	239
9	915	68	194	89	564	70	494	326	277	222
10	927	70	198	89	570	70	500	315	265	200
11	918	69	198	89	562	70	492	295	241	182
12	908	68	198	89	553	70	483	276	223	160
13	900	67	198	89	546	67	479	259	206	144
14	890	67	198	89	536	67	469	244	188	131
15	882	66	198	89	529	67	462	226	176	116
16	873	65	198	89	521	67	454	213	159	104
17	864	65	198	89	512	67	445	200	147	93
18	855	64	198	89	504	67	437	188	135	83
19	846	63	198	89	496	67	429	176	124	73
20	846	63	198	89	496	67	429	167	116	69
21	837	63	198	89	487	67	420	155	105	59
22	837	63	198	89	487	67	420	147	97	55
23	837	63	198	89	487	67	420	139	92	50
24	828	62	198	89	479	67	412	132	82	45
25	828	62	198	89	479	67	412	124	78	41
								3330	2345	1319

1/ Years before bearing

APPENDIX 13-1

Table 3 - Farm Gross Margin on Rubber Holdings

(M$ per year)

Year		Gross Margin from Houselot			Acres of Main Crop			
		Consumed	Sold	Total	6	8	10	12
					Farm Gross Margin from Main Crop and Houselot			
(1971)	0	-	-	-	(1820)	(2420)	(3030)	(3636)
	1	-	-	-	(660)	(880)	(1100)	(1320)
	2	80	-	80	(200)	(300)	(390)	(480)
	3	100	-	100	(180)	(280)	(370)	(460)
	4	120	-	120	(140)	(260)	(350)	(440)
	5	120	20	140	(120)	(240)	(330)	(420)
(1977)	6	120	40	160	620	740	930	950
	7	120	60	180	1580	2050	2610	2780
	8	120	80	200	2160	2820	3470	3690
	9	120	100	220	2600	3400	4190	4470
	10	120	110	230	2940	3850	4750	5080
	11	120	120	240	3090	4040	4990	5340
	12	120	130	250	3240	4230	5230	5600
	13	120	140	260	3240	4240	5230	5600
	14	120	150	270	3210	4190	5170	5530
	15	120	160	280	3200	4170	5140	5500
	16	120	170	290	3200	4170	5140	5470
	17	120	180	300	3160	4110	5060	5410
	18	120	190	310	3140	4090	5030	5400
	19	120	200	320	3120	4060	4990	5340
	20	120	210	330	3070	3990	4900	5240
	21	120	220	340	3000	3890	4780	5100
	22	120	230	350	2930	3790	4650	4970
	23	120	230	350	2860	3690	4530	4840
	24	120	230	350	2780	3590	4400	4690
	25	120	230	350	2720	3510	4300	4570

Note: a) Budgrafted rubber assumed in all tables in Appendix 13.1

b) 7½ per cent fall in yield assumed with 12 acres of rubber due to three day tapping.

APPENDIX 13-1

Table 4 - Farm Gross Margin on Oil Palm Holdings

(M$ per year)

Year		Gross Margin from Houselot			Acres of Main Crop			
		Consumed	Sold	Total	6	8	10	12
					Farm Gross Margin Main Crop and Houselot			
(1971)	0	-	-	-	(2070)	(2760)	(3450)	(4140)
	1	-	-	-	(1140)	(1600)	(2000)	(2400)
	2	80	-	80	(100)	(160)	(220)	(280)
	3	100	-	100	(200)	(300)	(400)	(500)
(1975)	4	120	-	120	710	830	1110	1310
	5	120	20	140	1860	2430	3010	3580
	6	120	40	160	3190	4200	5210	6220
	7	120	60	180	3370	4440	5500	6560
	8	120	80	200	3540	4660	5770	6880
	9	120	100	220	3600	4730	5860	6990
	10	120	110	230	3650	4790	5930	7070
	11	120	120	240	3620	4740	5860	6980
	12	120	130	250	3570	4680	5790	6900
	13	120	140	260	3540	4630	5720	6810
	14	120	150	270	3490	4570	5640	6710
	15	120	160	280	3450	4510	5570	6630
	16	120	170	290	3420	4460	5500	6540
	17	120	180	300	3370	4400	5420	6440
	18	120	190	310	3330	4340	5350	6360
	19	120	200	320	3300	4290	5280	6270
	20	120	210	330	3310	4300	5290	6280
	21	120	220	340	3260	4240	5210	6180
	22	120	230	350	3270	4250	5220	6190
	23	120	230	350	3270	4250	5220	6190
	24	120	230	350	3220	4180	5140	6100
	25	120	230	350	3170	4180	5140	6100

APPENDIX 13-1

Table 5 - Rubber - Refund of replanting Cess to FLDA

(M$ per acre)

Year	Amount @ M ¢ 4.5 per lb.	Present worth discounted to date of Planting 5%	7%	10%
6	15	11	10	9
7	36	26	23	19
8	48	33	29	24
9	58	38	32	26
10	66	41	35	26
11	70	42	34	26
12	73	42	34	24
13	74	40	32	22
14	74	38	30	21
15	74	36	28	19
16	74	35	26	17
17	74	33	24	16
18	74	32	23	14
19	74	30	21	13
20	73	28	20	12
21	72	27	18	10
22	71	25	16	9
23	70	23	15	8
24	68	22	14	7
25	67	20	13	7
		622	477	329

State Land Rent 1/ (Assumed Rent - M$ per acre)

Rubber				
6	66	50	45	39
7-25	6	56	43	26
		106	88	65
Oil Palm				
4	66	55	52	48
5-25	6	64	51	37
		119	103	85

1/ excluded from analysis of smallholding as amount uncertain

APPENDIX 13-1

Table 6 - Cost of Farm Labour on Rubber Holdings

Cash income per settler including cost of subsistence payment, house and cash income from main crop

Year	Income per settler plus house and tools			
	I M$2400 throughout	II Rising to M$3600 p.a.	III Rising to M$2400 p.a.	IV Rising to M$1800 p.a.
0	1880 1/	1880 1/	1880 1/	1880 1/
1	600 2/	600 2/	600 2/	600 2/
2	1300 2/	1300 2/	1300 2/	1300 2/
3	1100 2/	1100 2/	1100 2/	1100 2/
4	700 2/	700 2/	700 2/	700 2/
5	500 2/	500	500	500
6	700	700	700	700
7	2400	1200	1200	1200
8	2400	1500	1300	1300
9	2400	1600	1400	1400
10	2400	1700	1450	1430
11	2400	1900	1500	1460
12	2400	2000	1550	1500
13	2400	2100	1600	1520
14	2400	2200	1650	1550
15	2400	2400	1700	1570
16	2400	2500	1750	1600
17	2400	2600	1800	1620
18	2400	2800	1850	1650
19	2400	2900	1900	1670
20	2400	3000	1950	1700
21	2400	3100	2000	1720
22	2400	3200	2100	1750
23	2400	3400	2200	1770
24	2400	3600	2400	1800
25	2400	3600	2400	1800
Present worth 5%	28898	27978	22285	20[illegible]35
discounted to 7%	23624	22415	18924	17362
date of planting 10%	18151	11869	14255	13073

1/ Capital cost of house and clearing and destumping houselot area.
2/ Income being payment for maintenance work done or subsistence allowance.

APPENDIX 13-1

Table 7 - Cost of Farm Labour on Oil Palm Holdings

Cash income per settler including cost of subsistence payment and house

Year	Income per settler plus house and tools			
	I M$2400 throughout	II Rising to M$3600 p.a.	III Rising to M$2400 p.a.	IV Rising to M$1800 p.a.
0	1880 1/	1880 1/	1880 1/	1880 1/
1	600 2/	600 2/	600 2/	600 2/
2	900 2/	900 2/	900 2/	900 2/
3	600 2/	600 2/	600 2/	600 2/
4	2400	1000	1000	1000
5	2400	1200	1200	1200
6	2400	1400	1300	1300
7	2400	1500	1400	1400
8	2400	1600	1450	1430
9	2400	1800	1500	1460
10	2400	1900	1550	1500
11	2400	2000	1600	1520
12	2400	2100	1650	1550
13	2400	2200	1700	1570
14	2400	2300	1750	1600
15	2400	2400	1800	1620
16	2400	2500	1850	1650
17	2400	2600	1900	1670
18	2400	2800	1950	1700
19	2400	2900	2000	1720
20	2400	3000	2050	1760
21	2400	3100	2100	1770
22	2400	3200	2150	1800
23	2400	3400	2200	1800
24	2400	3500	2400	1800
25	2400	3600	2400	1800
Present worth 5%	31167	29274	23657	22005
discounted to 7%	25653	23521	19418	18253
date of planting 10%	19871	17719	15074	14360

1/ Capital cost of house and clearing and destumping houselot area.
2/ Income being payment for maintenance work done or subsistence allowance.

APPENDIX 13-1

Table 8 - Possible Settler's Incomes on Rubber Holdings including Income from Houselot

(M$ per year)

Year		Possible Settler's Incomes			
		I	II	III	IV
(1978)	7	2580	1380	1380	1380
	8	2600	1700	1500	1500
	9	2620	1820	1620	1620
	10	2630	1930	1680	1660
	11	2640	2140	1740	1700
	12	2650	2250	1800	1750
	13	2660	2360	1860	1780
	14	2670	2470	1920	1820
	15	2680	2680	1980	1850
	16	2690	2790	2040	1890
	17	2700	2900	2100	1920
	18	2710	3110	2160	1960
	19	2720	3220	2220	1990
	20	2730	3330	2280	2030
	21	2740	3440	2340	2060
	22	2750	3550	2450	2100
	23	2750	3750	2550	2120
	24	2750	3950	2750	2150
	25	2750	3950	2750	2150

APPENDIX 13-1

Table 9 - Possible Settler's Incomes on Oil Palm Holdings including Income from Houselot

(M$ per year)

Year		Possible	Settler's		Incomes
		I	II	III	IV
(1976)	5	2540	1340	1340	1340
	6	2560	1560	1460	1460
	7	2580	1680	1580	1580
	8	2600	1800	1650	1630
	9	2620	1820	1720	1680
	0	2630	1930	1780	1730
	11	2640	2140	1840	1760
	12	2650	2250	1900	1800
	13	2660	2360	1960	1830
	14	2670	2470	2020	1870
	15	2680	2680	2080	1900
	16	2690	2790	2140	1940
	17	2700	2900	2200	1970
	18	2710	3100	2260	2010
	19	2720	3220	2320	2040
	20	2730	3330	2380	2090
	21	2740	3440	2440	2110
	22	2750	3550	2500	2150
	23	2750	3750	2550	2150
	24	2750	3950	2750	2150
	25	2750	3950	2750	2150

APPENDIX 13-1

Table 10 - Investment by and repayment to FLDA (10 acre Rubber Holding)

(M$)

FLDA INVESTMENT PERIOD

Year		Settler's Income	Management	Development Costs	Interest @ 7 per cent.	Total Annual investment
(1971)	0	1880 1/	3220	3030	240	8370
	1	600 2/	1040	1120	730	3490
	2	1300 3/	1000	470	870	3640
	3	1100 3/	1070	470	1230	3870
	4	700 3/	1000	470	1450	3620
	5	500 3/	820	470	1640	3430
	6	860 4/	730	-	780	2370

FLDA REPAYMENT PERIOD

Year		Settler's Income	Management	Annual repayment of loan 5/	Farm Gross Margin	Replanting Cess
(1978)	7	1380	730	500	2610	360
	8	1500	700	1270	3470	480
	9	1620	700	1870	4190	580
	10	1660	700	2390	4750	660
	11	1700	700	2590	4990	700
	12	1750	700	2780	5230	730
	13	1780	670	2760	5230	740
	14	1820	670	2680	5170	740
	15	1850	670	2620	5140	740
	16	1890	670	2580	5140	740
	17	1920	670	2470	5060	740
	18	1960	670	2400	5030	740
	19	1990	670	2330	4990	740
	20	2030	670	2200	4900	730
	21	2060	670	2050	4780	720
	22	2100	670	1880	4650	710
	23	2120	670	1740	4530	700
	24	2150	670	1580	4400	680
	25	2150	670	1480	4300	670

Notes: 1/ Values of settler's house and clearing house and village area.
2/ Settlers on project for second half of year only.
3/ Includes maintenance income and subsistence loan in immature period and income from houselot.
4/ Includes cash income from main crop and income from houselot.
5/ Repayment of principal and interest at 7 per cent.

APPENDIX 13-1

Table 11 - Investment by and repayment to FLDA
(10 acre Oil Palm Holding)

(M$)

FLDA INVESTMENT PERIOD

Year		Settler's Income	Management	Development Costs	Interest @ 7 per cent.	Total Annual Investment
(1971)	0	1880 1/	3220	3450	260	8810
	1	600 2/	1040	2000	790	4430
	2	900 3/	1000	300	960	3160
	3	600 3/	1070	500	1270	3440
	4	1120 4/	1000	-	340	2460

FLDA REPAYMENT PERIOD

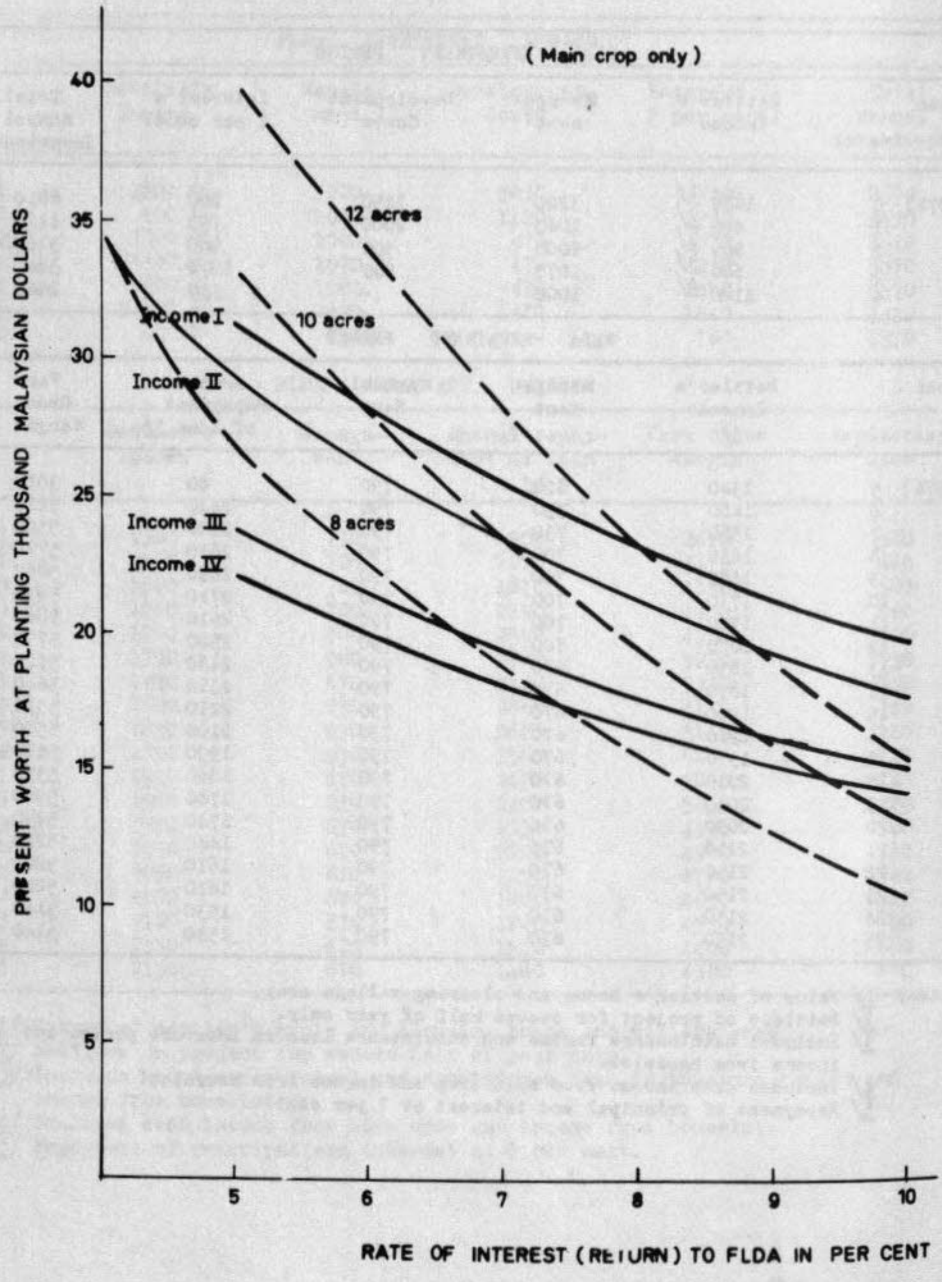
Year		Settler's Income 4/	Management	Annual Rent	Annual Repayment of Loan 5/	Farm Gross Margin
(1976)	5	1340	820	790	60	3010
	6	1460	730	790	2230	5210
	7	1580	730	790	2400	5500
	8	1630	700	790	2650	5770
	9	1680	700	790	2690	5860
	10	1730	700	790	2710	5930
	11	1760	700	790	2610	5860
	12	1800	700	790	2500	5790
	13	1830	670	790	2430	5720
	14	1870	670	790	2310	5640
	15	1900	670	790	2210	5570
	16	1940	670	790	2100	5500
	17	1970	670	790	1990	5420
	18	2010	670	790	1880	5350
	19	2040	670	790	1780	5280
	20	2090	670	790	1740	5290
	21	2110	670	790	1640	5210
	22	2150	670	790	1610	5220
	23	2150	670	790	1610	5220
	24	2150	670	790	1530	5140
	25	2150	670	790	1530	5140

Notes: 1/ Value of settler's house and clearing village area.
2/ Settlers on project for second half of year only.
3/ Includes maintenance income and subsistence loan in immature period and income from houselot.
4/ Includes cash income from main crop and income from houselot.
5/ Repayment of principal and interest at 7 per cent.

APPENDIX 13-1

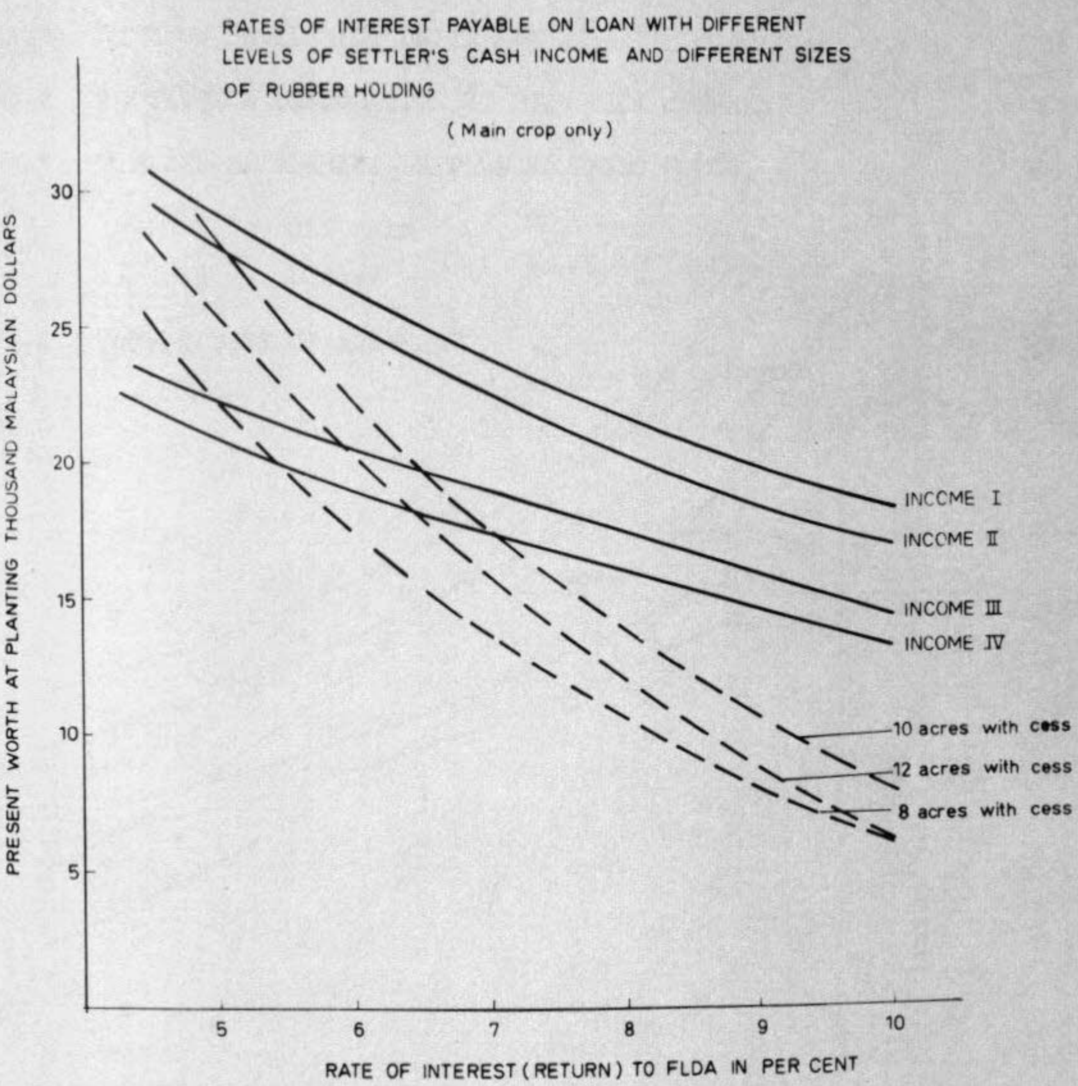
FIGURE 1

RATES OF INTEREST PAYABLE ON LOAN WITH DIFFERENT LEVELS OF SETTLER'S CASH INCOME AND DIFFERENT SIZES OF OIL PALM HOLDING



APPENDIX 13-1

Figure 2



APPENDIX 14

SETTLEMENT UNITS

APPENDIX 14-1

LIST OF SETTLEMENT UNITS

(acres)

Project	Settlement Unit No.	Gross Area Rubber	Gross Area Oil Palm	Nett Planting Area (acres) Rubber	Nett Planting Area (acres) Oil Palm	Village Area (acres)	Settler Families	Settler Population
I	1		1169		965	87	97	615
	2		1517		1252	113	125	793
	3		1079		891	80	89	564
	4		1075		887	80	89	564
	5	785		612		55	61	387
	6		1404		1160	104	116	735
	7		1424		1176	106	118	748
	8		1119		924	83	92	583
	9		1376		1135	103	114	723
	10		1233		1018	92	102	647
	11		1230		1015	92	102	647
	12		1312		1084	97	108	685
TOTAL		785	13938	612	11507	1092	1213	7691

APPENDIX 14-1

LIST OF SETTLEMENT UNITS (CONTD.)

(acres)

Project	Settlement Unit No.	Gross Area Rubber	Gross Area Oil Palm	Nett Planting Area (acres) Rubber	Nett Planting Area (acres) Oil Palm	Village Area (acres)	Settler Families	Settler Population
II	13		1065		879	79	88	558
	14		1182		976	88	98	621
	15		910		751	68	75	476
	16		1320		1090	98	109	691
	17		772		637	58	64	406
	18		857		707	64	71	450
	19		1160		958	86	96	609
	20		997		823	74	82	520
	21		1354		1118	101	112	710
	22		1041		860	77	86	545
	23		1250		1032	93	103	653
	24		1235		1019	92	102	647
	25	1346		1049		95	105	666
	26	1214		946		86	95	602
	27	991		773		69	77	488
	28	1397		1089		98	109	691
	29	1187		925		84	93	590
TOTAL		6135	13143	4782	10850	1410	1565	9923

APPENDIX 14-1

LIST OF SETTLEMENT UNITS (CONTD)

Project	Settlement Unit No.	Gross Area Rubber	Gross Area Oil Palm	(acres) Nett Planting Rubber	Area (acres) Oil Palm	Village Area (acres)	Settler Families	Settler Population
III	30		920		782	71	78	499
	31		1171		984	90	98	632
	32		1592		1331	122	133	854
	33		1104		929	85	93	594
	34		778		665	60	66	423
	35		867		737	68	73	429
	36		952		803	74	80	519
	37		1535		1285	117	128	822
	38		992		841	77	84	537
	39		942		800	73	80	512
	40		887		755	68	75	480
	41	1016		827		75	82	524
	42		1019		859	78	86	550
	43		889		757	69	75	486
	44		1017		857	78	85	550
	45		1516		1269	115	127	810
	46		1029		870	80	87	562
	47		1312		1103	101	111	708
	48		847		721	66	72	461
	49	803		662		59	66	416
	50	1070		870		78	87	550
TOTAL		2889	19369	2359	16348	1704	1866	11918

APPENDIX 14-1

LIST OF SETTLEMENT UNITS (CONTD.)

(acres)

Project	Settlement Unit No.	Gross Area Rubber	Gross Area Oil Palm	Nett Planting Area (acres) Rubber	Nett Planting Area (acres) Oil Palm	Village Area (acres)	Settler Families	Settler Population
IV	51		1260		1040	94	104	659
	52		983		812	73	81	514
	53		1379		1138	103	114	723
	54		1082		894	80	89	564
	55		1110		916	83	92	583
	56		1157		955	86	96	609
	57		1386		1144	103	114	723
	58		1036		855	77	86	545
	59		1446		1194	107	119	754
	60		921		761	68	76	482
	61		1239		1023	92	102	647
	62		981		810	73	81	514
	63		1137		938	85	94	596
	64		1238		1022	92	102	647
TOTAL			16355		13502	1216	1350	8560

APPENDIX 14-1

LIST OF SETTLEMENT UNITS (CONTD.)

Project	Settlement Unit No.	Gross Area Rubber	Gross Area Oil Palm	Nett Planting (acres) Rubber	Area (acres) Oil Palm	Village Area (acres)	Settler Families	Settler Population
V	65		1957		1615	146	162	1027
	66		1032		852	77	85	539
	67		987		815	73	81	514
	68		1087		897	81	90	571
	69		998		824	74	82	520
	70		1160		958	86	96	609
	71		1158		956	86	96	609
	72	1034		806		73	81	514
	73	1221		952		86	95	602
	74	1145		893		80	89	564
	75	1211		944		85	94	596
	76	1225		955		86	96	609
	77	1335		1041		94	104	659
	78	1129		881		79	88	558
	79	1477		1151		104	115	729
	80	1041		812		73	81	514
	81	1148		895		81	90	571
	82	1287		1004		90	100	634
TOTAL		13253	8379	10334	6917	1554	1725	10939

APPENDIX 14-1

LIST OF SETTLEMENT UNITS (CONTD.)

(acres)

Project	Settlement Unit No.	Gross Area Rubber	Gross Area Oil Palm	Nett Planting Rubber	Area (acres) Oil Palm	Village Area (acres)	Settler Families	Settler Population
VI	83		1517		1252	113	125	793
	84		1441		1190	107	119	754
	85		1165		962	86	96	609
	86		1172		968	87	97	615
	87		1246		1028	93	103	653
	88		1210		999	90	100	634
	89	1024		798		72	80	507
	90	1419		1106		100	111	704
	91	1530		1193		107	119	754
	92	1050		818		74	82	520
	93	2077		1619		146	162	1027
	94	994		775		70	78	495
	95	1137		886		80	89	564
	96	1524		1188		107	119	754
	97	1345		1048		95	105	666
TOTAL		12100	7751	9431	6399	1427	1585	10049
GRAND TOTAL 6 PROJECTS		35162	78935	27518	65523	8403	9304	59080
		114097		93041				

APPENDIX 14-2

POPULATION COMPOSITION ON FOUR FLDA SCHEMES

FLDA SCHEME	NO. OF FAMILIES	AGE GROUPS (YEARS)					AVERAGE FAMILY SIZE
		6 AND BELOW	7 - 13	14 - 20	21 AND ABOVE	ALL AGES	
Kemmendore	208	281	369	187	454	1291	6.21
S. Tekam	117	207	135	32	238	612	5.23
Kg. Awah	117	212	221	82	245	760	6.50
Bilut	575	1007	936	533	1315	3791	6.59
All Schemes	1017	1707	1661	834	2252	6454	6.35
Percentage	-	26.5	25.7	12.9	34.9	100	-

APPENDIX 14-3

TYPICAL SETTLEMENT UNIT DEVELOPMENT COSTS

Table 1 - Oil Palm

	Unit	Quantity	Unit Cost (M$)	Estimated Cost (M$)	Percentage of total
Site Preparation					
Forest Clearing	acre	1,161	167	194,000	
Land Draining (15% of Plantable Land)	"	144	40	5,800	
Platforming (67% of Plantable Land)	"	650	60	39,000	
Destumping Village	"	87	242	21,100	
		Sub-Total		259,900	28
Agricultural Planting	acre	960	160	153,600	16
Roads (within Settlement Unit)					
Tertiary (Harvesting)	mile	12.00	7,675	92,100	
Tertiary - improved in villages	"	0.56	22,000	12,300	
outside villages	"	0.40	22,000	8,800	
Secondary in villages	"	0.62	68,000	42,500	
outside villages	"	0.63	68,000	42,800	
		Sub-Total		198,500	21
Water Supply	lump sum	-	-	136,500	15

(Contd.)

APPENDIX 14-3

TYPICAL SETTLEMENT UNIT DEVELOPMENT COSTS

Table 1 - Oil Palm (Contd.)

	Unit	Quantity	Unit Cost (M$)	Estimated Cost (M$)	Percentage of total
Buildings					
Settler Houses	each	96	1,430	137,300	
FLDA Field Office	"	1	6,000	6,000	
Assistant Manager's House	"	1	9,000	9,000	
Senior Supervisor's House	"	2	6,000	12,000	
Field Assistant House	"	1	2,000	2,000	
Religious Building	"	1	2,000	2,000	
Community Building	"	1	2,000	2,000	
Co-operative Shop	"	1	7,000	7,000	
Market Shed	"	1	2,000	2,000	
			Sub-Total	179,300	19
Amenities					
Sports Field (Padang)	acre	2	1,000	2,000	
Walks: Village Centre	sq. yard	400	6	2,400	
			Sub-Total	4,400	
			TOTAL COST	932,200	100

TYPICAL SETTLEMENT UNIT DEVELOPMENT COSTS

Table 2 - Rubber

		Unit	Quantity	Unit Cost (M$)	Estimated Cost (M$)	Percentage of total
Site Preparation						
Forest Clearing		acre	1,212	167	202,400	
Terracing (67% of Plantable Land)		"	635	110	69,800	
Destumping Village		"	86	242	20,800	
			Sub-Total		293,000	36
Agricultural Planting		acre	950	76	72,200	9
Roads						
Tertiary (Harvesting)		mile	7.12	3,400	24,200	
Tertiary - improved	in villages	"	0.56	22,000	12,300	
	outside villages	"	0.40	22,000	8,800	
Secondary	in villages	"	0.62	68,000	42,500	
	outside villages	"	0.68	68,000	42,500	
			Sub-Total		130,300	16
Water Supply		lump sum	-	-	136,500	16

(Contd.)

APPENDIX 14-3

TYPICAL SETTLEMENT UNIT DEVELOPMENT COSTS

Table 2 - Rubber (Contd.)

	Unit	Quantity	Unit Cost (M$)	Estimated Cost (M$)	Percentage of total
Buildings					
Settler Houses	each	95	1,430	135,800	
FLDA Field Office	"	1	6,000	6,000	
Assistant Manager's House	"	1	9,000	9,000	
Senior Supervisor's House	"	2	6,000	12,000	
Field Assistant House	"	1	2,000	2,000	
Religious Building	"	1	2,000	2,000	
Community Building	"	1	2,000	2,000	
Co-operative Shop	"	1	7,000	7,000	
Market Shed	"	1	2,000	2,000	
		Sub-Total		177,800	22
Amenities					
Sports Field (Padang)	acre	2	1,000	2,000	
Walks: Village Centre	sq. yard	400	6	2,400	
		Sub-Total		4,400	1
		TOTAL COST		814,200	100

APPENDIX 14-4

COMPARISONS OF AREAS

	EXISTING FLDA-TYPE SETTLEMENT	AVERAGE SETTLEMENT UNIT (RUBBER)	
		1 - unit	4 - units for comparisons
BASIC SETTLEMENT UNIT CHARACTERISTICS	(Kg. Awah)		
Settler families	450	95	380
Settler population	2,860	603	2,409
Houselot Size	$\frac{1}{4}$ acre	$\frac{3}{4}$ acre	-
Dusun	800 acres	nil	nil
Main crop area	3,600	950 acres	3,800 acres
SETTLEMENT VILLAGE AREAS			
Houselot	112 acres (44%)	71.2 ac. (83%)	285 acres (83%)
Other	145 acres (56%)	14.8 ac. (17%)	59 acres (17%)
Total	257 acres (100%)	86.0 ac. (100%)	344 acres (100%)

APPENDIX 15

PROJECTS

APPENDIX 15-1

ALTERNATIVE PALM OIL MILL PLANS

Mill Site	Project	Oil Palm Area (acres)	FFB in Peak Month (tons)	Avg.haul (miles ex-field to mill)	Max.haul (miles ex-field to mill)	Mill Capacity (tons FFB per hour)	Hours worked Peak Month	Capital Cost[2/] (M$ million)
				Plan 1 - Processing Independently by Projects				
A	I	16,700[1/]	18,800	10	15	45/40	418/470	7.2/6.2 [3/]
B	II	10,800	12,150	6	8	30/30	405/405	5.1/5.1
C	III	16,400	18,450	7	11	45/40	410/461	7.2/6.0
D	IV	13,500	15,200	6	12	30/30	506/506	5.1/5.1
E	V	6,900	7,750	7	10	15/15	517/517	2.8/2.8
F	VI	6,400	7,200	6	15	15/15	480/480	2.8/2.8
		70,700	79,550	7.3		180/170	442/468	30.2/28.0
				Plan 2 - Processing Independently, except Projects V and VI				
E	V, VI	13,300	14,950	8	18	30/30	499/499	5.1/5.1
		70,700	79,550	7.5		180/170	442/468	29.7/27.5
				Plan 3 - FFB to Nearest Mill, regardless of Project				
A	I V	16,700[1/] 1,900	20,900	10	15	45/45	464/464	7.2/7.2
B	II VI III	10,800 2,000 3,000	17,000	7	11	45/40	420/444	7.2/6.0
C	III VI	13,400 4,400	20,000	8	13	45/40	445/500	7.2/6.0
D	IV V	13,500 5,000	20,850	7	12	45/45	462/462	7.2/7.2
		70,700	79,550	8.0		180/170	442/468	28.8/26.4

(Contd.)

APPENDIX 15-1

ALTERNATIVE PALM OIL MILL PLANS (Contd.)

Mill Site	Project	Oil Palm Area (acres)	FFB in Peak Month (tons)	Avg. haul (miles ex-field to mill)	Max. Haul (miles ex-field to mill)	Mill Capacity (tons FFB per hour)	Hours worked Peak Month	Capital[2] Cost (M$ million)
Plan 4 - As per Plan 2, except FFB to Nearest mill regardless of Project								
A	I	16,700[1]	18,800	10	15	45/40	418/470	7.2/6.2 [3]
B	II VI	10,800 1,000	13,300	6	10	30/30	443/443	5.1/5.1
C	III VI	15,500 1,000	18,550	7	11	45/40	412/466	7.2/6.0
D	IV V III	10,300 1,600 900	14,400	6	12	30/30	480/480	5.1/5.1
E	V VI IV	5,300 4,400 3,200	14,500	7	10	30/30	484/484	5.1/5.1
		70,700	79,550	7.2		180/170	442/468	29.7/27.5
Plan 5 - As per Plan 2, except mill size changes at A, C and E								
A	I	15,300[1]	17,200			40/40	430/430	6.2/6.2 [3]
B	II	10,800	12,150			30/30	405/405	5.1/5.1
C	III	15,500	17,450			40/40	436/436	6.0/6.0
D	IV	13,500	15,200			30/30	506/506	5.1/5.1
E	V & VI I III	13,300 1,400 900	17,550			40/30	439/585	6.0/5.1
		70,700	79,550	7,8		180/170	442/468	28.4/27.5

1/ Includes 5,200 acres Ulu Jempol FLDA Scheme
2/ Not including site preparation, workshop, housing and contingencies
3/ Includes additional M$0.2 million for initial (3-ton) phase Ulu Jempol

APPENDIX 15-2

PROJECT I PALM OIL MILL PHASING (MILL A)

Year	FFB Processing Requirement (Tons FFB in peak month) Ulu Jempol	Balance Project I	Mill Capacity in tons per hour	Hours worked in peak month
1966/7	525	-	3	142
7/8	1,500	-	3	500 1/
8/9	2,530	-	10	253
9/70	3,920	-	10	392
1970/1	4,840	1,797	20	331
1/2	5,300	6,040	30	384
2/3	5,530	9,330	40	371
3/4	5,710	10,950	40	416
4/5	5,800	11,700	40 (45) 2/	438 (389) 2/
1975/6	5,850	12,300	40 (45)	454 (403)
6/7	5,850	12,700	40 (45)	464 (412)
7/8	5,850	12,910	40 (45)	469 (416)
8/9 onwards	5,850	12,940	40 (45)	470 (417)

1/ Temporarily exceeds desirable working rate; addition of 10-ton phase could be advanced if adequate management not available

2/ ( ) refers to possible 45-ton mill

APPENDIX 15-3

PALM OIL MILL STAFFING

Table 1 - Requirements

	Staff Required by Mill Phase				
	3 - 5	10 - 25	20 - 25 (tons/hr)	30	40
Mill					
Senior Mill Engineer	-	1	1	1	1
Mill Engineer	1	1	2	2	2
Trainee Engineer	1	2	2	2	2
Electrical Chargeman	1	1	1	1	1
Boiler House Chargeman	1	2	2	2	2
Production Foreman	1	2	2	2	2
Fitter, Mechanical	2	3	4	5	6
Fitter, Electrical	1	2	2	2	2
Engine Driver, Steam	2	3	3	4	4
Engine Driver, Diesel	1	2	2	2	2
Laboratory Analyst	1	2	2	2	2
Engineers	2	2	3	4	5
Supervisors	2	2	3	4	5
Artisans	4	7	10	13	16
Clerks	2	3	3	4	5
Labourers	30	45	60	75	90
Workshop					
Chargeman	1	1	2	2	2
Assistant Chargeman	-	1	1	2	2
Welders	1	2	3	3	3
Turner	1	1	2	2	2
Blacksmiths/Carpenter/ Mason	2	3	5	5	5

APPENDIX 15-3

Table 2 - Phasing of Staff

	1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	1977/8	1978/9 (onwards)
Skilled Technical Staff													
Senior Factory Engineer 1/C	-	-	1	1	1	1	2	3	3	4	4	5	5
Factory Engineer	1	1	1	1	2	2	3	5	6	7	8	9	10
Laboratory Analyst	1	1	2	2	2	2	4	6	6	8	8	10	10
Chargemen, Fitters and Mechanics, etc. (assuming one workshop per factory)	16	16	25	25	33	38	66	104	112	142	142	183	196
Supervisors Clerks etc.	5	5	7	7	7	8	16	24	24	32	34	41	42
Labourers and Artisans	34	34	52	52	70	88	158	246	264	334	338	440	476

RUBBER FACTORY PHASING

Year	Processing Requirements (000 lbs/day)				Capacity Installed (000 lbs/day)				
	FLDA Schemes	Projects I, II, III	Projects V, VI	Total	Factory G	Factory H	Factory J	Factory K	Total
1966/7									
7/8	2			2		-			- 1/
8/9	7			7		-			- 1/
1969/70	13			13		27			27
1970/71	20			20		27			27
1/2	31			31		53			53
2/3	41			41		53			53
3/4	56	1		57	(27)	80 (53)			80
4/5	69	2		71	(27)	80 (53)			80
5/6	77	6		83	27 (27)	80 (53)	(27)		107
6/7	83	14		97	27 (27)	80 (53)	(27)		107
7/8	87	26		113	67 (67)	80 (53)	(27)		147
8/9	89	36		125	67 (67)	80 (53)	(27)		147
9/80	90	44	5	139	67 (67)	80 (53)	(27)		147
1980/1	90	49	24	163	" "	" "	27 (54)		174
1/2	90	52	57	199	" "	" "	67 (94)		214
2/3	90	54	86	230	" "	" "	67 (94)	27	241
3/4	90	55	106	251	" "	" "	67 (94)	27	241
4/5	90	55	121	266	" "	" "	67 (94)	67	281
5/6	90	55	131	276	" "	" "	67 (94)	67	281
6/7	90	55	136	281	" "	" "	67 (94)	67	281
7/8	90	55	140	285	" "	" "	67 (94)	67	281
8/9	90	55	140	285	" "	" "	67 (94)	67	281

( ) Alternative programme required if Sg. Tekam latex is to be processed in Project V

1/ Transported out of Triangle for processing

2/ Shortage of installed capacity due to use of even-sized 6 ton increments of capacity.

APPENDIX 15-5

RUBBER FACTORY STAFFING

Table 1 - Requirements

	Staff Required by Factory Phase (Capacity of Phase in 000lbs/day)		
	27	53-67	80
Factory			
Senior Factory Engineer	-	1	1
Factory Engineer	1	1	1
Trainee Engineer	1	1	1
Electrical Chargeman	1	1	1
Shift Production Supervisor	2	2	3
Fitter/Welder	1	2	2
Fitter, Electrical	1	1	1
Laboratory Analyst	1	1	1
Clerks	2	3	3
Labourers	20	35	50
Workshop (Where Applicable)			
Chargeman	1	1	1
Assistant Chargeman	-	1	1
Welders	2	2	2
Turner	1	1	1
Blacksmiths	1	2	2
Carpenter/Mason	1	1	1

Note: The staff required for a collection station (one per village/settlement) is one supervisor and 2 labourers.

APPENDIX 15-5

Table 2 - Phasing of Staff

Skilled Technical Staff	1969/71	1971/3	1973/5	1975/7	1977/80	1980/1	1981/2	1982/3	1983/4	1984/5
Senior Factory Engineer i/c	-	1	1	1	2	2	3	3	3	4
Factory Engineer	1	1	1	2	2	3	3	4	4	4
Laboratory Analyst	1	1	1	2	2	3	3	4	4	4
<u>Chargeman, Fitters and Mechanics etc.</u> (assuming one workshop per factory)	10	14	14	24	24	38	42	52	52	56
<u>Supervisors Clerks etc.</u>	4	6	6	10	12	16	18	22	22	26
Labourers, Artisans	20	35	50	70	85	105	120	120	140	155

APPENDIX 16

TOWNS

APPENDIX 16-1

POPULATION RELATIONSHIPS IN FIVE WEST MALAYSIAN TOWNS

TOWN	KUALA LIPIS	JERANTUT	KUALA KLAWANG	BATU GAJAH	KOTA BHARU	AVERAGE
STATE	PAHANG	PAHANG	NEGERI SEMBILAN	PERAK	KELANTAN	
Town Population (1957)	8,700	3,200	2,900	10,100	38,000	12,600
Estimated 1/ Tributary Population (1957)	35,300	11,000	15,400	44,700	187,000	58,700
Total Population	44,000	14,200	18,300	54,800	225,000	71,300
Town Pop. (%) / Trib. Pop.	24	29	19	23	20	21

1/ Tributary area populations estimated for the approximate commercial and governmental service areas of town.

APPENDIX 16-2

LAND USE IN FIVE WEST MALAYSIAN TOWNS

Planning is a relatively new total in Malaysia and with a few exceptions, records of land use in rural Malaysian towns and cities do not exist. This lack of historical land use indices is a serious drawback in the establishment of new land use ratios either for renewal of existing towns or cities, or the development of new towns.

Towns for Study

As a basis for assessing the approximate proportions of varying types of land use in Jengka's new towns and the character of each type, five West Malaysian towns were selected for study. Each town was visited and existing land use was inventoried and mapped approximately. While the five towns varied considerably in size, location and importance, each could be reasonably closely related to an identifiable tributary area which it serves. The five towns were:

1. Kuala Lipis in the state of Pahang which was the state capital until recently (1958) when the functions of the capital were transferred to Kuantan. Kuala Lipis is at the end of a road and hence it has a close geographical relationship with its surrounding tributary area.
2. Jerantut in the state of Pahang, while not as isolated as Kuala Lipis, was selected because of its close proximity to the Triangle.
3. Kuala Klawang in the state of Negri Sembilan is at the terminus of a loop road serving a large agricultural tributary area.
4. Batu Gajah in the state of Perak was a former administrative centre for the state. It is situated in a tin mining area on a secondary road off the main north-south trunk road.
5. Kota Bharu the state capital of Kelantan is on the east coast terminus of the main north-south trunk road.

Town maps and selected photographs appear on pages 206 to 210.

Land Use Categories and Summary

The following categories for summarizing existing land use were established.

1. Commercial - including all shophouses (with residential uses on upper floors) minor industrial use if in shophouses, markets, filling stations and other commercial activities.
2. Residential - all types of housing regardless of ownership or density, but excluding shophouses.
3. Institutional - all Government and religious uses.
4. Public Utilities and Transportation - power stations, water treatment and supply, roads, railroads, bus and taxi terminals and similar uses.
5. Industrial
6. Recreational - all playing fields, clubs, stadiums and other similar uses.
7. Open space and residual - including vacant land and agricultural uses.

Table 1 gives the acreage and percentage represented by each of the major land use categories in the five towns.

The scope of the land use study was limited. However, with the exception of the category of open space and residual land use, land use/population ratios appear to be reasonably uniform.

Types of Existing Land Use

Commercial - Commercial use is characterized by the ubiquitous shophouse. This building serves as a home, shop, industry, hotel, club, school and for a number of other uses. Many larger commercial buildings are no more than structurally enlarged shophouses. Shophouses are generally centrally grouped in town commercial centres. Throughout the towns, however, there are occasional small clusters of shophouses serving smaller neighbourhoods. Population density for shophouses is high and averages about 9.6 persons per building in residence or about 209 persons per nett use acre. In addition there are approximately 4.3 employees per building who live elsewhere.

Markets are also an important feature of town commercial areas. There are both market buildings but often temporary structures of frame and cloth serve adequately. Markets are an important part of the social activity of the towns.

One of the characteristics in town commercial areas was the consistency of cinema size to town population. Cinemas, ranged from 1 seat for every 7.2 persons in Kuala Klawang to 1 seat for every 8.7 persons in Kuala Lipis.

In summary the town commercial patterns are generally characterised by a dense core of multi-use shophouses with larger commercial uses, i.e. rest houses, car salesrooms, and larger hotels on the periphery.

Residential - In all towns, large areas of spacious wooden houses on large lots are evident; they lend grace to all the towns studies. A great deal of residential space is also devoted to indigenous wooden and attap single family houses on large lots.

Squatter areas, characterized by small single family houses of makeshift construction occur at intervals throughout all the towns.

New estate-type houses are making noticeable inroads at all the towns studied.

Institutional - Institutional use constitutes an important part of the land use of all the towns. A great deal of life centres around the established institutions and the variety of governmental activity in towns far exceeds its western counterpart. In addition most of the towns have large military and police units.

Also allocated to the towns is the responsibility for higher and specialised education.

The government offices, schools and hospital in most of the towns present are often housed in older buildings or temporary frame structures.

Religious institutions are an important component of institutional land use. All the major religions are represented in the towns. With the exception of the Buddhist and some cults of hinduism burial is required by all. Burial grounds are numerous and constitute an important part of the land use.

Public Utilities and Transportation - The present land allotted to public utilities and transportation is very limited; sewage treatment plants do not exist and power supply is generally produced locally and varies greatly in quality and quantity of service.

Roads constitute only 6 per cent of the town area - a ratio of 0.57 acres per 100 persons. Bus stations in the towns visited were primitive and undeveloped, with the exception of Kota Bharu Outstation taxi services (a popular, cheap form of transportation) were commonly operated from town streets, with no provision for off-street terminal facilities.

In summary the land use and quality of service devoted to public utilities and circulation appeared inadequate for existing levels of population.

Industrial - Industrial development has taken place haphazardly. Cottage industries in some cases have enlarged and expanded but the overall industrial pattern is scattered. In Kota Bharu and Kuala Lipis sawmills, ore refining and new industrial uses have spread to outlying parts of the towns and have acquired larger acreages.

Much of the industrial use is carried on in shophouses. Uses in these versatile buildings, include every type of light industry, as well as residential use on upper floors.

Recreational - In all towns space for recreation was intensively used and well developed. It is customary throughout Malaysia for each town to have a community football field or 'padang'. Even in the smallest of communities a padang will be much in prominence.

In addition to the town padangs, other typical recreational uses observed included lighted badminton courts, small playgrounds and parks, and a large number of clubs and social associations

(Kuala Lipis has five, Jerantut two).

Locations of recreational uses with respect to other land use activities is of interest. In Kuala Klawang part of the commercial and civic activity fronts on the padang, presenting an extremely pleasant aspect.

Though not in the towns analysed, Kuantan, the capital of Pahang, has a small park along the river next to a fruit market; both the park and fruit markets are fronted on by shophouses. The nightly concourse of sellers, shoppers, strollers and others provides a vitality to the area.

In Kota Bharu, Kuala Trengganu (capital of Trengganu) and Kuantan sports stadiums are under construction, evidently a state capital function.

<u>Open Space and Residual</u> - Open space in the sense of land unused for urbanization varies from town to town. Much of its character is dependent on where the municipal boundary has been established. If the boundary is generous then this use is large and conversely if the town boundary is unrealistically small then open space practically does not exist. Most open space within the town boundaries was devoted to small farms and some space was in evident use as reserve along stream valleys.

APPENDIX 16-2

Table 1 - Existing Land Use Of Five Towns In Western Malaysia

TOWN	KUALA LIPIS			JERANTUT			KUALA KLAWANG			BATU GAJAH			KOTA BAHRU			5 TOWN AVERAGES		
STATE	PAHANG			PAHANG			NEGRI SEMBILAN			PERAK			KELANTAN					
POPULATION (Est. 1966)	11,100 (8,700) **			4,100 (3,200)			3,600 (2,900)			13,200 (10,100)			49,700 (38,000)			16,300 (12,600)		
AREA *	2,100			638			115			1,038			2,048			1,188		
DENSITY (PER ACRE)	5.3 (4.1)			6.4 (5.0)			31.3 (25.2)			12.7 (9.7)			24.2 (18.5)			13.7 (10.6)		
LAND USE	Area (Acres)	% of total area	Ac.per 100 pop.	Area (Acres)	% of total area	Ac.per 100 pop.	Area (Acres)	% of total area	Ac.per 100 pop.	Area (Acres)	% of total area	Ac.per 100 pop.	Area (Acres)	% of total area	Ac.per 100 pop.	Area (Acres)	% of total area	Ac. per 100 pop.
1. Commercial	8.4	0.3	0.1	4.1	6.0	0.1	9.7	8.9	0.2	15.0	1.5	0.1	85.2	4.3	0.1	24.6	2.3	0.1
2. Residential	85.8	4.0	0.7	12.0	1.6	0.2	50.6	44.0	1.4	239.6	23.2	1.8	1243.6	59.9	2.5	326.4	27.5	2.0
3. Institutional	160.3	1.8	1.4	19.2	2.7	0.4	17.8	15.5	0.4	85.2	8.2	0.6	219.5	10.8	0.4	100.5	8.7	0.6
4. Public Utilities & Transportation																		
Roads	62.6	2.9	0.5	47.8	7.2	1.1	8.0	6.9	0.2	53.7	5.2	0.4	187.6	9.3	0.3	71.9	6.0	0.4
Railroads	57.5	2.7	0.5	118.0	17.4	2.8	-	-	-	37.3	3.6	0.2	-	-	-	42.5	3.4	0.2
Other	4.9	0.2	0.1	-	-	-	0.4	0.4	0.1	-	-	-	5.8	0.3	0.1	2.2	0.1	0.1
Sub-Total	125.0	5.9	1.1	165.8	24.6	4.0	8.4	7.3	0.2	91.0	8.8	0.6	193.4	9.6	0.3	116.7	9.5	0.7
5. Industrial	-	-	-	0.4	0.1	0.1	-	-	-	85.2	8.2	0.6	26.0	1.4	0.1	22.3	1.5	0.1
6. Recreational	14.9	0.7	0.1	9.6	1.4	0.2	6.3	5.5	0.1	64.5	6.2	0.4	65.1	3.4	0.1	32.1	2.9	0.1
7. Open space and Residual	1705.6	81.5	15.4	426.8	63.6	10.4	22.2	19.3	0.6	457.5	43.9	3.4	215.2	10.5	0.4	565.5	47.6	3.4
TOTAL AREA.	2100	100%		638	100%		115	100%		1038	100%		2048	100%		1188	100%	

* By planimeter from town maps

** ( ) - 1957 data

APPENDIX 16-2

Figure 1

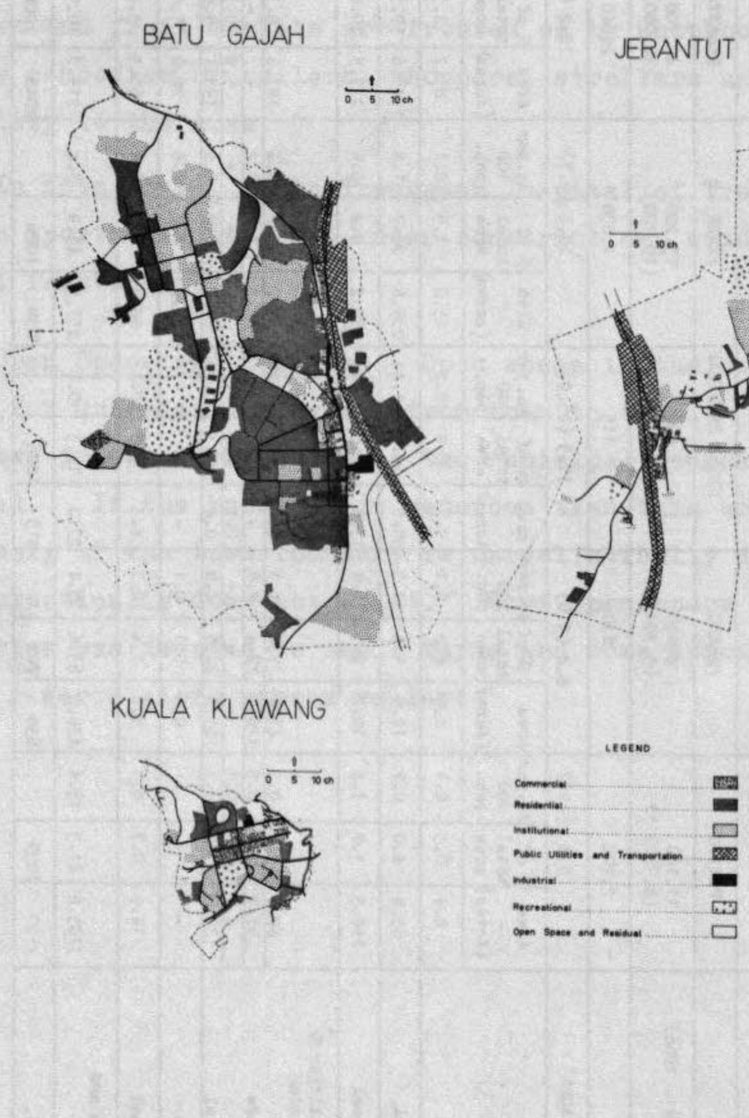
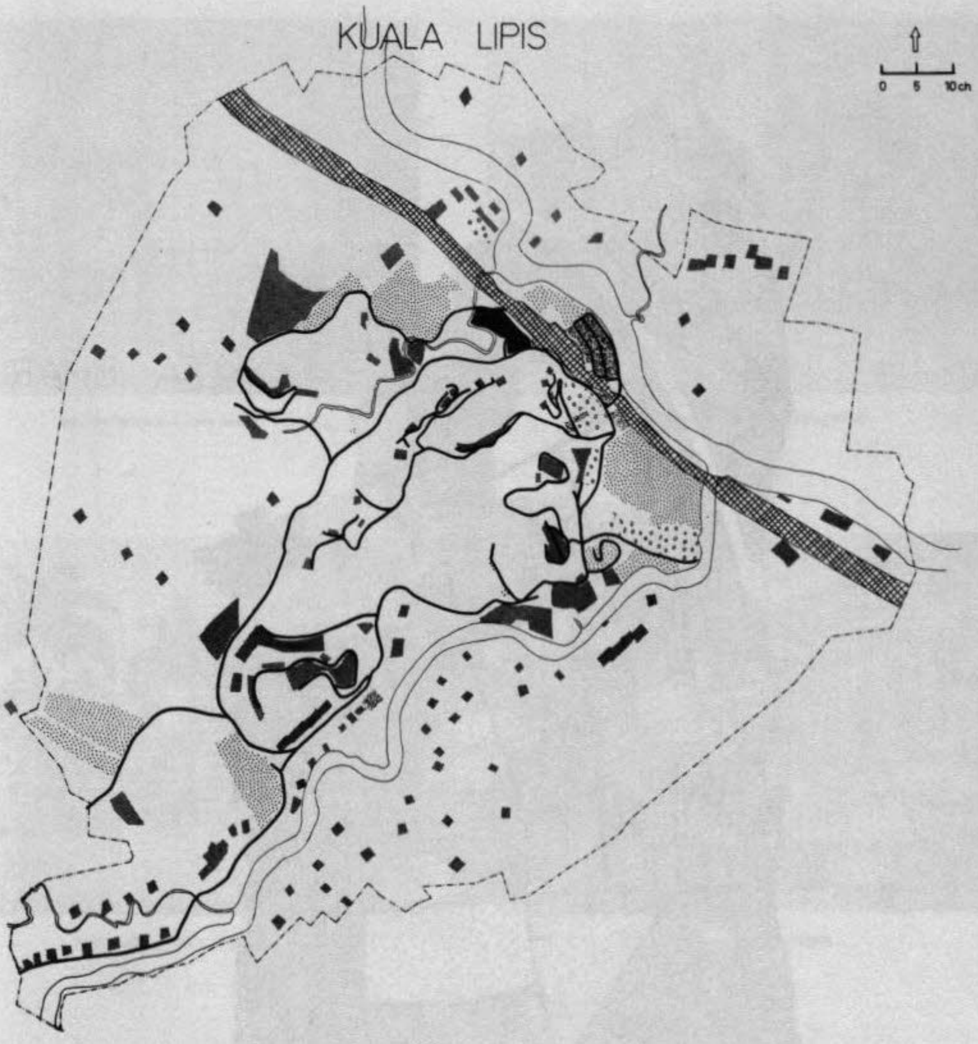
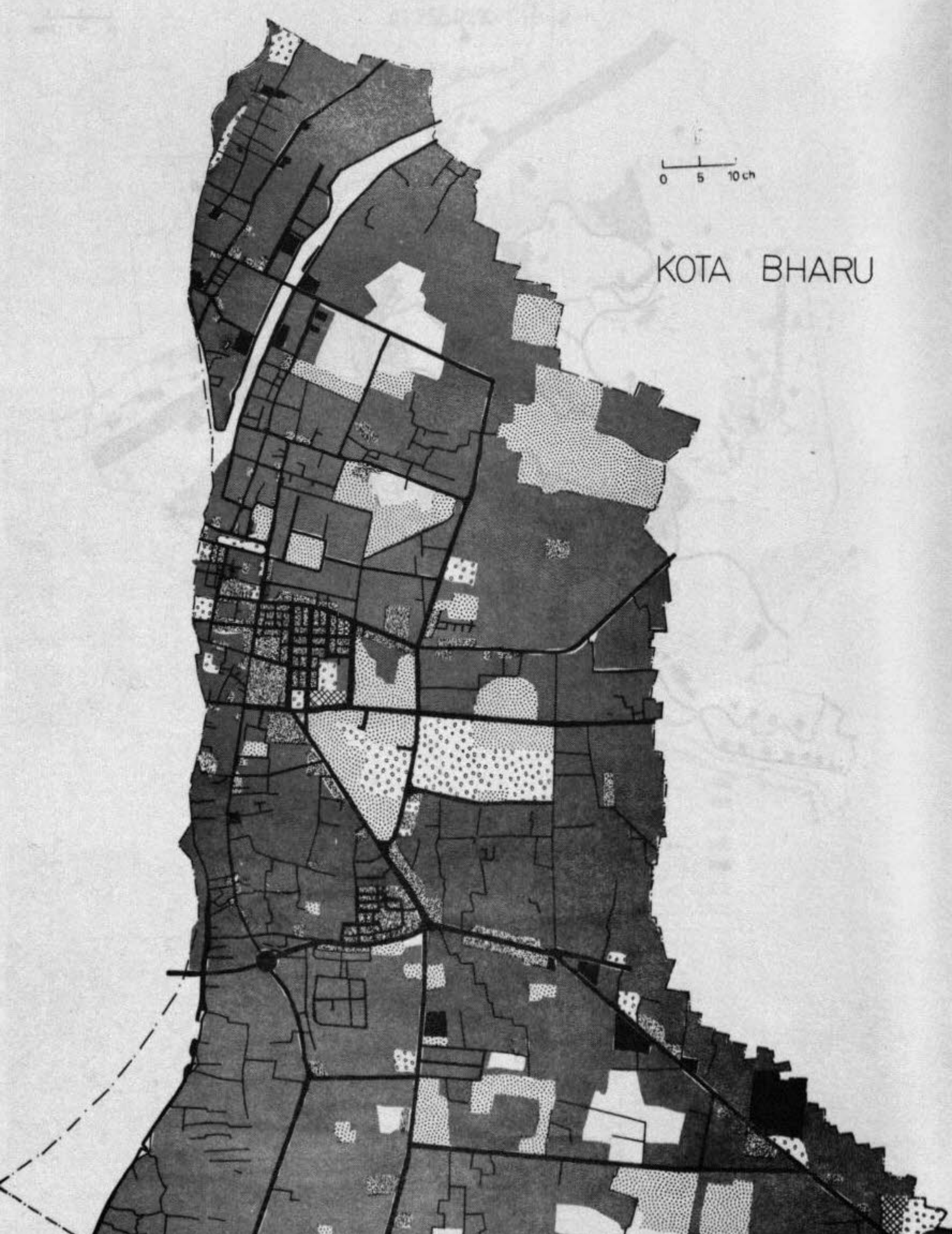


Figure 2



APPENDIX 16-2

Figure 3

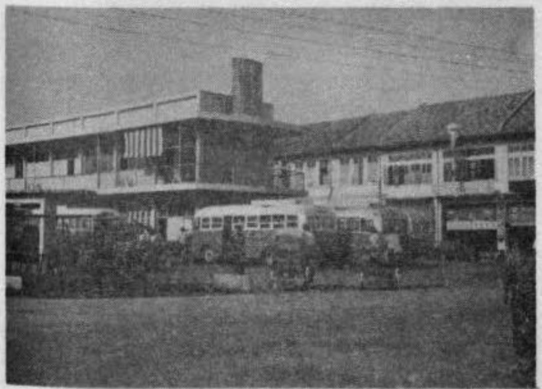


NEW SHOPHOUSES - KOTA BHARU

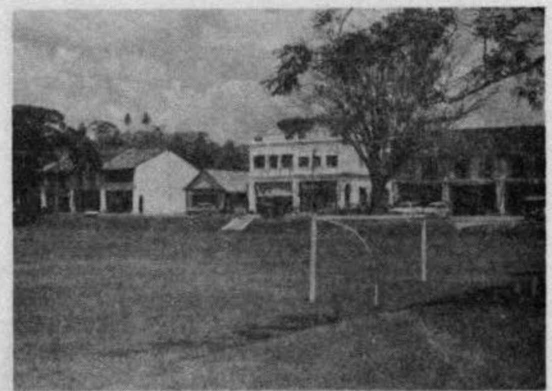
NEW GOVERNMENT OFFICES, KOTA BHARU

TOWN CENTRE - KOTA BHARU

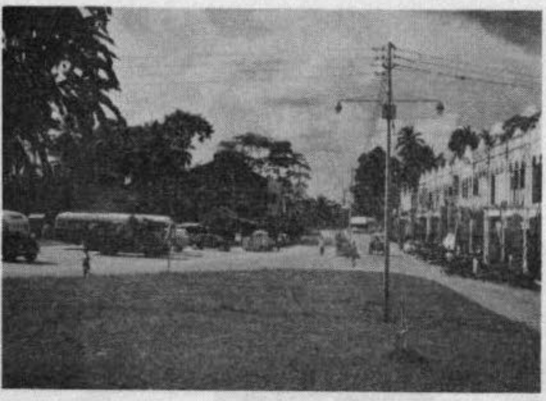
KOTA BHARU - SIDE STREET



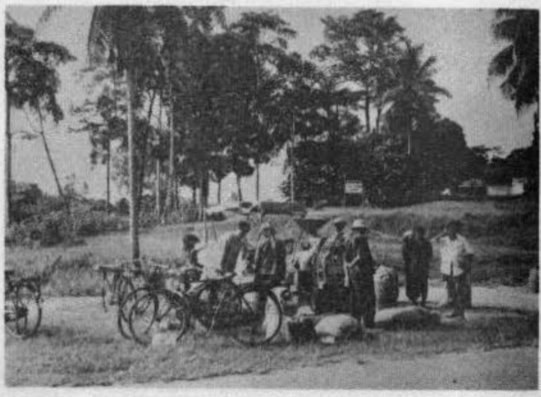
BUS STATION - KOTA BHARU



PADANG - SHOP HOUSES - KUALA KLAWANG



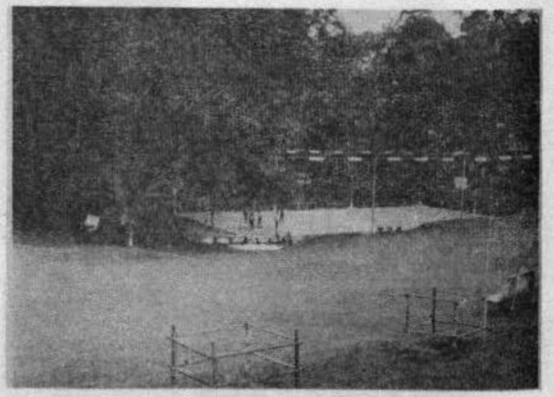
JERANTUT - MAIN STREET WITH BUS STATION



RICE MILLING - JERANTUT

RURAL MOSQUE, KUALA LIPIS - FINE INTEGRATION OF BUILDING AND ENVIRONMENT

KUALA LIPIS - MAIN STREET



CLUB PLAYGROUND - KUALA LIPIS

APPENDIX 16-3

ESTIMATED TOWN DEVELOPMENT COSTS

(M$)

	Regional Centre	Southeast Town	Southwest Town	Source
Site Preparation and Land Drainage 1/	2,900,000	1,000,000	1,000,000	M$2,000/acre (excluding airport)
Roads 1/	5,000,000	1,250,000	1,250,000	M$200,000/mi
Water Supply	1,400,000	460,000	460,000	Chapter 19
Sanitation	2,200,000	616,000	616,000	Chapter 20
Electric Power	1,851,000	775,000	775,000	Chapter 22
Schools 2/	2,620,000	920,000	920,000	Chapter 21
Airport 1/	1,150,000	-	-	Lump sum estimate
Miscellaneous 1/ (padang, parking, public markets)	600,000	200,000	200,000	Lump sum estimate
	17,720,000	5,221,000	5,271,000	
SAY	17,700,000	5,200,000	5,200,000	

1/ Includes 25% for engineering, supervision of construction and contingencies. These allowance made elsewhere (see source) for other items.

2/ Includes schools for estimated town population only.

APPENDIX 16-4

ESTIMATED SALES OF IMPROVED LOTS [1]

	Acres	M$ / Ac	Total
egional Centre			
Commercial [2]	40	40,000	600,000
Industrial [2]	60	35,000	2,100,000
Residential [3]	250	25,000	6,250,000
Sub-Total			8,950,000
own (One)			
Commercial [2]	10	40,000	400,000
Industrial [2]	30	35,000	1,050,000
Residential [3]	75	25,000	1,875,000
Sub-Total			3,325,000
Sub-Total x 2 Towns			6,650,000
TOTAL			15,600,000

/ No sales to local, state and National Government agencies.

/ All commercial and industrial land assumed sold to private interests (except forest industry land which would be developed independently by the industry).

/ 75% sold to private interests.

APPENDIX 17

TRANSPORTATION

APPENDIX 17-1

INTERNAL TRANSPORT COSTS

Table 1 - Lorry System (FFB)

<u>Vehicle</u> 5 ton lorry; cost M$12,600 (M$11,430 excluding tyres)

<u>Trips</u> 1) 4 trips per 8 hour day only (25 days per month) 20 tons per day

2) average distance $7\frac{1}{2}$ miles from field to mill round trip 15 miles (loading covers 3 miles)

3) speed on inward and outward journeys 25 mph

4) loading, weighing and unloading plus contingencies 92 minutes

<u>Crop</u> Average yield 0.75 tons FFB per acre per month

Peak yield 1.125 tons FFB per acre per month

<u>Usage</u> Average yield basis: 1800 miles per year

6000 tons per year

Vehicle life 6 years

Peak yield basis: (1/3 lower annual average utilisation per vehicle) 12,000 miles per year

4,000 tons per year

Vehicle life 9 years

<u>Road Cost (Tertiary System)</u>

Basis: Capital Cost M$7,500 1/ per mile) @ 1 chain per acre (M$93.7 per acre)

Maintenance Cost M$750 per mile) @ 1 chain per acre (M$9.4 per acre per year)

Per ton (M$):	Market Prices		Social Prices
Capital (20 yrs. 7%)	8.8	(20 yrs. 12%)	12.5
Maintenance	9.4		9.4
per acre/yr.	18.2		21.9
per ton	2.0		2.4

1/ Subsequently adjusted to M$7645 per mile

INTERNAL TRANSPORT COSTS

Table 1 - Lorry System (FFB) (Contd.)

Vehicle Cost M$	At Market Prices			At Social Prices	
Fixed Annual Cost	Average	Peak		Average	Peak
Overheads (at 50¢ per ton)	3,000	2,000		3,000	2,000
Wages of driver & loaders	4,920	4,920		4,920	4,920
Insurance	650	650		650	650
Road Tax & licence	3,790	3,790		-	-
	12,360	11,360		8,570	7,570
Maintenance & Repairs	1,905	1,270		1,905	1,270
Depreciation & Interest at 7%	2,405	1,750	at 12%	2,780	2,150
	16,670	14,380		13,250	10,990
Add 10% of total (less over head wages) for stand by vehicles	875	746		533	407
	17,545	15,126		13,783	11,297
Variable Cost (M$0.137 per mile)	2,466	1,644		2,466	1,644
Total	20,011	16,770		16,249	13,041
Cost per ton carried	3.3	4.2		2.7	3.3

APPENDIX 17-1

Table 2 - Tractor-Trailer System (FFB)

Vehicle Tractor with 6-ton trailer; cost M$12,710 (M$11,216 excluding tyres)

Trips 1) 3 trips per 8 hour day (25 days per month) 18 tons per day.

2) average distance 7½ miles from field to mill round trip 15 miles (loading covers 3 miles)

3) speed when on inward and outward journeys 10 mph

4) loading, weight and unloading plus contingencies 92 minutes

Crop Average and Peak yields 0.75 and 1.125 tons FFB per acre per month

Usage 1) Average Vehicle Capacity
13,500 miles per year for 5 years 2,400 hours worked
5,400 tons carried per year

2) Peak Vehicle Capacity
(1/3 lower annual avg. utilisation)
9,000 miles per year for 8 years 1,600 hours worked
3,600 tons carried per year

Road Cost (Tertiary System)

Basis: Capital Cost M$3,400 per mile } 1.0 chain per acre (M$42.5 per acre

Maintenance Cost M$400 per mile } 1.0 chain per acre (M$5.0 per acre/year

Per ton (M$):	Market Prices		Social Prices
Capital (20 yrs. 7%)	4.0	(12%)	5.7
Maintenance	5.0		5.0
per acre/yr.	9.0		10.7
per ton	1.0		1.2

Table 2 - Tractor-Trailer System (FFB) (Contd.)

Vehicle Cost M$	At Market Prices			At Social Prices	
Fixed Annual Cost	Average	Peak		Average	Peak
Overheads	2,700	1,800		2,700	1,800
Wages of driver and loaders	4,680	4,680		4,680	4,680
Insurance	170	170		170	170
Licence	240	240		-	-
	7,790	6,890		7,550	6,650
Maintenance and Repair	1,683	1,052		1,683	1,052
Depreciation and Interest at 7%	2,735	1,878	at 12%	3,111	2,257
	12,208	9,820		12,344	9,959
Add 10% of total cost (less overhead and wages) for standby vehicles	483	334		496	348
	12,691	10,154		12,840	10,307
Variable Cost (M$1.24 per hour)	2,980	1,980		2,980	1,980
Total	15,671	12,134		15,820	12,287
Cost per ton carried	2.9	3.4		2.9	3.4

APPENDIX 17-1

Table 3 - Tractor-Trailer with Transfer to Lorry - Peak Yield basis (FFB)

Vehicles

5 ton lorry	Cost M$ 12,600
Tractor and Trailer 5 ton	Cost M$ 12,480
Ramps	Cost M$ 3,500 (each to serve about 1000 acres)

Trips and Usage	Lorries	8 trips per day 300 days 8000 tons carried (1/3 lower annual average utilisation)
	Tractor and Trailers	5 trips per day 300 days 5000 tons carried (as above)

Crop as in Tables 1 and 2

Cost 1. **Tertiary Roads** as in Table 2

Cost per ton at Market Prices M$1.0
at Social Prices M$1.2

2. Vehicle	At Market Prices	At Social Prices
Lorry Cost (excl. loaders) Table 1)	14,010	10,280
Cost per ton	1.75	1.25
Tractor Cost (incl. loaders) (Table 2)	12,134	12,287
Cost per ton	2.43	2.46
Transfer facilities per ton	0.05	0.05
	4.23 (4.2)	3.76 (3.8)

Loss of Revenue

1% rise on F.F.A. content @ f.o.b. price M$500 per ton loss of M$5.0 per ton

Loss in revenue per ton of F.F.B. = 20% oil content = M$1.0 per ton

Summary	At Market Prices	At Social Prices
Cost of Vehicles and Transfer M$ per ton	4.2	3.8
Loss of Revenue to bruising M$ per ton	1.0	1.0
	5.2	4.8

APPENDIX 17-1

Table 4 - Tank Lorry (Latex)

Vehicle 5 ton tank lorry (1000 gal.) with space for scrap; Cost M$16,000 (M$15,030 excl. tyres)

Trips 3 per day (25 days per month) carrying 10,000 lbs. liquid plus scrap per trip 5 tons (4 miles loaded)

Crop Average yield per acre 116 lbs. latex d.r.c. per month (375 lbs. liquid latex and scrap)

Usage Peak yield 30% greater

1) Average yield vehicle capacity 7200 miles per year for 7 years 4,500 tons carried per year
2) Peak yield vehicle capacity 5540 miles per year for 9 years 3,460 tons carried per year

Cost M$	At Market Prices			At Social Prices	
	Average	Peak		Average	Peak
Fixed Annual Cost					
Overheads	2,250	1,730		2,250	1,730
Wages	2,160	2,160		2,160	2,160
Insurance	650	650		650	650
Road Tax Licence	3,790	3,790		-	-
Maintenance and Repairs	2,147	1,670		2,147	1,670
Depreciation and Interest (7%)	2,790	2,306	(12%)	3,294	2,821
	13,787	12,306		10,501	9,031
10% less wages and overheads for standby vehicles	928	842		609	514
	14,715	13,148		11,110	9,545
Variable Cost					
M$0.137 per mile	986	759		986	759
	15,701	13,907		12,096	10,204
Cost per ton carried	3.5	4.0		2.7	3.0

APPENDIX 17-1

Table 5 - Tractor with Tank Trailer (Latex)

<u>Vehicle</u> Tractor and 5 ton tank trailer; cost M$14,000 (M$17,516 excluding tyres)

<u>Trips</u> 2 per day (25 days per month) 10,000 lbs. liquid latex plus scrap per trip (5 tons)

<u>Crop</u> As in Table 4

<u>Usage</u> 1) Average yield vehicle capacity 4,800 miles for 6 years 3,000 tons carried per year (1200 hrs.)

2) Peak yield vehicle capacity 3,700 miles for 8 years 2,310 tons carried per year (925 hrs.)

Cost M$	At Market Prices			At Social Prices	
	Average	Peak		Average	Peak
Vehicle Cost					
Wages	1,920	1,920		1,920	1,920
Overheads	1,500	1,150		1,500	1,150
Insurance and Licence	410	410		170	170
Maintenance and Repair	1,562	1,171		1,562	1,171
Depreciation and Interest at 7%	2,626	2,096	(12%)	3,044	2,519
	8,018	6,747		8,196	6,930
10% of total less wages and overheads for standby vehicles	460	368		478	386
	8,478	7,115		8,674	7,316
Variable Cost M$1.24 per hour	1,490	1,145		1,490	1,145
	9,968	8,260		10,164	8,461
Cost per ton carried	3.3	3.6		3.4	3.6

APPENDIX 17-1

Table 6 - Fleet Size (FFB)

	1970	1975	1985
FFB per year (tons)	55,300	375,000	640,000
Average month:			
Tons	4,600	31,200	53,400
Lorries (450 tons/month) 1/	11	76	131
Cost (M$12,600/lorry)	138,000	958,000	1,650,000
Peak month:			
Tons (12½% annual)	6,900	46,900	80,000
Lorries 1/	17	115	196
Cost (M$)	214,000	1,449,000	2,470,000

1/ Includes 10% for spares

Table 7 - Fleet Size (Latex)

	1970	1975	1985
Latex per year (tons)	5,600	23,000	80,000
Average month:			
Tons	470	1,900	6,700
Lorries (375 tons/yr.) 1/	2	6	20
Cost (M$16,000)	32,000	96,000	320,000
Peak month:			
Tons (30% over average)	600	2,500	8,700
Lorries 1/	2	8	26
Cost (M$)	32,000	128,000	416,000

1/ Includes 10% for spares

APPENDIX 17-2

EXTERNAL TRANSPORT COSTS

Table 1 - Summary of Road, Road Rail and Road Sea Transport Cost (M$ per ton)

Market Prices		Road	Road Rail				Road Sea			
			Road	Transfer	Rail	Total	Road	Transfer	Sea	Total
Palm Oil	12½ ton	15.5	4.9	2.5	15.0 1/ =	22.4	9.3	5.0	17.0	31.3
Palm Kernel) Rubber)	7½ ton	17.6	5.8	2.5	16.0 1/ =	24.3	10.7	5.0	17.5	33.2
Palm Kernel) Rubber)	5 ton 3/	20.3	6.7	2.5	16.0 =	25.2	-	-	-	-
Social Prices										
Palm Oil		13.9	4.2	2.5	8.3 =	15.0	8.3	N/A	N/A	N/A
Palm Kernel) Rubber)	7½ ton	14.5	(4.6 (4.6	2.5 2.5	8.7 = 3.9 2/ =	15.8 11.0 2/	) 8.8)	N/A	N/A	N/A
Palm Kernel) Rubber)	5 ton 4/	16.7	5.6	2.5	8.7 =	16.8	-	-	-	-

1/ Contract rates offered by Malayan Railways. They could reduce these and still make a profit charging as low as M$8.3 and 8.7 per ton respectively or lower in the case of kernels and rubber possibly as low as M$3.9 per ton.

2/ If no new rolling stock required.

3/ At contract rates of M ¢ 14 per ton mile long haul, M ¢ 19 per ton mile short haul.

4/ At rates of M ¢ 11 per ton mile long haul, M ¢ 16 per ton mile short haul.

APPENDIX 17-2

Table 2 - Road Transport (large lorries) - Palm Oil

Vehicle $12\frac{1}{2}$ ton payload tank lorry; cost M\$50,000 (M\$47,930 excl. tyres)

Trip			
A	Jengka - Port Swettenham	145 miles	(290 miles round trip)
B	Jengka - Mentakab	35 miles	(70 miles round trip)
C	Jengka - Kuantan	80 miles	(160 miles round trip)

Usage (after allowance for maintenance, loading etc.)	Annual Mileage	Annual Tons Carried	Vehicle Life Miles	Vehicle Life Years
Trip A 1 trip per day for 240 days per year	70,000	3,000	280,000	4
B $2\frac{1}{2}$ trips per day for 240 days per year	42,000	7,500	294,000	7
C $1\frac{1}{2}$ trips per day for 240 days per year	58,000	4,500	290,000	5

Cost M$	At Market Prices Trip A	At Market Prices Trip B	At Market Prices Trip C		At Social Prices Trip A	At Social Prices Trip B	At Social Prices Trip C
Fixed Annual							
Insurance	1,388	1,388	1,388		1,388	1,388	1,388
Wages	6,840	6,840	6,840		6,840	6,840	6,840
Taxes	6,118	6,118	6,118		-	-	-
Overhead	6,000	6,000	6,000		6,000	6,000	6,000
	20,346	20,346	20,346		14,228	14,228	14,228
Depreciation and interest							
Trip A (@ 7%)	14,150			(@ 12%)	15,779		
B (@ 7%)		8,893		(@ 12%)		10,502	
C (@ 7%)			11,690	(@ 12%)			13,296
Variable cost @							
0.170 per mile	11,900	7,140	9,860		11,900	7,140	9,860
	46,396	36,379	41,896		41,907	31,870	37,384
Cost per ton carried	15.5	4.9	9.3		13.9	4.2	8.3

Variable Cost

Fuel and Oil	(0.048 per mile)
Tyres	(0.049 per mile)
Repairs	(0.073 per mile)
	0.170 per mile

APPENDIX 17-2

Table 3 - Road Transport (Large Lorries) - Palm Kernels and Rubber

Vehicle: 7½ ton payload lorry; cost M$17,700 (M$15,630 excl. tyres)

Trip A	Jengka - Port Swettenham	145 miles	(290 miles round trip)
B	Jengka - Mentakab	35 miles	(70 miles round trip)
C	Jengka - Kuantan	80 miles	(160 miles round trip)

Usage (after allowance for maintenance, loading etc.)	Annual Mileage	Annual Tons Carried	Vehicle Life Miles	Vehicle Life Years
Trip A 1 trip per day for 240 days per year	70,000	1,800	280,000	4
B 2½ trips per day for 240 days per year	42,000	4,500	294,000	7
C 1½ trips per day for 240 days per year	58,000	2,700	290,000	5

Cost M$	At Market Prices Trip A	At Market Prices Trip B	At Market Prices Trip C		At Social Prices Trip A	At Social Prices Trip B	At Social Prices Trip C
Fixed Annual							
Insurance	1,011	1,011	1,011		1,011	1,011	1,011
Wages	6,840	6,840	6,840		6,840	6,840	6,840
Taxes	5,640	5,640	5,640		-	-	-
Overhead	4,000	4,000	4,000		4,000	4,000	4,000
	17,491	17,491	17,491		11,851	11,851	11,851
Depreciation and interest							
Trip A (@ 7%)	4,614			(@ 12%)	5,145		
B (@ 7%)		2,900		(@ 12%)		3,424	
C (@ 7%)			3,812	(@ 12%)			4,335
Variable cost @ 0.130 per mile	9,100	5,460	7,540		9,100	5,460	7,540
	31,655	26,301	28,843		26,096	20,735	23,726
Cost per ton carried	17.6	5.8	10.7		14.5	4.6	8.8

Variable Cost

Fuel and oil	(0.042 per mile)
Tyres	(0.043 per mile)
Repairs	(0.055 per mile)
	0.130 per mile

APPENDIX 17-2

Table 4 - Rail Transport (existing track)

Distance 216 miles Mentakab Port Swettenham - average turn round 3 days

Usage 270 operating day per year (90 x 3 day trips)

Operating Cost per train mile	Locomotive Maintenance	M$0.50
	Rolling Stock "	1.25
	Locomotive operation	1.50
		3.25

Palm Oil (128,000 tons per annum)

Capital Cost of additional rolling stock (trains of (12 x 30 ton tankers) 360 tons and one locomotive each train doing on average 90 trips per year)

48 tank cars	@ M$ 35,000 each	1,680,000
4 locomotives	@M$750,000 each	3,000,000
		4,680,000

Marginal Cost including new rolling stock

Cost of rolling stock per ton carried (interest @ 12% over 25 years) = $\frac{\text{M\$ } 563,500}{128,000}$ = M$4.4 per ton

Operating Cost (216 x 2 miles @ M$3.25 per mile per 360 tons) = M$3.9 per ton

M$8.3

Palm Kernels and Rubber (57,000 tons per annum)

Capital cost of additional rolling stock (2 trains (12 x 30 ton cars) 360 tons and one locomotive each train doing on average 80 trips per year)

24 cars	@ M$ 32,000	768,000
2 locomotives	@ M$750,000	1,500,000
		2,268,000

Marginal Cost including new rolling stock

Cost of rolling stock carried (interest @ 12% over 25 years) = $\frac{\text{M\$ } 273,250}{57,000}$ = M$ 4.8 per ton

Operating Cost (216 x 2 miles @ M$ 3.25 per mile per 360 tons) = M$ 3.9 per ton

M$ 8.7

Marginal Cost excluding new rolling stock

Operating Cost (as above) = M$ 3.9 per ton

Table 5 - External Fleet Size (Jengka - Port Swettenham)

	1970	1975	1985
Palm Oil (tons/yr.)	9,000	69,000	128,000
No. of Tank lorries (3,000 tons/yr.) 1/	4	25	47
Cost (M$50,000)	200,000	1,250,000	2,350,000
Palm Kernel and Rubber (tons/yr.)	4,400	25,000	57,000
No. of lorries (1,800 tons/yr.) 1/	3	15	35
Cost (M$17,700)	53,000	266,000	619,000

1/ Includes 10% for spares

APPENDIX 18

ROADS AND PORTS

APPENDIX 18-1

ROAD CONSTRUCTION MATERIALS

This appendix reviews the availability and quality of road construction materials in the Jengka Triangle, based on field and map inspection, air photograph interpretation and limited laboratory tests. Materials considered were soils and their capability for use in highway sub-grades or as sub-base materials, laterite, soil and rock mixtures, rock, and river sands and gravels.

Soils

The main agricultural soil series identified in the course of the soil survey were classified broadly as to their engineering characteristics, based on tests made at PWD Headquarters, Kuala Lumpur, to assess particle size, moisture content and liquid and plastic limits. Two broad groups of soils were established (Table 1). The particle size distributions of the two groups are shown in Figure 1.

Group I soils are least suitable as foundation material, and where a choice exists should be avoided. Many of these soils were formed from shales; they are usually from 5 to 10 feet thick. Below this depth an increasing proportion of unaltered shale occurs in the form of angular fragments, until the rock surface which is irregularly penetrated by clayey bands, is reached. Excavations into these shales can be seen in innumerable road cuttings in the district and however executed, have usually suffered slips.

The stablization of the Triangle's soils, using particularly lime as being suitable for the prevailing climatic conditions, has been considered. The Group I soils are too heavy to be satisfactorily mixed. Stabilization could be applicable to the Group II soils, which might lend themselves best to central

Table 1 - Soil Groups

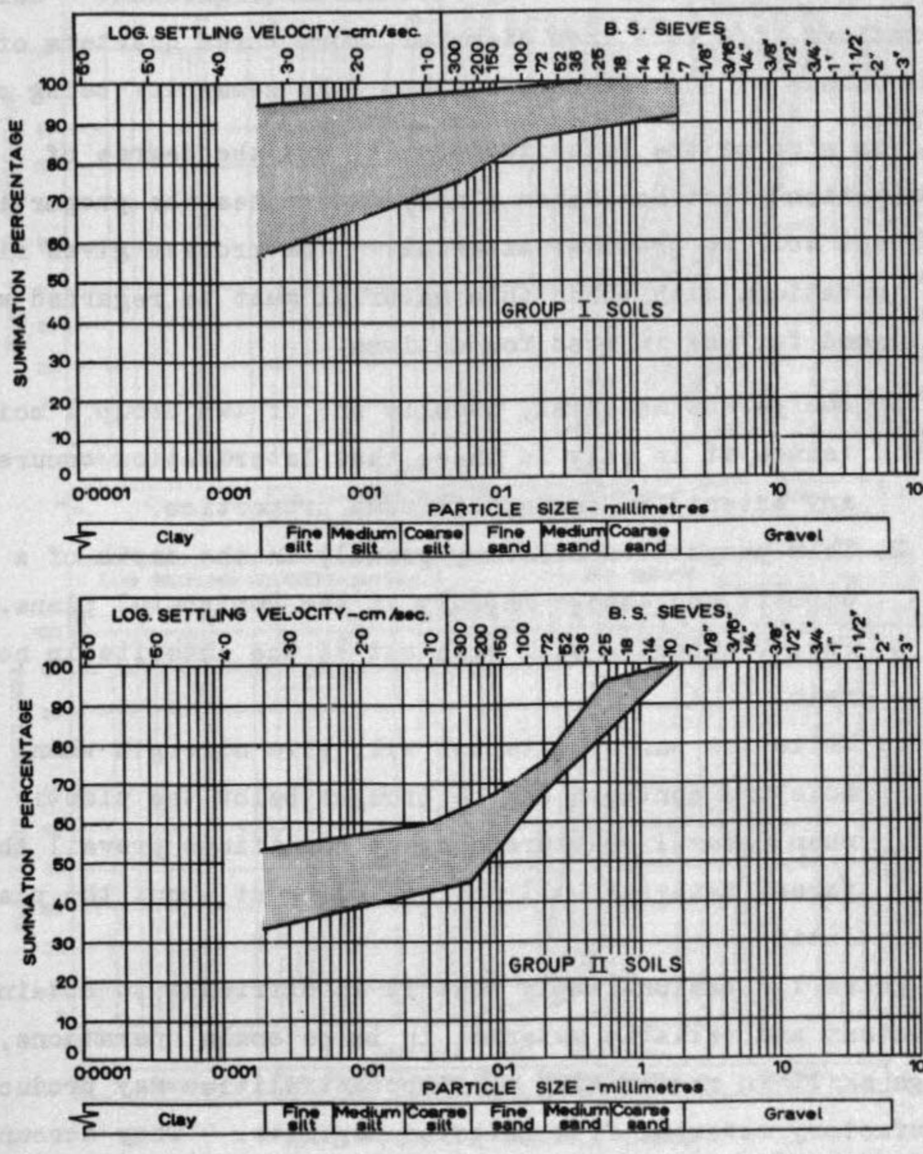
Soil Series	Derivation	Depth	Laterite	General Characteristics of Group
GROUP I SOILS				
AKOB	Alluvial	+ 6 ft	None	
BATU ANAM	Shale	+ 6 ft	Little	
DURIAN	Shale	+ 6 ft	Little	Liquid limits 80-100%
MALACCA	Iron rich shale	+ 6 ft	Nodular 2½ ft layers at 1 ft depth	Plastic limits 35-50% In site D_s = 65 lbs/cu ft
MUNCHONG	Shale or siltstone	+ 6 ft	Little	SG = 2.66 - 2.78
SEGAMAT	Andesite	Generally + 6 ft	Sometimes deep nodular	Clay over 50%
TAVY	Shale or siltstone	+ 6 ft	Nodular 2½ ft layers at 1 ft depth 1/	

1/ Western half; remainder at 2 ft

Soil Series	Derivation	Depth	Laterite	General Characteristics of Group
GROUP II SOILS				
BUNGOR	Sandy Shale and siltstone	+ 10 ft	None	
KEDAH	Sandstone and quartzite	2 ft-4ft on steep slopes	Pan at interface	Liquid limits 30% Plastic limits to 20%
SERDANG	Sandstone	4 ft to 10 ft deep		Sand over 30%
TELEMONG	Alluvial	+ 10 ft deep	None	Clay under 50%

APPENDIX 18-1

Figure 1 - Particle Size Distribution of Soil Groups



mixing, using a stationary plant and processing soil from a borrowpit.

Laterite

The more promising sources of laterite are the Malacca and Tavy soil series where laterite tends to occur about one foot below the surface, in bands 2½ feet thick (Figure 2). Hard concretions, 1/4 to 1 inch diameter, form three quarters of the total volume of the laterite horizon (the remainder being clay).

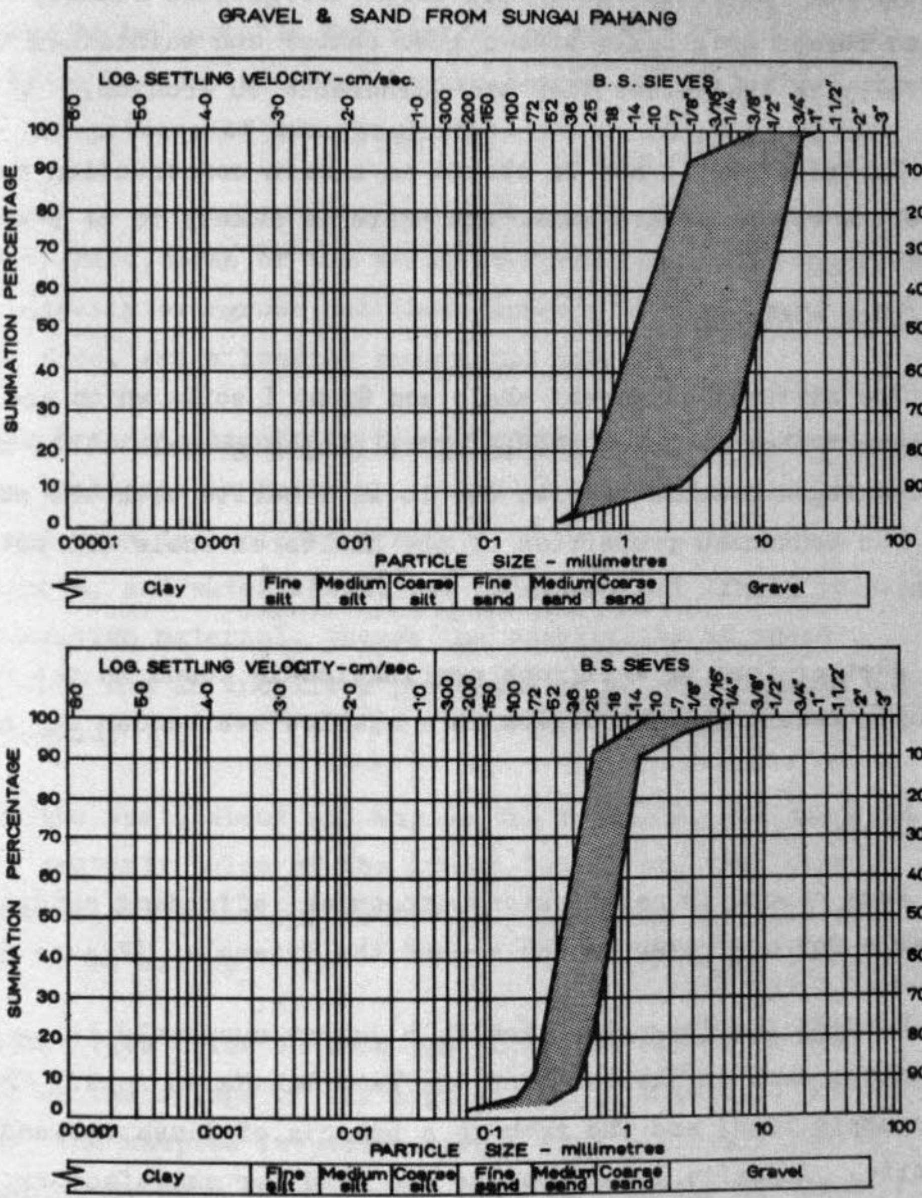
The size of the laterite nodules, and the degree of "laterisation" that has taken place, determines the proportion of parent soil to granular material. The process gives rise to the limitations with which this material must be regarded when considered for use in road foundations.

1. The parent material, usually one of two Group I soils (since it is only in these that laterisation occurs to any extent) is present in some proportion.
2. This proportion can vary greatly in the depth of a deposit and change rapidly in the horizontal plane.
3. Parent material will wash out of the laterite in heavy rain.
4. While the parent material will give strength when moisture contents can be brought below the plastic limit, when natural moisture content conditions prevail the parent material will soften, being at about the plastic limit.

These limitations imply that it is difficult to obtain a consistent and reliable material in large scale operations, even though skill in recognising local potentialities may produce a satisfactory material from selected deposits. They account for the unreliable behaviour of the exposed laterite used in unsurfaced roads at present, and for the way in which they are covered with a layer of loose material, the binder from which has been washed away. They also account for the failures which have

APPENDIX 18-1

Figure 2 - Particle Size Distribution -
River Sands and Gravel



SAND FROM THE TRIANGLE RIVERS

PARTICLE SIZE DISTRIBUTION - RIVER SANDS AND GRAVELS occured when roads of this type have been sealed.

Laterite is only satisfactory for slow traffic of low density because of the loose surface which forms in high rainfall conditions. Laterite roads will form corrugations readily and unless formed originally with a good camber and maintained carefully in that state they are vulnerable to erosion.

Laterite should not be chosen as a main construction material, since the resources are small and there is likely to be a shortage.

Soil/rock mixtures

The mixtures of parent shale and Group I soils which are found as the parent rock is approached, form a clayey gravel. This has the disadvantages associated with the local laterite with the addition that the soundness properties of the unaltered shale are not known.

Another form of soil/rock combination is found in the Group II soil, Kedah, where boulders in a shallow overburden may occur.

Rock

Rock occurs in satisfactory exposures affording conditions suitable for quarrying in and around the Triangle. (Figure 2).

Outside the Triangle there is a quarry currently being worked at Kampong Awah on the south of the Temerloh-Maran road. There is an ample face, and the rock is a breccia of limestone and andesite. Andesite itself may be too hard for satisfactory compaction in crusher run form, but if limestone is present this disadvantage is alleviated. Andesite also may exhibit unsatisfactory qualities in adhering to bitumen. Limestone does not, and this stone might prove by combining the properties of its components to behave suitably as a surfacing. The harder andesite may alleviate the slipperiness which limestone is prone to acquire under the polishing action of tyres.

North of the Maran road junction at Kuala Sentul there is a disused quarry again with an ample face. Here the rock is a hard diorite with limestone inclusions. The qualities of this rock are likely to be suitable for roadmaking materials. Its use is likely to be most affected by the degree to which its hardness affects the process of quarrying it.

There is a quarry, also now disused, in the limestone at Kampong S. Batu, north of the Jerantut-Maran road. The approach road is heavily overgrown but there appears to be a large workable face, and a loading ramp still exists.

The Triangle itself is traversed centrally from South slightly westwards to North by a band of sedimentary rocks in narrow and usually inclined strata. These are soft, often conglomerate, and water sensitive. They are not likely to yield road foundation material, though the possibility of their satisfactory use in localised positions as sub-base should not be overlooked.

To the west, about mid-way up the Triangle, and opposite the most westerly bulge of the Sungai Pahang are two large limsetone deposits the approaches to which from the west are reported to be marshy.

About five miles in from the northeast corner of the Triangle on the fringe of the high ground is a deposit of arenite. The samples inspected ranged from a friable coarse yellowish sandy clay which breaks down very easily to fines (but which might be suitable as sub-base) through a coarse grained sound purple and white sandstone, to a dark fine grained very hard amorphous material, and finally a fine bluish black probably water-sensitive siltstone. The pale purple coarse sandstone looks to be good road material, might be easily won, and may in its weathered form yield a sub-base material capable of being dug by shovel.

Finally, immediately north of Kampong Awah lies a large area of andesite, which is exposed in river channels but may not offer a suitable face for quarrying. This material should be avoided in earthworks. Cuttings within the confines of this area on the geological map may need to be limited in depth.

<u>River Sands and Gravels</u>

The locations of presently accessible sources of sand and gravel are shown in Figure 2. The largest source of river sands and gravels is the Sungai Pahang which can be regarded as inexhaustible. Borings in the vicinity of Temerloh indicate granular deposits to a depth of about 50 feet below the bed. Good frictional sand and some gravels are obtained from the river at Temerloh and at Jerantut, and there is no reason to suppose that they do not occur continually between these points. The particle size distribution of Pahang sand is shown in Figure 2.

In addition there are finer sands in some quantities in the beds of the Sungai Salan, Sungai Batu, Sungai Siang, Sungai Tekam, Sungai Jempol (N), Sungai Jeh, Sungai Jempol (S), and Sungai Jengka. Typical particle size distribution of these sands appear in Figure 3. In the bed of the river Jeh where it runs near the Maran-Jerantut road, there are extensive deposits of boulders visible from the road and boulders are reported in the length of the bed of the Jempol. Such boulders can form a convenient and economical feed material for a stone-crusher.

The river deposits should be the subject of an investigation as to the extent and workability of the deposits. They form an easily won material which makes an excellent sub-base and can replace crushed rock. The coarser sands from the Pahang might form a cheaper base and possibly surfacing material than crushed rock when used in bituminous mixture, or for surface dressing.

Appendix 18-2

GRASSES FOR TERTIARY ROAD SURFACING

In areas of Group II soils where there may be opportunities to eliminate the application of laterite or other foundation materials on the tertiary road system, the following grasses which occur naturally in the vicinity of the Triangle should be considered.

1. Axonopus compressus
2. Cynodon dactylon
3. Desmodium triflorum
4. Crysopogon aciculatus
5. Paspalum conjugatum

All of these grasses could be propagated by turfing, but in view of potentially large areas involved, seed would be preferable. Seed should be applied after grading and before rolling. Laboratory tests by the Faculty of Agriculture of the University of Malaya on Axonopus compressus indicated a germination of 80 per cent. If Axonopus compressus is used, it can be mown when about six inches high to encourage a flat growing habit, thus minimising later mowing requirements. The total cost of the grass surface, including seed (150 lb. per mile at M$300 per cwt.), equipment and labour, is estimated at roughly M$400 per mile.

DRAINAGE AND BRIDGES

Drainage

Based on plots of run-off for catchments of one square mile and above and assumed circular catchment areas, volumes of road cross-flow were computed for 25 per cent and 50 per cent run-off. The 25 per cent run-off coincided with a theoretical curve constructed separately for a 5 in/hr storm and was used to determine cross drainage requirements.

Cross drainage was estimated for typical road layouts on the FLDA Ulu Jempol Scheme where adequate topographic data was available. The drainage requirement thus computed was used for all classes of roads.

Pipe drains were taken as pre-cast reinforced concrete pipe. For primary roads a concrete surround was added; for secondary and tertiary roads, pipe drains were assumed to be bedded on river sand and backfilled.

Reinforced concrete box culverts were assumed for all points where flows were estimated to exceed the capacities of 72-inch pipes.

The amount of cross drainage and the estimated cost is given in Table 1.

Bridges

Allowances for minor bridges were made on the basis of map inspection and correlated approximately with the actual linear feet of bridge per mile on existing roads in the area. Assumed bridge quantities and costs (based on unit prices obtained for estimating purposes from the Public Works Department are given in Table 2.

The proposed Sungai Pahang bridge was assumed to have a crossing length of 400 feet, based on map inspection. An allowance of M$1,500,000 was included in the estimates for its construction; this assumes that some type of practicable low-level design could be developed, otherwise costs would be higher.

APPENDIX 18-3

Table 1 - Road Cross Drainage

Pipe Size (in)	Culvert Size (sq. ft.)	No. of Crossings per mile	Cost Per Mile (M$) Primary L = 75 ft	Secondary L = 50 ft	Tertiary (improved) L = 40 ft	Tertiary L = 20 ft
24	-	2.20	M$ 2,640	M$ 1,120	M$ 902	M$ 451
30	-	0.20	304	130	104	52
36	-	0.30	505	218	174	87
42	-	0.30	930	330	264	132
48	-	0.15	535	185	146	73
54	-	0.15	595	200	160	80
60	-	0.22	1,010	345	276	138
72	-	0.22	1,380	552	442	221
-	100	0.32 1/	1,350	900	360	-
-	150	0.26 1/	1,440	960	384	-
-	200	0.31 1/	831	554	222	-
			M$11,520	M$5,494	M$3,434	M$1,234

1/ Reduced by 1/2 for tertiary (improved) roads

APPENDIX 18-3

Table 2 - Minor Bridge Construction

Road Class	No. Bridges	Type	Width (ft)	Length per mile (ft)	Cost (M$/sq ft)	Total Cost per mile (M$)
Primary	16	concrete	24.5	17.6	40	17,250
Secondary	9	concrete	22.5	10.6	40	9,540
Tertiary (improved)	-	wood	12.0	5.0	20	1,200
Tertiary	-	-	-	-	-	-

APPENDIX 18-4

ESTIMATED ROAD CONSTRUCTION COSTS

Table 1 - Primary Roads, Stage 1

Item	Unit	Unit Price (M$)	Quantity per mile	Est. Cost per mile (M $)
Earthwork	cu yd	0.98	70,000	68,000
Drainage	L. S.	-	-	11,520
Base	cu yd	8.70	4,700	40,836
Seal coat	sq yd	0.175	14,080	2,464
Bridges	lin ft	980.00	17.6	17,250
Grassing	sq yd	0.0825	10,560	870
				141,540
Engineering, supervision of construction, and contingencies (25%)				35,385
Total				176,925
Say				177,000

Table 2 - Primary Roads, Stage II

Item	Unit	Unit Price (M$)	Quantity	Est. Cost per mile (M $)
Levelling Grade	L. S.	-	-	1,210
Double Surface treatment	sq yd	1.11	14,080	15,630
				16,840
Engineering, supervision of construction, and contingencies (25%)				4,210
Total				21,050
Say				21,000

APPENDIX 18-4

Table 3 - Secondary Roads

Item	Unit	Unit Price (M$)	Quantity	Estimated Cost per mile (M$)
Earthwork	cu yd	0.98	18,600	18,200
Base Course	cu yd	6.82	3,130	21,300
Drainage	L.S.	-	-	5,494
Bridges	lin ft	900	10.6	9,540
				54,534
Engineering, supervision of construction, and contingencies (25%)				13,633
		Total		68,167
		Say		68,000

Table 4 - Tertiary (improved) Roads

Item	Unit	Unit Price (M$)	Quantity per mile	Est. cost per mile (M $)
Earthwork	cu yd	-	-	3,624
Laterite	cu yd	6.79	1,370	9,300
Drainage	L.S.	-	-	3,434
Bridges	lin ft	240	5	1,200
				17,558
Engineering, supervision of construction, and contingencies (25%)				4,389
		Total		21,947
		Say		22,000

APPENDIX 18-4

Table 5 - Tertiary Roads, Oil Palm Areas

Item	Unit	Unit Price (M$)	Quantity per mile	Est. Cost per mile (M$)
Earthworks	cu yd	0.515	1,760	906
Laterite	cu yd	6.79	587	4,000
Drainage	L.S.	-	-	1,234
				6,140
Engineering, supervision of construction, and contingencies (25%)				1,535
		Total		7,675

Table 6 - Tertiary Roads, Rubber Areas

Item	Unit	Unit Price (M$)	Quantity per mile	Est. Cost per mile (M$)
Earthworks	cu yd	0.515	1,760	906
Drainage	L.S.	-	-	1,234
Grassing	sq yd	0.0825	7,040	580
				2,720
Engineering, supervision of construction, and contingencies (25%)				680
		Total		3,400

APPENDIX 18-5

ROAD CONSTRUCTION SCHEDULE 1/

(Miles)

Class	Initial Construction	Initial Standard	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Total
Primary	Government	Primary	6.0	12.5	-	4.8	2.5	3.2	-	4.4	1.6	4.5	0.1	39.6
	Logger	Main Logging	-	1.4	8.8	5.3	-	-	-	-	-	-	-	15.5
	Logger	Secondary Logging	-	-	3.8	5.4	-	-	-	-	-	-	-	9.2
														64.3
Secondary	Government	Secondary	7.5	15.5	13.0	16.4	3.6	6.1	16.8	1.6	-	-	-	80.5
	Logger	Secondary Logging	-	-	6.6	4.0	12.5	-	1.5	-	-	-	-	24.6
	Logger	Main Logging	-	10.4	-	-	-	-	-	-	-	-	-	10.4
	Logger	Spur Logging	-	-	-	3.1	12.2	14.0	16.3	12.9	11.4	11.2	5.7	86.8
														202.3
Tertiary-improved	Government	Tertiary-improved	3.7	7.2	13.1	5.9	8.1	8.0	10.0	8.7	8.0	2.1	-	74.8
	Logger	Spur Logging	-	-	-	1.5	3.1	4.2	3.1	2.5	2.8	1.8	-	19.0
														93.8
Tertiary	Government	Tertiary	38.8	99.0	110.0	130.0	138.5	148.0	133.8	107.0	64.4	56.2	-	1025.7

1/ Years shown are those of expected initial construction by Government or logger. See Appendices 18-6 and 18-7 for years of assumed investment.

APPENDIX 18-6

PHASING OF CAPITAL COST - PRIMARY AND SECONDARY ROADS 1/

(Thousands of M$)

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	TOTAL
Primary Roads 2/												
Miles 3/	6.00	12.51	-	4.82	13.11	3.20	5.30	4.35	1.67	13.22	0.10	64.28
Est. Cost	1,062	2,214	389	853	2421	842	1,005	881	887	2875	778	14,207
Secondary Roads												
1. Outside SU's 4/												
Miles	2.41	7.32	2.54	8.52	17.40	6.12	16.81	1.65	14.03	4.00	-	80.80
Est. Cost	164	498	1.73	632	1183	734	1143	112	1080	272	-	5,991
2. Within SU's, but outside Villages 5/												
Miles	2.56	3.81	4.23	2.86	8.44	4.66	9.41	7.25	5.10	6.80	5.75	60.87
Est. Cost	174	259	288	194	574	317	640	493	347	462	391	4,139
3. Within Villages 6/												
Miles	2.50	4.37	6.25	8.12	6.88	9.38	6.88	5.62	6.25	4.37	-	60.62
Est. Cost	170	297	425	552	468	638	468	382	425	297	-	4,122
4. Total												
Miles	7.47	15.50	13.02	19.50	32.72	20.16	33.10	14.52	25.38	15.17	5.75	202.29
Est. Cost	508	1054	886	1378	2225	1689	2251	987	1852	1031	391	14,252

1/ Years shown are assumed years of capital expenditure.
2/ Capital cost assumed to be incurred in year of initial construction if by Government, or in year of improvement to public standard (after logging) if by logger.
3/ Mileage is for Stage I only; Stage II (bituminous surfacing) mileage not shown,
4/ See note 3/.
5/ Capital cost assumed to be incurred one year after land clearing, whether inital construction by Government or logger.
6/ See note 5/

APPENDIX 18-7

PHASING OF CAPITAL COST - TERTIARY ROADS 1/

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	TOTAL
Tertiary-Improved												
1. Within Villages												
Miles	2.25	3.94	5.62	7.31	6.19	8.44	6.19	5.06	5.62	3.94	-	54.56
Est. Cost (M$000)	50	87	123	161	136	186	136	111	123	87	-	1,200
2. Outside Villages												
Miles	1.50	3.21	7.51	-	4.99	3.80	6.90	6.21	5.20	-	-	39.32
Est. Cost (M$000)	33	70	165	-	110	84	152	137	114	-	-	865
3. Total												
Miles	3.75	7.15	13.13	7.31	11.18	12.24	13.09	11.27	10.82	3.94	-	93.88
Est. Cost (M$000)	83	157	288	161	246	270	288	248	237	87	-	2,065
Tertiary												
1. Oil Palm												
Miles	38.75	90.00	110.00	115.00	117.50	130.00	133.75	80.00	-	-	-	815.00
Est. Cost (M$000)	297	690	844	883	903	998	1026	614	-	-	-	6,255
2. Rubber												
Miles	-	9.00	-	15.00	21.00	18.00	-	27.00	64.50	56.25	-	210.75
Est. Cost (M$000)	-	31	-	52	71	61	-	92	219	191	-	717
3. Total												
Miles	38.75	99.00	110.00	130.00	138.50	148.00	133.75	107.00	64.50	56.25	-	1025.75
Est. Cost (M$000)	297	721	844	935	974	1059	1026	706	219	191	-	6,972

1/ Years shown are assumed years of capital expenditure. Capital costs are assumed to be incurred one year after clearing, whether initial construction by Government or logger.

WATER SUPPLY, DRAINAGE AND IRRIGATION (Contd.)

APPENDIX 19

WATER SUPPLY, DRAINAGE AND IRRIGATION

(Contd.)

APPENDIX 19-1

DOMESTIC WATER SUPPLY STANDARDS

Description	World Health Standards (ppm)	Normal Range expected at Jengka Triangle (ppm)	Remarks
Residual Chlorine	1.0 - 2.0	1.0 - 2.0	After treatment
*Chlorides as Cl	200	Nil - 18	
*Total solids	500	30 - 100	
Oxygen absorption	See remarks	0.5 - 4.7	Increases above these values indicate a rise in pollution and thus indicate a need for further investigation
Ammoniacal nitrogen	See remarks	0.01 - 0.05	
Albuminoid nitrogen	See remarks	0.06 - 0.22	
Oxidized nitrogen	See remarks	0.03 - 0.42	
*Total hardness as $CaCO_3$	300	5 - 50	
*Total alkalinity as $CaCO_3$	335	5 - 50	
Nitrates as NO_3	100	Unknown	
*Turbidity	5	14 - 85	
*pH range	7.0 - 8.5	6.5 - 9.0	
*Silica as SiO_2	20	7 - 14	20 ppm is the upper limit for small rural supplies
*Iron	0.3 (1.0)	0.4 - 1.5	(1.0) is upper limit for small rural supplies
Manganese	0.1	0 - 0.06	
*B. COLI-Aerogenes colonies	10 colonies per 100 ml	3500 - 9000 per 100 ml	Raw water
*B. COLI-Faecal types	10 colonies per 100 ml	250 - 5500 per 100 ml	Raw water
Colour	5 Hazen units	5 - 40 Hazen units	

* Only these items are of interest for Malayan conditions.

APPENDIX 19-2

BOILER FEEDWATER STANDARDS

Description	Tolerance limit for 250 psi pressure (ppm)	Range of Jengka Triangle Rivers (ppm)	Remarks
Turbidity	10	14 - 85	High values cause foaming and priming
Dissolved oxygen	0.2	0.5 - 4.7	High values cause corrosion
Hydrogen sulphide	3	Unknown	Unimportant except on acccunt or odour
Total hardness as $CaCO_3$	40	5 - 50	High values cause scale formation
Sulphate/carbonate ratio (Na_2SO_4 : N Na_2CO_3)	2:1	Unknown	Causes caustic embrittlement if ratio is high
Aluminium oxide (Al_2O_3)	0.5	Unknown	Causes scale formation if high
Silica (SiO_2)	20	7 - 14	Causes scale formation if high
Bicarbonate (HCO_3^-)	30	Unknown	Causes corrosion if high
Carbonate ($CO_3^=$)	100	3 - 34	Causes corrosion if high
Hydroxide (OH^-)	40	Unknown	
*Total solids	500 - 2500	30 - 100	High values cause foaming and priming
Maximum pH value	8.5	6.5 - 9.0	Low pH causes corrosion
Colour	40 Hazen units	5 - 40 Hazen units	

* Depends upon boiler design

APPENDIX 19-3

ESTIMATED CAPITAL AND OPERATING COSTS FOR RURAL WATER SUPPLIES

Table 1 - Village Water Supply Capital Costs Using Stream Supplies

(1200 design population)

Description	Cost 1/ M$
Intake and pump-well	2,000
Pumps, pump-house, instruments etc.	17,000
Treatment plant 2/	25,000
Transmission mains	21,000
Distribution system	32,000
Service reservoir (one day supply)	18,000
Stand pipes	1,000
Engineering, supervision and contingencies	24,000
Total	140,000 3/

1/ Lump sum cost based on estimated costs of 16 FLDA water schemes, 2 large PWD schemes, mining company data, and quotations from equipment suppliers.

2/ Filtration but not sedimentation.

3/ Cost per head for design population (1200 people) M$117
Cost per head for initial population (690 people) M$203

Table 2 - Village Water Supply Capital Costs Using Groundwater Supplies

(1200 design population)

Description	Cost 1/ M$
Exploration, test drilling, casing, screening, development, pumps, pump-house, instruments etc.	31,000
Treatment plant 2/	2,000
Transmission mains	17,000
Service reservoir (one day supply)	18,000
Distribution system	30,000
Stand pipes	1,000
Engineering supervision and contingencies	26,000
Total	125,000 3/

1/ Lump sum cost based on estimated costs of 16 FLDA water schemes, 2 large PWD schemes, mining company data, and quotations from equipment suppliers.

2/ Chlorination only.

3/ Cost per head for design population (1200 people) M$105
Cost per head for initial population (690 people) M$182

Table 3 - Village Water Supply Capital Costs
Using Local Catchment Supplies

(1200 design population)

Description	Cost 1/ M$
Reservoir construction 2/	12,000
Pumps, pump-house, instruments etc.	17,000
Treatment plant 3/	25,000
Transmission mains	22,000
Distribution system	32,000
Service reservoir (one day supply)	18,000
Standpipes	1,000
Engineering, supervision and contingencies	29,000
Total	156,000 4/

1/ Lump sum cost based on estimated costs of 16 FLDA water schemes, 2 large PWD schemes, mining company data, and quotations from equipment suppliers.

2/ Dam site assumed to supply 4 villages (M$10.2 per capita)

3/ Filtration but not sedimentation.

4/ Cost per head for design population (1200 people) M$130
Cost per head for initial population (690 people) M$226

APPENDIX 19-3

Table 4 - Village Water Supply: Operating Costs For One Village Per Annum

(1200 design population)

Description	Unit rate	Operating Costs M$
Power costs for fuel, oil etc.	M$1.00 for 5000 gallons output	5,000
Staff wages plus supervisory over-head housing, leave etc.	wages of 2 engine driver/operators plus 50%	4,500
Maintenance of plant	at 3% per annum	1,000
Maintenance of pipe-lines	at 2 cents per foot run of all mains	500
Chemicals	M$1.00 per 20,000 gallons output	1,000
	Cost per annum	12,000

APPENDIX 19-4

ESTIMATED CAPITAL AND OPERATING COSTS FOR TOWN WATER SUPPLIES

Table 1 - Regional Centre Water Supply Capital Costs Using Ground Water Supplies

(12,000 Design Population)

Description	Cost 1/ M$
Exploration, bore-holes screens, 2/ casing, development, pumps, power lines, transformers, switches, etc.	230,000
Treatment plant 3/	200,000
Transmission mains	125,000
Service reservoir (one day supply)	255,000
Distribution system	320,000
Engineering, supervision and contingencies	270,000
Total	1,400,000

1/ Lump sum cost based on estimated costs of 16 FLDA water schemes, 2 large PWD schemes, mining company data, and quotations from equipment suppliers.

2/ Electric power from town is assumed.

3/ Includes sedimentation and filtration for iron removal.

Table 2 - Southeast and Southwest Town Water Supply Capital Costs Using Stream Supplies

(4000 Design Population Each)

Description	Cost per town [1/] M$
Intake structure	3,000
Pumps, including motors, power lines, wiring, switches, transformers [2/]	33,000
Treatment plant [3/]	80,000
Transmission mains	55,000
Service reservoir (one day supply)	75,000
Distribution system	128,000
Engineering, supervision and contingencies	86,000
Total Each Town	460,000

1/ Lump sum cost based on estimated costs of 16 FLDA water schemes, 2 large PWD schemes, mining company data, and quotations from equipment suppliers.

2/ Electric power from town is assumed.

3/ Includes sedimentation and filtration.

Table 3 - Regional Centre Water Supply Operating Costs Per Annum Using Ground Water Supplies

Description	Unit Rate	Operating Cost M$
Power costs for electricity, oil etc.	80 cents per 5000 gallons	49,000
Staff wages plus supervisory overheads, housing, leave etc.	Wages of 6 engine driver/operators plus 50%	13,000
Maintenance of plant	at 3% per annum	8,200
Maintenance of pipelines	at 2 cents per foot run	4,500
Chemicals	33 cents for 20,000 gallons output	5,300
	Cost per annum	80,000

Table 4 - Southeast and Southwest Town Water Supply Operating Costs Per Annum Using Stream Supplies

Description	Unit Rate	Operating Costs per town M$
Power costs for electricity, oil etc.	80 cents per 5000 gallons	16,000
Staff wages plus supervisory overheads, housing, leave etc.	Wages of 4 engine driver/operators, plus 50%	9,000
Maintenance of plant	at 3% per annum	3,000
Maintenance of pipelines	at 2 cents per foot run	1,500
Chemicals	M$1 per 20,000 gallons output	4,500
	Cost per annum	34,000

APPENDIX 19-5

ESTIMATED CAPITAL COSTS OF INDUSTRIAL WATER SUPPLIES [1]

PALM OIL MILL

Table 1 - Water Supply Capital Costs
Using Ground Water Supplies

Description	Cost [2] M$
Exploration, bore-holes, screens, casing, development	14,000
Pumps, pump-house, instruments etc.	7,000
Treatment plant [3]	25,000
Transmission mains	6,000
Reservoir (service tanks) [4]	-
Distribution system [4]	-
Electric power line	25,000
Engineering supervision and contingencies	19,000
Total	96,000

1/ Operating costs are included in the over-all mill and factory operating costs.

2/ Lump sum cost based on estimated costs of 16 FLDA water schemes, 2 large PWD schemes, mining company data, and quotations from equipment suppliers.

3/ Includes sedimentation and filtration for iron removal.

4/ Included in mill costs.

APPENDIX 19-5

PALM OIL MILL

Table 2 - Water Supply Capital Costs
Using Stream Supplies

Discription		Cost [1/] M$
Intake and pump-well		1,500
Pumps, pump-house, instruments etc.		5,500
Treatment plant [2/]		30,000
Transmission mains		6,000
Reservoir (service tanks) [3/]		-
Distribution system [3/]		-
Electric power line		25,000
Engineering supervision and contingencies		17,000
	Total	85,000

1/ Lump sum cost based on estimated costs of 16 FLDA water schemes, 2 large PWD schemes, mining company data, and quotations from equipment suppliers.

2/ Includes sedimentation and filtration.

3/ Included in mill costs.

APPENDIX 19-5

RUBBER FACTORY

Table 1 - Water Supply Capital Costs Using Stream Supplies

Description	Cost 1/ M$
Intake and pump-well	1,500
Pumps, pump-house, instruments etc.	3,300
Treatment plant 2/	25,000
Transmission mains	6,000
Reservoir (service tanks) 3/	-
Distribution system 3/	-
Electric power line	25,000
Engineering supervision and contingencies	15,200
Total	76,000

1/ Lump sum cost based on estimated costs of 16 FLDA water schemes, 2 large PWD schemes, mining company data, and quotations from equipment suppliers.

2/ Includes filtration but not chlorination.

3/ Included in mill costs.

APPENDIX 19-5

RUBBER FACTORY

Table 2 - Water Supply Capital Costs Using Ground Water Supplies

Description	Cost 1/ M$
Exploration, test drilling, casing, screening, development, pumps, pump-house, instruments etc.	19,000
Treatment plant 2/	-
Transmission mains	6,000
Reservoir (service tanks) 3/	-
Distribution system 3/	-
Electric power lines	25,000
Engineering supervision and contingencies	12,000
Total	62,000

1/ Lump sum cost based on estimated costs of 16 FLDA water schemes, 2 large PWD schemes, mining company data, and quotations from equipment suppliers.

2/ Not required.

3/ Included in mill costs.

APPENDIX 19-6

ESTIMATED CAPITAL AND OPERATING COSTS
FOR A SPRAY IRRIGATION SCHEME FOR
150 ACRES OF OIL PALM NURSERY

Table 1 - Capital Cost

Description	Cost M$
Engines, pumps, mountings, pipe manifold, gauges, bends, foot valves	85,000
Main pipeline-pumps to irrigation areas	12,000
Main pipelines in irrigation areas	40,000
Spray lines and fittings	83,000
Engineering and contingencies (10%) 1/	25,000
Total	245,000 2/

1/ A low figure is used because very little engineering work is required in establishing the scheme. The above costs cover supply of equipment and are based upon suppliers' quotations.

2/ M$1,640 per acre.

Table 2 - Operating Costs

Description	Cost M$
Pumping costs for fuel, 1/ lubricating oil.	17,300
Staff wages, plus overheads, housing 2/ leave etc.	34,800
Maintenance of equipment including pipelines at 2% P.A. of capital cost.	4,900
Establishment costs for setting up in 3/ new areas each year.	5,000
Total	62,000

1/ Operating time 1300 hours/year at 385 H.P. from a total of 8 pumping units.
Lubricating oil at 0.004 pints/BHP-Hr. at 80% load at M$0.60/pint.
Fuel oil at 0.42 pints/BHP-Hr. at 80% load at M$0.60/gallon.

2/ Area divided into 3 separate schemes using a total of 8 labourers, 6 pump attendants, 2 supervisors.

3/ Assumes new irrigation areas established each year to accord with development phasing, with labour provided by item 2, but requiring transport, some earthmoving and replacement of breakages.

APPENDIX 20

SANITATION AND HEALTH

APPENDIX 20-1

RURAL HEALTH UNIT - CAPITAL AND OPERATING COSTS 1/

Table 1 - Capital Costs for One Rural Health Unit 2/

Description		Cost (M$)
Main Health Centre		
Clinic building	35,000	
Administrative block	20,000	
Staff quarters, garage, store	270,000	
Land	-	
Furniture and equipment	25,000	
Total for one main centre		350,000
Health Sub-Centre		
Clinic building	35,000	
Staff quarters, garage, store	110,000	
Land	-	
Furniture and equipment	10,000	
Total for four sub-centres		620,000
Midwife's Clinic and Quarters		
Building	13,000	
Land	-	
Furniture and equipment	1,500	
Total for seventeen clinics		246,500
Total for one rural health unit		1,216,500

1/ "Organization of Rural Health Services in Malaysia" - Ministry of Health, Kuala Lumpur 1963.

2/ Inclusive of allowances for engineering, contingencies etc.

APPENDIX 20-1

Table 2 - Operating Costs for One Rural Health Unit per annum

Description	Operating Cost (M$)	
Main Health Centre		
Personal emoluments	95,000	
Other recurrent charges	40,000	
Total for one main centre		135,000
Four Health Sub-centres		
Personal emoluments	120,000	
Other recurrent charges	80,000	
Total for four sub-centres		200,000
Total for one rural health unit		335,000

Table 3 - Operating Costs for One 50-bed Rural Hospital per annum

Description	Operating Cost (M$)
Personal emoluments and other recurrent charges	1,000,000
Total	1,000,000

APPENDIX 21

EDUCATION

APPENDIX 21-1

SCHOOLS AND TEACHERS' HOUSENG

Table 1 - Primary School Data

School	Numbers of students estimated	Numbers of students used for planning	Required Numbers of		
			Classrooms (40 students per room)	Teachers (1.2 per room)	Headmasters (Number per School)
Settlement Unit Primary Schools					
1	402	400	10	12	1
2	482	480	12	14	1
5	380	400	10	12	1
6	380	400	10	12	1
7	503	520	13	16	1
8	465	440	11	13	1
9	488	480	12	14	1
10	304	320	8	10	1
13	479	480	12	14	1
14	361	360	9	11	1
15	312	320	8	10	1
16	363	360	9	11	1
20	252	280	7	8	1
21	414	400	10	12	1
22	292	280	7	8	1
23	288	280	7	8	1
24	550	560	14	17	1
28	406	400	10	12	1
29	481	480	12	14	1
30	368	360	9	11	1
31	429	440	11	13	1
32	597	600	15	18	1
33	364	360	9	11	1
34	350	360	9	11	1
35	365	360	9	11	1
36	492	480	12	14	1
37	361	360	9	11	1
38	499	480	12	14	1

APPENDIX 21-1

Table 1 - Primary School Data (Contd.)

School	Numbers of students estimated	Numbers of students used for planning	Required Numbers of Classrooms (40 students per room)	Teachers (1.2 per room)	Headmasters (Number per School)
Settlement Unit Primary Schools (cont'd)					
39	185	200	5	6	1
40	331	360	9	11	1
41	371	360	9	11	1
42	511	560	14	17	1
52	493	480	12	14	1
53	466	480	12	14	1
54	535	520	13	16	1
55	301	320	7	8	1
56	378	360	8	10	1
57	466	480	12	14	1
58	542	560	14	17	1
FLDA Scheme Primary Schools					
3) 1/	1133	560	14 7/	17	1
4)		560	8 7/	7	-
17) 2/	659	640	16	19	1
18)	659	640	6	7	-
19)	659	640	16	19	1
59 3/	659	640	10 7/	12	-
Town Primary Schools					
11) 4/	1040	520	13	16	1
12)		520	13	16	1
25) 5/	1361	400	10	12	1
26)		400	10	12	1
27)		400	10	12	1
43) 6/	3521	400	10	12	1
44)		400	10	12	1
45)		400	10	12	1
46)		400	10	12	1
47)		400	10	12	1
48)		400	10	12	1
49)		400	10	12	1
50)		400	10	12	1
51		400	10	12	1
TOTAL	25,697	25,640	617	737	56

1/ Ulu Jempol schools.

2/ Bukit Tajau, Kampong Awah, Sungei Nerek schools.

3/ Sungei Tekam school.

4/ Southeast town schools.

5/ Southwest town schools including two adjacent settlement unit schools.

6/ Regional centre schools including two adjacent settlement unit schools.

7/ Additional classrooms to those already in use.

APPENDIX 21-1

Table 2 - Secondary School Data

School	Numbers of Students Estimated	Numbers of Students used for planning	Required Numbers of Classrooms (40 Students per Room)	Required Numbers of Teachers (1.4 per Room)	Required Numbers of Headmasters (Number per School)
Settlement Unit Secondary Schools					
6	725	720	18	26	1
9	695	720	18	26	1
13	1054	1000	25	36	1
14	970	960	24	34	1
15	851	840	21	30	1
19	1176	1200	30	43	1
20	574	600	15	21	1
FLDA Scheme Secondary Schools					
1) 1/	563	600	15	21	1
2)	793	800	20	29	1
3)	919	920	23	33	1
7) 2/	800	800	20	29	1
8)	1061	1040	26	37	1
21 3/	800	800	20	29	1
Town Secondary Schools					
4) 4/	2078	1000	25	36	1
5)		1000	25	36	1
10) 5/	2516	800	20	29	1
11)		800	20	29	1
12)		800	20	29	1
16) 6/	3052	1000	25	36	1
17)		1000	25	36	1
18)		1000	25	36	1
TOTAL	18,627	18400	460	661	21

1/ Ulu Jempol School
2/ Bukit Tajau and Sungai Nerek Schools
3/ Sungai Tekam School
4/ Southeast town Schools
5/ Southwest Town Schools
6/ Regional centre Schools.

APPENDIX 21-1

Table 3 - Upper Secondary School Data

Schools	Required numbers of				
	Numbers of students estimated 1/	Numbers of students used in planning	Classrooms (40 students per room)	Teachers (1.4 teachers per room)	Headmasters (number per school)
1) 3/	600	600	15	21	1
2) 3/	600	600	15	21	1
3) 3/	1200	1200	30	43	1
TOTAL	2400	2400	60	85	3

1/ Based on 10% of about 25,000 primary school children

2/ One upper secondary school in each town

APPENDIX 21-1

Table 4 - School Requirements on Existing FLDA Schemes

Primary Schools	Estimated Children	Classrooms Required	Classrooms Existing	Additional Classrooms
Ulu Jempol	1,120	28	6	22
Bukit Tajau	640	16	-	16
Kampong Awah	640	16	10	6
Sungai Nerek	640	16	-	16
Sungai Tekam	640	16	6	10
Secondary Schools				
Ulu Jempol	800	20	-	20
Bukit Tajau	800	20	-	20
Kampong Awah) Sungai Nerek)	1,040	26	-	26
Sungai Tekam	800	20	-	20

APPENDIX 21-1

Table 5 - Capital Costs 1/ for Schools and Teachers Housing

Description	Cost (M$)	
Primary Schools including teachers houses		
39 Settlement unit schools	9,653,000	
3 FLDA schemes schools	785,000	
14 Town schools	2,708,000	
56 schools 2/		13,146,000
Secondary Schools including teachers houses		
9 Settlement unit schools	4,812,000	
4 FLDA schemes schools	1,523,000	
8 Town schools	4,270,000	
21 schools 3/		10,605,000
Upper Secondary Schools including teachers houses		
3 Town schools	1,375,000	
3 schools 4/		1,375,000
Teachers Training School including housing		
1 Town (regional centre) training school	445,000	
1 school 5/		445,000
Total capital cost for all schools including housing		25,571,000

1/ including allowance for engineering, contingencies etc.
2/ 617 classrooms
3/ 460 classrooms
4/ 60 classrooms
5/ 15 classrooms

Table 6 - Operating Costs of Schools per annum

Description	Unit Cost (M$)	Operating Cost (M$)
56 Primary schools teaching 25,100 children	332 per child	8,330,000
21 Secondary schools teaching 18,400 students	1300 per student	23,920,000
3 Upper secondary schools teaching 2400 students	1500 per student	3,600,000
1 Teachers training school training 600 teachers	3300 per teacher	2,000,000
Cost per annum		37,850,000

APPENDIX 22

TELECOMMUNICATIONS AND ELECTRIC POWER

APPENDIX 22-1

TELECOMMUNICATION SERVICES 1/

Table 1 - Capital Costs

DESCRIPTION		COST (M $)
Temporary facilities		
Land lines from Southeast and Southwest towns to Maran and Temerloh	150,000	
Telegraph facilities in southeast towns	15,000	
CSX connection to timber mill near regional centre	7,000	
		172,000
Permanent facilities		
Four telephone exchanges	480,000	
Four distribution systems		
(a) from exchanges to urban subscribers	110,000	
(b) from exchanges to rural subscribers	672,000	
Two CSX links and connections	85,000	
VHF connection from regional centre to Mentakab exchange	600,000	
Telegraph facilities in regional centre	11,000	
Land lines from regional centre to dependent exchanges	226,000	
Engineering and contingency provision	610,000	
Gross capital cost		2,794,000
		2,966,000
Less salvage value of temporary facilities		66,000
Nett Capital Cost		2,900,000

1/ From unit costs provided by the Telecommunications Department of Malaysia

Table 2 - Operating and Maintenance Costs per Annum 1/

DESCRIPTION		OPERATING COST (M $)
Exchange equipment 2/		
One Group centre exchange	13,000	
Three Dependent exchanges	19,500	
		32,500
Telephone lines 3/		
Overhead lines	79,600	
Underground lines	6,600	
		86,200
Telegraph Service 4/		
Operating costs	4,000	
		4,000
Cost per annum		122,700

1/ Recoverable from subscribers

2/ Wages for five men and including costs of power, spares, transport and overheads

3/ Wages for 15 men and including costs of power, spares, transport and overheads

4/ Wages of one operator (8 hour daily service) including overheads.

APPENDIX 22-2

ELECTRIC POWER SUPPLY

Table 1 - Capital Costs for Regional Centre

DESCRIPTION	COST (M $)
Purchase and installation of six 200 KW alternators and diesel prime movers including one spare	690,000
Purchase and erection of transmission lines including transformer sub-stations	297,000
Distribution network	250,000
Service connections including meters	131,000
Street lighting	114,000
Engineering, contingencies etc.	368,000
Total	1,850,000

Table 2 - Capital Costs for Southeast and Southwest Towns

DESCRIPTION	COST PER TOWN (M $)
Purchase and installation of three 200 KW alternators and diesel prime movers	350,000
Purchase and erection of transmission lines including transformer sub-stations	104,000
Distribution network	83,000
Service connections including meters	46,000
Street lighting	38,000
Engineering, contingencies etc.	154,000
Total Cost for each Town	775,000

Table 3 - Capital Costs for One Village

DESCRIPTION	COST (M$)
One 28 KW diesel electric generating unit and house	15,000
Distribution network and service connections	17,000
Engineering, contingencies etc.	8,000
Total cost for one village	40,000

Table 4 - Operating Costs for Generation and Distribution per Annum

DESCRIPTION	OPERATING COST Regional Centre (M$)	Two Towns (M$)	
Fuel and lubricants 1/	90,000	84,000	
Labour 2/	90,000	130,000	
Maintenance of machinery 3/	34,000	42,000	
Maintenance of distribution network 4/	26,000	24,000	
	240,000	280,000	
Cost per annum			520,000

1/ Based on consumption of 1 lb. of diesel fuel per KW-hour at 60 cents per gallon.

2/ Includes wages of labourers, drivers, linesmen, chargemen, engine operators, clerks and supervisors plus 50 per cent overhead charges for housing, leave etc.

3/ Ten per cent of capital cost.

4/ Two per cent of distribution network capital costs.

APPENDIX 23

OTHER PUBLIC SERVICES

APPENDIX 23-1

POLICE DISTRICT CAPITAL AND OPERATING COSTS

Table 1 - Capital Costs for One Police District 1/

Description	Cost 2/ (M$)	
District Headquarters		
Station house	190,000	
Senior officers housing	172,000	
Barracks and other housing	860,000	
Furniture and equipment	250,000	
Total for one headquarters		1,472,000
Type 'A' Police Station		
Station house	15,000	
Accommodation for staff	115,000	
Furniture and equipment	50,000	
Total for four stations		720,000
Enlargement of existing Kg. Awah Station		
Station house	50,000	
Furniture and equipment	25,000	
		75,000
Total for one police district		2,267,000

1/ Including contingencies.

2/ Based on figures provided by Police Headquarters, Kuala Lumpur.

APPENDIX 23-1

Table 2 - Operating Costs for One Police District per Annum

Description	Operating Cost (M$)	
District Headquarters		
Personal emoluments	250,000	
Other charges	80,000	
Total for one district Headquarters		330,000
Police Station		
Personal emoluments	48,000	
Other charges	16,000	
Total for six police stations		384,000
Total for one police district per annum		714,000

APPENDIX 23-2

POSTAL SERVICES CAPITAL AND OPERATING COSTS

Table 1 - Capital Costs 1/

Description	Cost (M$)	
Main Post Office		
Building	150,000	
Land (0.5 acre)	-	
Equipment 2/	60,000	
Total capital cost for one post office		210,000
Subsidiary Post Office		
Building	78,000	
Land (0.25 acre)	-	
Equipment 2/	30,000	
Total capital cost for two post offices		216,000
Postal Agency		
Equipment 3/	600	
Total for twenty four postal agencies		14,000
Total capital costs for postal services		440,000

1/ Inclusive of engineering and contingencies.

2/ Exclusive of telephone exchange and telegraph equipment which is included in Telecommunications costing (Chapter 22). Inclusive of motor vehicles.

3/ Motor vehicles are not included as letter deliveries are not made from postal agencies, and mail bag delivery and collection is by contract.

APPENDIX 23-2

Table 2 - Operating Costs per Annum 1/

Description		Operating Cost (M$)	
Post Offices			
Personal emoluments		105,000	
Other recurrent charges		26,000	
			131,000
Postal Agencies			
Agency charges 2/		35,000	
Rural delivery costs 3/	(40,000)	-	
			35,000
Cost per annum			166,000

1/ Exclusive of Telecommunications annual costs.

2/ Mail deliveries to agencies from post offices and return, and agency operating fee of $25 per month.

3/ Includes wages of twelve postmen. Postmen will not be employed in the agencies until a suitable level of business is conducted.

APPENDIX 25

MANAGEMENT

APPENDIX 25-1

TRIANGLE HEADQUARTERS MANAGEMENT

Table 1 - Staff List and Phasing

	67/8	68/9	69/70	70/1	71/2	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/80	80/1	81/2	82/3	83/4
EXECUTIVE DEPARTMENT																	
Executive Director	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Personal Assistant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stenographer	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Progress Evaluation Section																	
Engineer Economist	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cost Accountant	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Agricultural Economist	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Financial Clerks	-	-	-	1	3	3	3	3	3	3	3	3	3	3	3	3	3
Chief Clerk	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Driver	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Messenger	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Executive Department Total	5	6	7	10	12	12	12	12	12	12	12	12	12	12	12	12	12

APPENDIX 25-1

Table 1 - Staff List and Phasing (Contd.)

	66/7	67/8	68/9	69/70	70/1	71/2	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/80	80/1	81/2	82/3	83/4
DEVELOPMENT DEPARTMENT (DEVELOPMENT GROUP)																		
Deputy Director	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Stenographer	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Chief Engineer	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Stenographer	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Drivers	4	4	4	4	4	4	4	4	4	4	4	-	-	-	-	-	-	-
Planning and Design Section																		
Industrial Planner	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Community Planner	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Agricultural Planner	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Clerks	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-
Draftsmen	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-
Typists	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Specification and Contracts Section																		
Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Assistants	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-
Statistical Clerks	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-
Typists	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Construction Supervision Section																		
Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Typist	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-

(Contd.)

APPENDIX 25-1

Table 1 - Staff List and Phasing (Contd.)

	66/7	67/8	68/9	69/70	70/1	71/2	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/80	80/1	81/2	82/3	83/4
Construction Supervision Section (continued)																		
(Engineering)																		
Clearing and Civil Works Unit:																		
Chief Supervisor	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Supervisors	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-
Buildings Unit:																		
Supervisors	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-	-	-
Factory Unit:																		
Resident Engineer	-	-	-	-	-	-	1	1	1	1	1	1	1	-	-	-	-	-
Clerk	-	-	-	-	-	-	1	1	1	1	1	1	1	-	-	-	-	-
Draftsmen	-	-	-	-	-	-	1	1	1	1	1	1	1	-	-	-	-	-
Driver	-	-	-	-	-	-	1	1	1	1	1	1	1	-	-	-	-	-
(Agriculture)																		
Operations Supervisor	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-
Senior Surveyor	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-
Assistants	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-
Draftsmen	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-
Typists	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-
Nursery Supervisors	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-	-	-
Clerk	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-
Planting Supervisors	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-	-	-
DEVELOPMENT DEPARTMENT (SETTLER SELECTION)																		
Selection Supervisor	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-
Assistant	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-
Chief Clerk	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-
Development Department Total	51	51	51	51	51	51	55	55	55	55	55	24	9	-	-	-	-	-

(Contd.)

APPENDIX 25-1

Table 1 - Staff List and Phasing (Contd.)

	66/7	67/8	68/9	69/70	70/1	71/2	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/80	80/1	81/2	82/3	83/4
OPERATIONS DEPARTMENT																		
Deputy Director	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stenographer	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Land Use Section																		
Fisheries Specialist	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Livestock Specialist	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Oil Palm Specialist	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Investigation Section																		
Agronomist in Charge	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Agricultural Economist	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Animal Husbandry Officer	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Assistants	-	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Stenographer	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Chief Clerk	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Driver	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Transportation and Storage Section																		
Fleet Supervisor	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Clerk	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Storage Supervisor	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Port Storage Supervisor	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ADMINISTRATIVE DEPARTMENT																		
Chief Accountant	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Examiner of Accounts	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stenographer	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

(Contd.)

Table 1 - Staff List and Phasing (Contd.)

	66/7	67/8	68/9	69/70	70/1	71/2	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/80	80/1	81/2	82/3	83/4
Staff Payroll																		
Chief Clerk	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Clerks	-	-	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Typist	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Personnel Officer	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Clerk	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stores and Services																		
Purchasing Officer	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Senior Examiner	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Clerks	-	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Typist	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Maintenance Supervisor	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Settler Loans																		
Accountant	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Senior Examiner	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Clerks	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Typist	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Data Processing																		
Operators	-	-	2	2	4	4	6	6	6	6	6	6	6	6	6	6	6	6
Community Development Section																		
Senior Community Development Officer	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stenographer	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Messenger	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Driver	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Telephonist	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Triangle Headquarters Total	3	24	42	50	53	53	55	55	55	55	55	55	55	55	55	55	55	55

APPENDIX 25-1

Table 2 - Unit Capital Costs (Staff)

(M$)

		Category of Structure	Construction 1/	Equip. or Staff transportation loan	Initial Cost	Contingencies (10%)	Unit Cost
MANAGEMENT	Executive Director	-	40,000	10,000	50,000	5,000	55,000
	Personal Assistant, Engineer Economist; Cost Accountant, Agricultural Economist	-	25,000	8,000	33,000	3,300	36,300
	Stenographer	Type 2	9,000	150	9,150	915	10,065
	Chief Clerk, Financial Clerk	Type 3	6,000	150	6,150	615	6,765
	Messengers	Improved settlers	2,000	150	2,150	215	2,365
OPERATIONS	Deputy Executive Director		35,000	10,000	45,000	4,500	49,500
	Chief Accountant	-	30,000	10,000	40,000	4,000	44,000
	Senior Community Development Officer	-	25,000	8,000	33,000	3,300	36,300
	Fisheries Specialist, Account; Animal Husbandry Specialist, Oil Palm Specialist; Agronomist in Charge, Personnel Officer, Purchasing Officer, Agricultural Economist, Fleet Supervisor; Accountant, Animal Husbandry Experimentalist	-	20,000	6,000	26,000	2,600	28,600
	Field Storage Supervisor, Port Storage Supervisor	Type 1	15,000	6,000	21,000	2,100	23,100
	Senior Examiner of Accounts	Type 1	15,000	5,000	20,000	2,000	22,000
	Stores and Maintenance Supervisor	Type 1	15,000	700	15,700	1,570	17,270
	Examiner of Accounts, Stenographer	Type 2	9,000	150	9,150	915	10,065
	Chief Clerk, Typist, Telephonist; Clerk, Machine Operator	Type 3	6,000	150	6,150	615	6,765
	Messenger	Improved settlers	2,000	150	2,150	215	2,365
DEVELOPMENT	Deputy Executive Director		35,000	10,000	45,000	4,500	49,500
	Chief Engineer	-	30,000	10,000	40,000	4,000	44,000
	Industrial Planner, Community Planner, Agric. Planner; Snr. Engineer, Resident Engineer, Agricultural Supervisor; Settler Selection Supervisor, Chief Supervisor (Works); Snr. Surveyor	-	20,000	6,000	26,000	2,600	28,600
	Planting Supervisor, Asst. Settler Selection Supervisor; Asst. Engineer, Building Supervisor, Supervisor (Works)	Type 1	15,000	6,000	21,000	2,100	23,100
	Assistant Surveyor	Type 2	9,000	700	9,700	970	10,670
	Stenographer, Draftsman	Type 2	9,000	150	9,150	915	10,065
	Clerk Typist, Chief Clerk, Financial Clerk	Type 3	6,000	150	6,150	615	6,765

1/ Based on 1965/6 prices (see Appendix 25-3 for details).

APPENDIX 25-1

Table 3 - Unit Capital Costs (Offices and Vehicles)

(M$)

	Construction	Equipment	Initial Cost	Contin-gencies (10%)	Recurrent Cost	Contin-gencies (10%)	Unit Cost	
							Initial	Recurrent
(a) <u>Offices</u>								
Administration Block	125,000 1/	200,000 2/	325,000	32,500	100,000	10,000	359,500	110,000
Mobile Office	15,000	7,500	22,500	2,250	7,500	750	24,750	8,250
(b) <u>Vehicles</u> (and drivers)								
L.W.B. Land Rover (diesel)	2,000 3/	9,000	11,000	1,100	7,500 4/	750	12,100	8,250

1/ Costed at 100 persons @ 125 feet per person @ $10 per sq. foot.

2/ Ordinary equipment costed at approximately three times Project Headquarters cost; accounting equipment equals $100,000 (no recurrent cost).

3/ Improved Settlers house for driver.

4/ Salvage value $1,500, life is 5 years.

APPENDIX 25-1

Table 6 - Unit Operating Costs (Offices and Equipment)

(M$)

	Current Monthly Salary Range	Average Annual Salary	Pension contribution 1/	Medical Provision 2/	Maintenance 3/	Operation 4/	Total Cost	Contingencies (10%)	Unit Cost
(a) Offices									
Administration Block	-	-	-	-	62,500	35,000	93,500	9,750	107,250
Mobile Office	-	-	-	-	750	25,000	25,750	2,575	28,625
(b) Vehicles and Driver									
L.W.B. Land Rover (Diesel)	120 - 160	1,680	168	240	100	3,600	5,788	579	6,367

Notes: 1/ Employers' contribution @ 10% of salary.
2/ Provision by employers for medical expenses @ $20 per month.
3/ @ 5% - all structures wooden.
4/ Office running costs @ approximately one third of equipment value; accounting equipment @ 5%; vehicle running costs - see Project Headquarters.

Table 7 - Phasing of Unit Operating Costs (Salaries, Offices and Vehicles) (M$ thousands)

	1967/8		1968/9		1969/0		1970/1 Onwards	
(a) **Executive Department**								
Executive Director	55	1	55	1	55	1	55	1
Personal Asst., etc.	31	1	31	1	62	2	123	4
Stenographer	-		9	1	18	2	18	2
Chief Clerk	6	1	6	1	6	1	6	1
Financial Clerk	-		-		6	1	18	3
Messenger	2	1	2	1	2	1	2	1
Vehicle - Land Rover	6	1	6	1	6	1	6	1
TOTAL	100		109		155		228	

	1966/7		1967/8		1968/9-1971/2		1971/2-1975/6		1976/7		1977/8		1978/9	
(b) **Development Department**														
Deputy Executive Director	-		-		47	1	47	1	47	1	-		-	
Chief Engineer	41	1	41	1	41	1	41	1	41	1				
Industrial Planner, etc.	194	7	194	7	194	7	222	8	194	7	83	3	55	2
Chief Supervisor (Works), etc.	44	2	44	2	44	2	44	2	44	2	22	1	22	1
Planting Supervisor	191	11	191	11	191	11	191	11	139	8	87	5	-	
Asst. Surveyor	32	3	32	3	32	3	32	3	32	3	32	3	32	3
Draftsman	45	6	45	6	45	6	53	7	53	7	30	4	8	1
Stenographer	9	1	9	1	18	2	18	2	18	2	-		-	
Chief Clerk	6	1	6	1	6	1	6	1	6	1	6	1	-	
Financial Clerk	18	3	18	3	18	3	18	3	-		-		-	
Typist	15	4	15	4	15	4	15	4	11	3	4	1		
Clerk	23	4	23	4	23	4	29	5	29	5	29	2	6	1
Vehicle - Land Rover	26	4	26	4	26	4	32	5	32	5	13	2	6	1
Mobile Office	143	5	143	5	143	5	114	4	114	4	86	3	57	2
TOTAL	787		787		843		891		760		392		186	

	1967/8		1968/9		1969/0		1970/1-1971/2		1972/3 Onwards	
(c) **Operations Department**										
Deputy Executive Director	-		-		47	1	47	1	47	1
Chief Accountant	36	1	36	1	36	1	36	1	36	1
Snr. Community Dev. Officer	31	1	31	1	31	1	31	1	31	1
Fisheries Specialist, etc.	57	2	57	2	115	4	115	4	115	4
Accountant, etc.	47	2	71	3	71	3	71	3	71	3
Agric. Economist, etc.	42	2	42	2	62	3	62	3	62	3
Field Storage Supervisor, etc.	-		-		33	2	33	2	33	2
Snr. Examiner of Accounts	12	1	24	2	24	2	24	2	24	2
Stores Supervisor	11	1	11	1	11	1	11	1	11	1
Examiner of Accounts	-		9	1	9	1	9	1	9	1
Clerk	11	2	51	9	57	10	63	11	63	11
Typist	8	2	11	3	11	3	11	3	11	3
Machine Operator	-		7	2	7	2	15	4	22	6
Stenographer	9	1	9	1	18	2	18	2	18	2
Chief Clerk	6	1	6	1	6	1	6	1	6	1
Messenger	2	1	2	1	2	1	2	1	2	1
Vehicle - Land Rover	6	1	6	1	6	1	6	1	6	1
Administration Block	107	1	107	1	107	1	107	1	107	1
Telephonist	4	1	4	1	4	1	4	1	4	1
TOTAL	389		484		657		672		679	

	1966/7	1967/8	1968/9	1969/0	1970/1 1971/2	1972/3 1975/6	1976/7	1977/8	1978/9	1979/0 Onwards
(d) **All Departments**	787	1276	1436	1655	1743	1798	1667	1299	1093	907

PROJECT MANAGEMENT

Table 1 - Staff List and Phasing (Summary All Projects)

	66/7	67/8	68/9	69/70	70/1	71/2	72/3	73/4	74/5	75/6	76/7	77/8	Totals
PROJECT MANAGEMENT													
Project Manager	1	-	1	1	-	1	1	1	-	-	-	-	6
Trainee Project Manager	-	1	1	1	-	-	-	-	-	-	-	-	3
Administrative Officer	-	1	1	-	1	1	1	1	-	-	-	-	6
Stenographer	1	-	1	1	-	1	1	1	-	-	-	-	6
Clerk	1	-	1	-	1	1	1	1	-	-	-	-	6
Agriculturist	-	1	-	1	1	-	1	1	1	-	-	-	6
Crop Transport													
Transport Controller	-	-	1	-	1	1	1	-	-	-	1	1	6
Asst. Transport Controller	-	-	1	-	1	1	1	-	-	-	1	1	6
Operations Clerk	-	-	1	-	1	1	1	-	-	-	1	1	6
Community Development													
Community Dev. Officer	-	-	2	-	1	-	1	1	1	-	-	-	6
Assistant	-	-	-	3	1	1	1	1	2	2	1	-	12
Maintenance													
Assistant Engineer	-	-	2	-	1	1	1	1	-	-	-	-	6
Roads Supervisor	-	1	1	1	-	1	1	1	-	-	-	-	6
Buildings Supervisor	-	-	1	1	1	-	1	1	-	1	-	-	6
Draughtsmen	-	-	2	2	1	2	2	2	1	-	-	-	12
Clerk	-	-	2	-	1	1	1	1	-	-	-	-	6
Accounts and Payroll													
Senior Examiner	-	1	1	1	-	1	1	1	-	-	-	-	6
Chief Clerk (Bldg.stores, staff)	-	-	1	1	1	-	1	1	1	-	-	-	6
Clerk	-	1	1	1	-	1	1	1	-	-	-	-	6
Chief Clerk (Settler Loans)	-	-	1	1	1	-	1	1	1	-	-	-	6
Clerk	-	-	1	1	1	-	1	1	1	-	-	-	6
Stenographer	-	1	1	1	-	1	1	1	-	-	-	-	6
Typists	-	-	4	-	2	-	1	2	2	1	-	-	12
Driver	-	1	3	1	1	2	2	2	-	-	-	-	12
Messenger	-	-	2	-	1	1	1	1	-	-	-	-	6
Telephonist	-	-	2	-	1	1	1	1	-	-	-	-	6
Cumulative Total	3	11	46	64	84	104	131	156	166	170	174	177	

APPENDIX 25-2

Table 2 - Unit Capital Costs (Housing, Offices & Vehicles)

(M$)

UNIT TYPE	Category of Structure	Construction 1/	Equipt. or Staff Transport-ation	Initial cost	Contin-gencies (10%)	Recurrent Cost	Contin-gencies (10%)	Unit Cost	
								Initial	Recurrent
Project Manager	-	30,000	10,000	40,000	4,000	-	-	44,000	-
Trainee Project Manager	-	25,000	8,000	33,000	3,300	-	-	36,300	-
Transport Controller Agricultural Advisory Officer Community Development Officer	-	20,000	6,000	26,000	2,600	-	-	28,600	-
Engineer Administrative Officer Asst. Community Dev. Officer	Type 1	15,000	6,000	21,000	2,100	-	-	23,200	-
Roads Supervisor Buildings Supervisor Asst. Transport Controller Senior Examiner of Accounts	Type 1	15,000	5,000	20,000	2,000	-	-	22,000	-
Stenographer Draughtsman	Type 2	9,000	150	9,150	915	-	-	10,065	-
Chief Clerk Operations Clerk Clerk Typist Telephonist	Type 3	6,000	150	7,150	715	-	-	7,865	-
Messenger	Improved Settlers	2,000	150	2,150	215	-	-	2,365	-
Administration Block	-	37,500 2/	32,000 3/	69,500	6,950	32,000	3,200	76,450	35,200
L.W.B. Land Rover-Diesel	Improved Settlers	2,000	9,000 4/	11,000	1,100	7,500 4/	750	12,100	8,250

1/ Based on 1965/6 prices (see field offices for details)
2/ Costed at 30 persons @ 125 sq. feet per person @ $10 per sq. foot.
3/ Equipment cost.
4/ Salvage value equals $1500, life is 5 years.

APPENDIX 25-2

Table 3 - Phasing of Unit Capital Costs (Housing, Offices & Vehicles)

(M$ thousands)

	PROJECT I			PROJECT II			PROJECT III		
	1967/8 1/	1968/9	1970/1	1967/8	1968/9	1971/2	1969/0 1/	1970/1	1971/2
Project Manager	44 1			44 1			44 1		
Trainee Proj. Manager	36 1			36 1			36 1		
Transp. Controller etc.	86 3			29 1	29 1	- 2/	86 3		
Engineer etc.	46 2	23 1	23 1	46 2	46 2		46 2	23 1	23 1
Roads Supervisor etc.	88 4			44 2	22 1	22 1	88 4		
Stenographer etc.	40 4			20 2	20 2		40 4		
Chief Clerk etc.	79 10			40 5	15 2	8 1	79 10		
Messenger	2 1			2 1			2 1		
Office 3/	77 1			77 1			77 1		
Vehicles 4/	24 2			24 2			24 2		
Total	522	23	23	362	132	30	522	23	23

	PROJECT IV				PROJECT V			PROJECT VI		
	1970/1	1971/2	1972/3	1973/4	1971/2	1972/3	1973/4 5/	1972/3	1973/4	1974/5 5/
Project Manager	44 1				44 1			44 1		
Transp. Controller etc.	29 1	29 1 2/				57 2			57 2	
Engineer etc.	46 2		23 1		46 2		23 1	46 2		23 1
Road Supervisor etc.	66 3	22 1		23 1	66 3	22 1		66 3	22 1	
Stenographer etc.	20 2	20 2			20 2	20 2		20 2	20 2	
Chief Clerk etc.	47 6	23 3	8 1		47 6	16 2	8 1	47 6	16 2	8 1
Messenger	2 1				2 1			2 1		
Office 3/	77 1				77 1			77 1		
Vehicles 4/	24 2				24 2			24 2		
Total	355	94	31	23	326	115	31	326	115	31

1/ Structures may not be built until end of year, a small number of staff required in 1966/67, no provision made for temporary accommodation, etc.
2/ One assumed to replace Trainee Project Manager
3/ Recurrent cost @ $35,200 every five years.
4/ Recurrent cost @ $8,250 every five years.
5/ Assumed to replace their equivalents in Project I or Triangle Headquarters.

APPENDIX 25-2

Table 4 - Unit Operating Costs (Staff)

(M$)

Unit Type	FLDA Equivalent	Current Monthly Salary Range	Average Annual Salary	Pension Contribu-tion 1/	Medical Provi-sion 2/	Main-tenance 3/	Oper-ation 4/	Total Cost	Contin-gencies 10%	Unit Cost
(a) Staff										
1. Project Manager	Executive Secretary	1950 - 2250	25,200	2,520	240	1,500	1,560	31,020	7,755 5/	38,775
2. Trainee Project Manager	Visiting Manager	1525 - 1750	19,656	1,966	240	1,250	1,560	27,372	6,845 5/	34,215
3. Transport Controller Agric. Advisory Officer Community Dev. Officer	Manager Grade I	1450 - 1600	18,300	1,830	240	1,000	1,560	22,930	5,733 5/	28,663
4. Administrative Officer	Administrative Officer	850 - 1500	13,100	1,310	240	750	1,560	16,960	1,696	18,656
5. Engineer Asst. Community Dev. Officer	Manager Grade III	1000 - 1200	12,100	1,210	240	750	1,560	15,860	1,586	17,446
6. Roads Supervisor Building Supervisor Asst. Transport Controller	Junior Manager	750 - 910	9,960	996	240	750	1,560	13,506	1,351	14,857
7. Snr. Examiner of Accounts	Snr. Exam of Accounts	630 - 900	9,180	918	240	750	380	11,468	1,147	12,615
8. Stenographer	Stenographer	375 - 700	6,456	646	240	450	-	7,792	779	8,571
9. Draughtsman	Draughtsman	180 - 750	5,580	558	240	450	-	6,828	683	7,511
10. Operations Clerk/Chief Clerk	Chief Clerk	300 - 500	4,800	480	240	450	-	5,970	597	6,567
11. Clerk	General Clerk	200 - 500	4,200	420	240	300	-	5,160	516	5,676
12. Typist	Typist	150 - 290	2,640	264	240	300	-	3,444	344	3,788
13. Telephonist	Telephonist	150 - 280	2,580	258	240	300	-	3,378	338	3,716
14. Messenger	Office Boy	84 - 90	1,044	104	240	100	-	1,488	149	1,637
(b) Offices										
15. Administration Block	-	-	-	-	-	1,875	10,000	11,875	1,188	13,063
(c) Vehicles (and driver)										
16. L.W.B. Land Rover-diesel	Driver - Land Rover/ Tractor	120 - 160	1,680	168	240	100	3,600	5,788	589	6,367

1/ Employers Contribution @ 10% of salary
2/ Provision by employer for medical expenses @ $20 per month
3/ @ 5% - all structures wooden
4/ Staff travelling expenses, vehicle, office running costs etc. Maintenance and running costs of Land Rover assumed to be 18 ¢ p.m. @ 20,000 miles p.a. All staff entitled to travelling expenses assumed to cover 400 miles per month except Senior Examiner of Accounts (100 miles only). Office running costs @ approximately one third of equipment value (projection of Bilut Valley Scheme Office costs).
5/ 25% contingencies to allow for additional cost of expatriate staff if required.

APPENDIX 25-2

Table 5 - Phasing of Unit Operating Costs (Salaries, Offices and Vehicles)

(M$ thousands)

	PROJECT I						PROJECT II					
	1966/7	1967/8	1968/9	1969/0-1971/2	1972/3 1976/7	1977/8 Onwards	1968/9	1969/0-1970/1	1971/2	1972/3	1973/4 1978/9	1979/0 Onwards
Project Manager	39 1	39 1	39 1	39 1	39 1	39 1	39 1	39 1	39 1	39 1	39 1	39 1
Trainee Project Mgr.	- -	34 1	34 1	34 1	-	-	34 1	34 1	34 1	34 -	- -	- -
Transp. Controller etc.	- -	29 1	86 3	86 3	86 3	57 2	29 1	57 2	57 2	86 3	86 3	57 2
Admin. Officer	- -	19 1	19 1	19 1	19 1	19 1	19 1	19 1	19 1	19 1	19 1	19 1
Engineer, etc.	- -	-	17 1	35 2	52 3	17 1	17 1	35 2	52 3	52 3	52 3	17 1
Roads Supervisor, etc.	- -	15 1	45 3	45 3	45 3	45 3	15 1	30 2	30 2	45 3	45 3	45 3
Senior Examiner of Accounts	- -	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1
Stenographer	9 1	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2
Draughtsman	- -	- -	8 1	15 2	15 2	15 2	8 1	15 2	15 2	15 2	15 2	15 2
Chief Clerk, etc.	- -	- -	20 3	20 3	20 3	20 3	- -	13 2	13 2	20 3	20 3	20 3
Clerk	6 1	11 2	23 4	23 4	23 4	23 4	17 3	23 4	23 4	23 4	23 4	23 4
Typist	- -	- -	8 2	8 2	8 2	8 2	8 2	8 2	8 2	8 2	8 2	8 2
Telephonist	- -	4 1	4 1	4 1	4 1	4 1	4 1	4 1	4 1	4 1	4 1	4 1
Messenger	- -	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1
Office	- -	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1
Vehicle	- -	6 1	13 2	13 2	13 2	13 2	13 2	13 2	13 2	13 2	13 2	13 2
TOTAL		202	361	386	369	305	248	335	352	403	369	305

APPENDIX 25-2

Table 5 - Phasing of Unit Operating Costs (Salaries, Offices and Vehicles) (Contd.)

(M$ thousands)

UNIT TYPE	PROJECT III						PROJECT IV				
	1969/0	1970/1	1971/2	1972/3-1973/4	1974/5-1977/8	1978/9 Onwards	1971/2	1972/3	1973/4	1974/5-1983/4	1984/5 Onwards
1. Project Manager	39 1	39 1	39 1	39 1	39 1	39 1	39 1	39 1	39 1	39 1	39 1
2. Trainee Project Mgr.	34 1	34 1	34 1	34 1	- -	- -	- -	- -	- -	- -	- -
3. Transp. Controller, etc.	- -	86 3	86 3	86 3	86 3	57 2	29 1	86 3	86 3	86 3	57 2
4. Administrative Officer	- -	19 1	19 1	19 1	19 1	19 1	19 1	19 1	19 1	19 1	19 1
5. Engineer, etc.	- -	17 1	35 2	52 3	52 3	17 1	17 1	17 1	35 2	52 3	17 1
6. Roads Supervisor, etc.	15 1	45 3	45 3	45 3	45 3	45 3	30 2	45 3	45 3	45 3	45 3
7. Snr. Examiner of Accounts	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1
8. Stenographer	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2
9. Draughtsman	- -	8 1	15 2	15 2	15 2	15 2	8 1	15 2	15 2	15 2	15 2
10. Chief Clerk, etc.	- -	20 3	20 3	20 3	20 3	20 3	7 1	20 3	20 3	20 3	20 3
11. Clerk	6 1	23 4	23 4	23 4	23 4	23 4	17 3	23 4	23 4	23 4	23 4
12. Typist	- -	8 2	8 2	8 2	8 2	8 2	8 2	8 2	8 2	8 2	8 2
13. Telephonist	- -	4 1	4 1	4 1	4 1	4 1	4 1	4 1	4 1	4 1	4 1
14. Messenger	- -	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1
15. Office	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1	13 1
16. Vehicle	6 1	13 2	13 2	13 2	13 2	13 2	13 2	13 2	13 2	13 2	13 2
TOTAL	143	361	386	403	367	305	224	330	352	369	305

(Contd.)

APPENDIX 25-2

Table 5 - Phasing of Unit Operating Costs (Salaries, Offices and Vehicles)

(M$ thousands)

Unit Type	PROJECT V												PROJECT VI											
	1972/3		1973/4		1974/5		1975/6		1976/7-1983/4		1983/4 Onwards		1973/4		1974/5		1975/6		1976/7		1977/8-1983/4		1983/4 Onwards	
1. Project Manager	39	1	39	1	39	1	39	1	39	1	39	1	39	1	39	1	39	1	39	1	39	1	39	1
2. Trainee Project Mgr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Transp. Controller, etc.	-	-	57	2	57	2	57	2	86	3	57	2	-	-	57	2	57	2	57	2	57	2	57	2
4. Administrative Officer	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1
5. Engineer, etc.	17	1	17	1	35	2	52	3	52	3	17	1	17	1	17	1	35	2	52	3	52	3	17	1
6. Road Supervisor, etc.	15	1	30	2	30	2	30	2	45	3	45	3	15	1	30	2	30	2	30	2	45	3	45	3
7. Snr. Examiner of Accounts	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1
8. Stenographer	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2
9. Draughtsman	8	1	15	2	15	2	15	2	15	2	15	2	8	1	15	2	15	2	15	2	15	2	15	2
10. Chief Clerk, etc.	-	-	13	2	13	2	13	2	20	3	20	3	-	-	13	2	13	2	13	2	20	3	20	3
11. Clerk	17	3	23	4	23	4	23	4	23	4	23	4	17	3	23	4	23	4	23	4	23	4	23	4
12. Typist	-	-	4	1	8	2	8	2	8	2	8	2	-	-	4	1	8	2	8	2	8	2	8	2
13. Telephonist	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1
14. Messenger	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
15. Office	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1	13	1
16. Vehicle	13	2	13	2	13	2	13	2	13	2	13	2	13	2	13	2	13	2	13	2	13	2	13	2
TOTAL	179		279		301		318		369		305		176		279		301		318		369		369	

APPENDIX 25-3

SETTLEMENT UNIT MANAGEMENT

Table 1 - Staff List and Phasing (All projects

	66/7	67/8	68/9	69/70	70/1	71/2	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/80	80/1	81/2	82/3	83/4
PROJECTS I - VI																		
Managers	1	5	8	13	19	26	32	33	35	36	31	29	26	26	25	25	25	25
Asst. Managers	3	12	21	33	46	60	72	75	77	76	65	60	54	54	51	51	51	51
Senior Supervisors	-	8	26	42	65	90	118	136	139	148	129	118	107	105	99	99	99	99
Field Assistants	-	-	-	-	4	14	22	32	43	55	68	78	81	81	85	94	102	102
Finance/Gen. Clerks	1	5	8	13	19	26	32	34	36	36	32	30	27	27	26	26	26	26
Stores Clerks	1	5	8	13	19	26	32	34	36	36	32	30	27	27	26	26	26	26
Tractor Drivers	-	5	5	8	14	18	25	31	39	43	43	43	43	43	43	43	43	43
L.R. Drivers	1	5	8	13	19	26	32	33	35	36	31	29	26	26	25	25	25	25
Total	7	45	84	135	205	286	365	408	440	466	431	417	391	389	380	389	397	397

APPENDIX 25-3

Table 2 - Staff and Office Requirements By Project

PROJECT	TYPE	STAFF : Annual Requirements 1966/7 -1968/9	1969/0 -1971/2	1972/3 -1974/5	1975/6 -1977/8	1978/9 -1980/1	1981/2 -1982/3	YR. 27	PROVISION OF STRUCTURES/EQUIPMENT 1/ - Initial Requirements 1966/7 -1968/9	1969/0 -1971/2	1972/3 -1974/5	1975/6 -1977/8	1978/9 -1980/1	1981/2
I	Managers	1 [illegible] 5	5 5 5	5 4 3	3 3 3	3 3 3	3 3 3	3	1 4 -	- - -	- - -	- - -	- - -	-
	Asst. Managers	3 12 12	12 12 12	12 10 7	7 7 7	7 7 7	7 7 7	7	3 9 -	- - -	- - -	- - -	- - -	-
	Snr. Supervisors	- 23 26	26 26 26	26 22 14	14 1 13	13 13 13	13 13 13	13	8 16 -	- - -	- - -	- - -	- - -	-
	Field Assts,	- - -	- 4 14	14 14 15	15 15 15	15 15 15	15 15 15	15	- - -	4 10 -	- - -	- - -	- - -	-
	Clerks	2 10 10	10 10 10	10 8 6	6 6 6	6 6 6	6 6 6	6	2 8 -	- - -	- - -	- - -	- - -	-
	Tractor Drivers	1 5 5	5 5 5	5 5 5	5 5 5	5 5 5	5 5 5	5	1 4 -	- - -	- - -	- - -	- - -	-
	L.R. Drivers	1 5 5	5 5 5	5 4 3	3 3 3	3 3 3	3 3 3	3	1 4 -	- - -	- - -	- - -	- - -	-
	Office	3 11 12	12 12 12	12 10 7	7 7 7	7 7 7	7 7 7	7	3 8 1	- - -	- - -	- - -	- - -	-
II	Managers	- - 3	5 6 6	6 6 6	5 4 4	4 4 4	4 4 4	4	- - 3	2 1 -	- - -	- - -	- - -	-
	Asst. Managers	- - 9	14 17 17	17 17 17	12 9 9	9 9 8	8 8 8	8	- - 9	5 3 -	- - -	- - -	- - -	-
	Snr. Supervisors	- - -	16 26 32	32 32 32	24 21 21	21 19 16	16 16 16	16	- - 16	10 6 -	- - -	- - -	- - -	-
	Field Assts.	- - -	- - -	8 11 11	11 13 16	16 16 16	16 16 16	16	- - -	- - 8	3 - -	- - -	- - -	-
	Clerks	- - 6	10 12 12	12 12 12	10 8 8	8 8 8	8 8 8	8	- - 6	4 2 -	- - -	- - -	- - -	-
	Tractor Drivers	- - -	3 6 6	6 6 6	6 6 6	6 6 6	6 6 6	6	- - 3	2 1 -	- - -	- - -	- - -	-
	L.R. Drivers	- - 3	5 6 6	6 6 6	5 4 4	4 4 4	4 4 4	4	- - 3	2 1 -	- - -	- - -	- - -	-
	Office	- - 9	14 17 17	17 17 17	12 9 9	9 9 8	8 8 6	8	- - 9	5 3 -	- - -	- - -	- - -	-
III	Managers	- - -	3 6 10	10 10 10	10 6 6	6 6 5	5 5 5	5	- - -	3 5 2	- - -	- - -	- - -	-
	Asst. Managers	- - -	7 17 21	21 21 21	21 13 13	13 13 11	11 11 11	11	- - -	7 10 4	- - -	- - -	- - -	-
	Snr. Supervisors	- - -	- 13 32	40 40 40	40 24 24	24 24 21	21 21 21	21	- - -	13 19 8	- - -	- - -	- - -	-
	Field Assts.	- - -	- - -	- 7 17	19 19 19	22 22 22	22 22 22	22	- - -	- - -	7 10 2	- - -	- - -	-
	Clerks	- - -	6 16 20	20 20 20	18 12 12	12 12 10	10 10 10	10	- - -	6 10 4	- - -	- - -	- - -	-
	Tractor Drivers	- - -	- 3 7	9 9 9	9 9 9	9 9 9	9 9 9	9	- - -	3 4 2	- - -	- - -	- - -	-
	L.R. Drivers	- - -	2 7 6	8 8 8	8 5 5	5 5 5	5 5 5	5	- - -	2 5 1	- - -	- - -	- - -	-
	Office	- - -	7 17 21	21 21 21	21 13 13	13 13 11	11 11 11	11	- - -	7 10 4	- - -	- - -	- - -	-
IV	Managers	- - -	- - 5	7 7 7	7 7 5	4 4 4	4 4 4	4	- - -	- - 5	2 - -	- - -	- - -	-
	Asst. Managers	- - -	- - 10	14 14 14	14 14 9	7 7 7	7 7 7	7	- - -	- - 10	4 - -	- - -	- - -	-
	Snr. Supervisors	- - -	- - -	20 28 28	28 28 18	14 14 14	14 14 14	14	- - -	- - 20	8 - -	- - -	- - -	-
	Field Assts.	- - -	- - -	- - -	10 14 14	14 14 14	14 14 14	14	- - -	- - -	- - 10	4 - -	- - -	-
	Clerks	- - -	- - 10	14 14 14	14 14 10	8 8 8	8 8 8	8	- - -	- - 10	4 - -	- - -	- - -	-
	Tractor Drivers	- - -	- - -	5 7 7	7 7 7	7 7 7	7 7 7	7	- - -	- - 5	2 - -	- - -	- - -	-
	L.R. Drivers	- - -	- - 5	7 7 7	7 7 5	4 4 4	4 4 4	4	- - -	- - 5	2 - -	- - -	- - -	-
	Office	- - -	- - 10	14 14 14	14 14 9	7 7 7	7 7 7	7	- - -	- - 10	4 - -	- - -	- - -	-
V	Managers	- - -	- - -	4 5 7	7 7 7	5 5 5	5 5 5	5	- - -	- - -	4 1 2	- - -	- - -	-
	Asst. Managers	- - -	- - -	8 10 14	14 14 14	10 10 10	10 10 10	10	- - -	- - -	6 2 4	- - -	- - -	-
	Snr. Supervisors	- - -	- - -	- 14 18	25 25 25	18 18 18	18 18 18	18	- - -	- - -	14 4 7	- - -	- - -	-
	Field Assts.	- - -	- - -	- - -	- 7 7	7 7 7	18 18 18	18	- - -	- - -	- - -	7 - -	- - -	-
	Clerks	- - -	- - -	8 10 14	14 14 14	10 10 10	10 10 10	10	- - -	- - -	8 2 4	- - -	- - -	-
	Tractor Drivers	- - -	- - -	- 4 9	9 9 9	9 9 9	9 9 9	9	- - -	- - -	4 2 3	- - -	- - -	-
	L.R. Drivers	- - -	- - -	4 5 7	7 7 7	5 5 5	5 5 5	5	- - -	- - -	4 1 2	- - -	- - -	-
	Office	- - -	- - -	7 10 14	14 14 14	10 10 10	10 10 10	10	- - -	- - -	7 3 4	- - -	- - -	-
VI	Managers	- - -	- - -	- 1 2	4 4 4	4 4 4	4 4 4	4	- - -	- - -	- 1 1	2 - -	- - -	-
	Asst. Managers	- - -	- - -	- 3 4	8 8 8	8 8 8	8 8 8	8	- - -	- - -	- 3 1	4 - -	- - -	-
	Snr. Supervisors	- - -	- - -	- - 7	9 17 17	17 17 17	17 17 17	17	- - -	- - -	- 7 2	6 - -	- - -	-
	Field Assts.	- - -	- - -	- - -	- - 7	7 7 7	9 17 17	17	- - -	- - -	- - -	- 7 -	- - 2	8
	Clerks	- - -	- - -	- 4 6	10 10 10	10 10 10	10 10 10	10	- - -	- - -	- 4 2	4 - -	- - -	-
	Tractor Drivers	- - -	- - -	- - 3	7 7 7	7 7 7	7 7 7	7	- - -	- - -	- 2 1	4 - -	- - -	-
	L.R. Drivers	- - -	- - -	- 2 3	5 5 5	5 5 5	5 5 5	5	- - -	- - -	- 2 1	2 - -	- - -	-
	Office	- - -	- - -	- 3 4	8 8 8	8 8 8	8 8 8	8	- - -	- - -	- 3 2	4 - -	- - -	-

1/ Provided in year prior to need except where required in Year 0; then provided at end of Year 0. Field Assistants in many cases can occupy homes left vacant due to staff reductions prior to their arrival. Minor error in respect of Tractor Drivers in that tractor provided at end of Year 0 when not required until Year I.

APPENDIX 25-3

Table 3 - Unit Capital Costs

	Category of Structure	Construction 1/	Equipment or staff transportation loan	Initial cost	Contingencies (10%)	Recurrent cost 3/	Contingencies (10%)	Unit Cost	
								Initial	Recurrent
(i) **Housing**									
Manager	Type 1	15,000	6,000	21,000	2,100	-	-	23,200	-
Assistant Manager	Type 2	9,000	700	9,700	970	-	-	10,670	-
Senior Supervisor	Type 3	6,000	700	6,700	670	-	-	7,370	-
Field Assistant	Improved Settlers	2,000	150	2,150	215	-	-	2,365	-
Clerk	Type 3	6,000	1,150	7,150	715	-	-	7,865	-
(ii) **Offices**									
Field office	-	6,000 2/	3,200	9,200	920	3,200	320	10,120	3,520
(iii) **Vehicles and Drivers**									
L.W.B. land Rover-diesel	Improved Settlers	2,000	9,000	11,000	1,100	7,500	750	12,100	8,250
Tractor & trailer	Improved Settlers	2,000	10,000	12,000	1,200	8,500	850	13,200	9,350

1/ Based on 1965/66 prices - recent 10-15% price increase to be negatived by reduction in costs possible once local timber industry developed (see settler housing). No salvage value for housing left vacant due to staff reduction in later years.

2/ Each village estimated to require equivalent of 4 - 5 rooms of 125 sq. ft. @ $10/- per sq. ft.

3/ Salvage value assumed to be $1,500 - life of equipment is five years.

APPENDIX 25-3

Table 4 - Unit Operating Costs

	FLDA Equivalent	Current Monthly Salary Range $	Average Annual Salary	Employers Pension Contribution (10% of salary)	Provision for medical attention	Operation/ main-tenance	Total Cost	Conti-gencies (10%)	Unit Cost
(i) **Staff**									
Manager	Manager	1,000 - 1,600	15,600	1,560	240	1,750 1/	19,150	1,915	20,165
Asst. Manager	Asst. Manager	450 - 630	6,480	648	240	700	8,068	807	8,875
Senior Super-visor	Senior Supervisor	300 - 500	4,800	480	240	550 1/	6,070	607	6,677
Field Assistant	Field Assistant	150 - 330	2,448	245	240	100 1/	3,032	303	3,355
Clerk	General/Fin. Clerk	200 - 500	4,200	420	240	300 1/	5,160	516	5,676
(ii) **Offices**									
Field office	As for Batu Lapan FLDA Scheme	-	-	-	-	3,114	3,114	311	3,425
(iii) **Vehicles & Dri-ver**									
L.W.B. Land Rover-diesel	Driver: Land Rover/ Tractor	120 - 160	1,680	168	240	3,700 2/	5,788	579	6,367
Tractor & Trailer	Driver: Land Rover/ Tractor	120 - 160	1,680	168	240	2,100 3/	4,188	419	4,607

1/ Housing maintenance @ 5% plus $1,000 p.a. travelling expenses (Manager) or $250 p.a. (Asst. Manager & Senior Supervisor)

2/ " " @ 5% " maintenance and running costs of Land Rover @ 18¢ p.m. @ 20,000 miles p.a.

3/ " " @ 5% " " ($1,600 p.a.) and other expenses ($400 p.a.)

APPENDIX 25-3

Table 5 - Staff List and Phasing (Existing FLDA Schemes) 1/

ULU JEMPOL, BUKIT TAJAU, KAMPONG AWAH, SUNGEI NEREK AND SUNGEI TEKAM	1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5
Managers	3	5	5	5	5	5	5	5	5
Asst. Managers	6	12	14	15	15	13	12	12	11
Senior Supervisors	6	24	30	37	37	32	28	28	24
Field Assistants	19	18	18	18	19	28	28	28	28
Finance/Gen. Clerks	5	5	5	5	5	5	5	5	5
Stores Clerks	1	5	5	5	5	5	5	5	5
Tractor Drivers	2	6	9	9	9	9	9	9	9
L.R. Drivers	3	5	5	5	5	5	5	5	5
	45	80	91	99	100	102	97	97	92

ULU JEMPOL, BUKIT TAJAU, KAMPONG AWAH, SUNGEI NEREK AND SUNGEI TEKAM	1975/6	1976/7	1977/8	1978/9	1979/80	1980/1	1981/2	1982/3	1983/4
Managers	5	5	5	5	5	5	5	5	5
Asst. Managers	11	11	11	11	11	11	11	11	11
Senior Supervisors	24	24	24	24	24	24	24	24	24
Field Assistants	28	28	28	28	28	28	28	28	28
Finance/Gen. Clerks	5	5	5	5	5	5	5	5	5
Stores Clerks	5	5	5	5	5	5	5	5	5
Tractor Drivers	9	9	9	9	9	9	9	9	9
L.R. Drivers	5	5	5	5	5	5	5	5	5
	92	92	92	92	92	92	92	92	92

1/ Staff numbers based on assumed levels of F.L.D.A. Staffing at manager level, higher densities initially at other levels.

APPENDIX 25-4

ANNUAL STAFF INTAKE BY CATEGORIES

	66/7	67/8	68/9	69/0	70/1	71/2	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/0	80/1	81/2	82/3	83/4
Executive Director		1																
Deputy	1				1													
Chief Engineer	1																	
Project Manager Trainees		1	1	1														
Chief Accountant		1																
Personal Assistant		1																
Engineer Economist					1													
Cost Accountant						1												
Agricultural Economist						1												
Snr. Comm. Dev. Officer		1																
Snr. Engineer	2																	
Community Planner	1																	
Agricultural Planner	1																	
Industrial Planner	1																	
Resident Const. Engineer							1											
Oil Palm Specialist		1																
Fisheries Specialist				1														
Livestock Specialist				1														
Agronomist in Charge		1																
Transport Controller			1		1	1	1				1	1						
Agriculturist		1		1	1		1	1	1									
Comm. Dev. Officer			2		1		1	1	1									
Accountant			1															
Personnel Officer		1																
Purchasing Officer		1																
Settler Selection Supervisor	1																	
Chief Field Supervisor	2																	
Senior Surveyor	1																	
Agricultural Economist		1																
Animal Husbandry Expert		1																
Fleet Supervisor				1														
Manager	1	4	3	5	6	7	6	1	2	1								
Administrative Officer		1	1		1	1	1	1										
Supervisor (Engineering)	11	2	2	3	2	1	2	2		1								
Asst. Settler Sel. Supervisor	1																	
Engineer Assistant	3		2		1	1	1	1										
Asst. Comm. Dev. Officer				3	1	1	1	1	2	2	1							
Asst. Transport Controller			1		1	1	1				1	1						
Senior Examiner		2	2	1		1	1	1										
Asst. Surveyor	3																	
Examiner			1															
Asst. Manager	3	9	9	12	13	14	12	3	2									
Stenographer	3	3	4	3		2	2	2										
Draughtsman	6		2	2	1	2	3	2	1									
Senior Supervisor		8	18	16	23	25	23	18	3	9								
Clerk	11	14	21	16	19	20	20	10	7		1	1						
Typist	4	1	6		2		1	2	2	1								
Telephonist	1		2		1	1	1	1										
Machine Operator			2		2		2											
Field Assistant		3	3		4	10	8	10	11	12	13	10	3	4	9	8		
Driver	4	12	6	9	13	13	16	9	10	5								
Messenger	1	1	2		1	1	1	1										

APPENDIX 26

FINANCIAL AND ECONOMIC ANALYSIS (Contd.)

APPENDIX 26

FINANCIAL AND ECONOMIC ANALYSIS

(Contd.)

APPENDIX 26

FINANCIAL AND ECONOMIC ANALYSIS (Contd.)

APPENDIX 26

FINANCIAL AND ECONOMIC ANALYSIS

(Contd.)

APPENDIX 26-1

FLDA CAPITAL EXPENDITURE

Table 1 - Fixed Capital - Agricultural Development

Land Preparation	Units	Acres	Unit Cost M$ Per Acre	Triangle M$ Million
Forest Clearance	Gross Area	114,100	167	19.0
Destumping house and village area	0.4 acres per settler	3,720	242	0.9
Drainage	15% Oil Palm	10,600	40	0.4
				20.3
Crop Establishment				
Oil Palms				
Platforms	2/3 planted area	43,000	60	2.5
Planting		65,500	160	10.4
				12.9
Rubber				
Terracing	2/3 planted area	18,100	110	2.0
Planting		27,500	76	2.1
				4.1
Tertiary Roads				
Oil Palm Land		65,500	122	8.0
Rubber		27,500	36	1.1
				9.1
Settler's Houses				
1st year	400 Settlers	4,000	160	0.6
2nd year onwards	8900 Settlers	89,000	143	12.7
				13.3
				59.7

Table 2 - Fixed Capital - Management
(Buildings, Houses and Equipment)

			Cost per unit M$	Triangle Total M$ Million	
Field Offices 1/					
I Houses	Managers	39	23,200	0.9	
	Assistant Managers	86	10,670	1.0	
	Snr. Supervisors	168	7,370	1.3	
	Field Assistants	82	2,365	.2	
	Clerks	80	7,865	.6	
	Drivers	81	2,200	.2	
					4.2
II Offices		94	10,100		1.0
III Vehicles	Land Rovers	38	9,900	0.4	
	Tractors and trailers	43	11,000	0.5	
					0.9
					6.1
Project Headquarters 2/					
	Housing			2.6	
	Offices (6)			0.5	
	Vehicles (12)			0.2	
					3.3
Triangle Headquarters 3/					
	Housing			1.6	
	Offices (2)			0.5	
	Vehicles (6)			0.1	
					2.2
					11.6

1/ Appendix 25-3

2/ Appendix 25-2

3/ Appendix 25-1

APPENDIX 26-1

Table 3 - Fixed Capital - Processing Factories

	OIL PALM			RUBBER			TOTAL PROCESSING FACTORIES	
	Project Factory	Allocation of Peripheral		Project Factory	Allocation of Peripheral		Other FLDA	Jengka
		Jengka	Other FLDA		Jengka	Other FLDA		
Project I	-	5.8	2.6	-	-	-	2.6	5.8
II	6.9	-	-	-	0.7	0.6	0.6	7.6
III	8.1	-	-	-	0.3	1.2	1.2	8.4
IV	6.8	-	-	-	-	-	-	6.8
V	6.8	-	-	1.5	-	-	-	8.3
VI	-	-	-	1.5	-	-	-	1.5
Port Swettenham Factories	-	0.7	0.4	-	-	-	0.4	0.7
	28.6	6.5	3.0	3.0	1.0	1.8	4.8	39.1

Table 4 - Apportionment of Capital Investment in Processing Factories and Port Installations Outside Jengka

		1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	1966/7 - 1976/7
Ulu Jempol Oil Palm Factory	Project I	-	-	1.1	1.3	2.1	1.3	-	-	-	-	-	5.8
	Other FLDA	1.7	-	0.9	-	-	-	-	-	-	-	-	2.6
Bukit Tajau and Kampong Awah Rubber Factory	Project II	-	-	-	-	-	-	-	-	0.3	-	0.4	0.7
	Project III	-	-	-	-	-	-	-	-	0.1	-	0.2	0.3
	Other FLDA	-	-	0.7	-	0.4	-	0.4	-	0.3	-	-	1.8
Port facilities at Port Swettenham	Jengka	-	-	-	-	0.7	-	-	-	-	-	-	0.7
	Other FLDA	-	-	-	-	0.4	-	-	-	-	-	-	0.4
		1.7	-	2.7	1.3	3.6	1.3	0.4	-	0.7	-	0.6	12.3

APPENDIX 26-1

Table 5 - Immature Period Expenditure

Crop Maintenance (M$ per acre)

		Oil Palms		Rubber		Triangle Total (M$ million)
Planting year	F/S [1]	15		32		
	S/T [2]	6	21	6	38	
Second year	F/S	20		45		
	S/T	3	23	3	48	
Third year	F/S	40		45		
	S/T	3	43	3	48	
Fourth year	F/S	79		45		
	S/T	3	82	3	48	
Fifth year	F/S			45		
	S/T		-	3	48	
Sixth year	F/S			40		
	S/T		-	3	43	
Total per acre			169		273	
65,500 acres oil palms @ M$ 169 per acre						11.1
27,500 acres rubber @ M$ 273 per acre						7.5
						18.6

Settler Income (M$ per settler)

	Oil Palms	Rubber	
First year	600	600	
Second year	900	1300	
Third year	600	1100	
Fourth year	1000	700	
Fifth year		500	
Sixth year		700	
	3100	4900	
65,500 settlers on oil palm land @ M$3,100 per settler			20.3
2,750 settlers on rubber land @ M$4,900 per settler			13.5
			33.8

1/ F/S denotes Fertilizer and sprays
2/ S/T denotes Settlers' Tools.

APPENDIX 26-1

Table 6 - Immature Period Expenditure

(Assumed as Expenditure During the Investment Period of each Project)

(b) Road Maintenance and Transport (M$ million)

	Road Maintenance		Transport		Triangle Total
	No. of years	Total	No. of years	Total	(M$ million)
Project I	6	0.7	2	0.3	1.0
Project II	6	0.6	2	0.4	1.0
Project III	6	1.0	2	0.3	1.3
Project IV	6	1.0	2	0.3	1.3
Project V	6	0.6	2	0.3	0.9
Project VI	6	0.5	2	0.3	0.8
		4.4		1.9	6.3

(d) Management (M$ million)

	Headquarters		Settlement Management			
	Cost per year 1/	Total	Cost per year 2/	No. of Settlements	Total	
Project I	0.340	1.7	0.050	12	3.0	4.7
Project II	0.340	2.0	0.040	17	3.5	5.5
Project III	0.340	2.0	0.044	21	4.7	6.7
Project IV	0.340	2.0	0.046	14	3.7	5.7
Project V	0.310	1.7	0.036	18	3.5	5.2
Project VI	0.310	1.7	0.033	15	2.4	4.1
Triangle 3/	1.600	17.5	-			17.5
		28.6			20.8	49.4

1/ The cost per year denotes an average full year during the investment period. Due to phasing in of staff, this would apply to 5 full years for Project I, 5.75 full years for Projects II to VI and 11 years for Triangle Headquarters.

2/ Fourth year of investment period is taken as typical. Due to phasing in, the number of effective years at which this average cost will apply varies between 5 - 5¾ years.

3/ The investment period for Triangle Headquarters is the period of cash flow deficits for the triangle as a whole.

APPENDIX 26-1

Table 7 - Cost of Development - Jengka and FLDA Schemes Compared

	Jengka: Total Triangle M$ Million	Jengka: Per Planted acre M$	Existing FLDA Schemes M$ per planted acre: Oil Palm	Existing FLDA Schemes M$ per planted acre: Rubber
Establishment	42.5 2/	457	558	363
Maintenance	58.7	631	349	627
Village area	2.3	25 1/	75	113
Settlers Houses and tools	14.9	160		
Management (Buildings)	9.4	101	225	225
			47	62
	127.8	1,374	1,254	1,390
Processing	38.4	413	700	200
			1,954	1,590
Management (recurrent expenditure) (immature period)	31.9	343	275	198
Triangle Headquarters	20.4	219		
Working Capital	21.4	235	N/A	N/A
	111.1		N/A	N/A
	239.9	2,584		

1/ excludes village roads

2/ includes tertiary improved roads in part village roads

N/A denotes not available

APPENDIX 26-1

Table 8 - FLDA Total Capital Expenditure by Projects

	1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	1977/8	1978/9	1979/80	1980/1	1981/2	1982/3-1987/8	1966/7-1987/8
Total Fixed and Working Capital																		
Project I	1.7	5.0	3.6	0.3	1.6	2.9	2.2	0.6	0.3	0.2	0.1	-	-	-	-	-	-	18.5
II	-	-	4.0	4.5	2.5	4.7	3.5	0.8	1.3	0.5	0.9	0.1	0.1	0.1	-	-	-	23.0
III	-	-	-	3.4	6.2	4.0	4.5	2.7	2.0	2.7	1.0	0.3	0.3	0.1	0.1	-	-	27.3
IV	-	-	-	-	-	4.8	4.7	1.2	4.1	3.6	0.9	0.9	0.4	0.1	0.1	0.1	-	20.9
V	-	-	-	-	-	-	4.4	3.1	3.6	0.5	4.5	3.4	0.5	1.1	1.1	0.5	0.9	23.6
VI	-	-	-	-	-	-	-	3.1	2.7	3.3	1.9	0.5	0.4	0.4	0.2	1.2	1.9	15.6
Triangle Headquarters	-	1.9	0.2	0.1	0.7 1/	-	-	-	-	-	-	-	-	-	-	-	-	2.9
	1.7	6.9	7.8	8.3	11.0	16.4	19.3	11.5	14.0	10.8	9.3	5.2	1.7	1.8	1.5	1.8	2.8	131.8
Immature Period Expenditure																		
Project I	0.2	1.1	2.1	2.4	2.9	2.7	0.2	-	-	-	-	-	-	-	-	-	-	11.6
II	-	-	0.6	1.6	2.3	3.0	4.0	2.6	0.6	0.4	0.3	-	-	-	-	-	-	15.4
III	-	-	-	0.4	1.6	3.0	3.5	4.2	3.9	0.5	0.3	0.3	-	-	-	-	-	17.7
IV	-	-	-	-	-	0.6	1.8	2.5	2.7	3.5	2.2	-	-	-	-	-	-	13.3
V	-	-	-	-	-	-	0.6	1.2	1.9	3.1	4.2	3.1	1.3	1.1	0.8	0.1	-	17.4
VI	-	-	-	-	-	-	-	0.4	1.1	1.7	2.6	4.1	2.6	1.1	0.9	0.7	-	15.2
Triangle Headquarters	0.8	1.3	1.4	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.7	-	-	-	-	-	-	17.5
	1.0	2.4	4.1	6.1	8.5	11.0	11.9	12.7	12.0	11.0	11.3	7.5	3.9	2.2	1.7	0.8	-	108.1
Total Capital Expenditure																		
Project I	1.9	6.1	5.7	2.7	4.5	5.6	2.4	0.6	0.3	0.2	0.1	-	-	-	-	-	-	30.1
II	-	-	4.6	6.1	4.8	7.7	7.5	3.4	1.9	0.9	1.2	0.1	0.1	0.1	-	-	-	38.4
III	-	-	-	3.8	7.8	7.0	8.0	6.9	5.9	3.2	1.3	0.6	0.3	0.1	0.1	-	-	45.0
IV	-	-	-	-	-	5.4	6.5	3.7	6.8	7.1	3.1	0.9	0.4	0.1	0.1	0.1	-	34.2
V	-	-	-	-	-	-	5.0	4.3	5.5	3.6	8.7	6.5	1.8	2.2	1.9	0.6	0.9	41.0
VI	-	-	-	-	-	-	-	3.5	3.8	5.0	4.5	4.6	3.0	1.5	1.1	1.9	1.9	30.8
Triangle Headquarters	0.8	3.2	1.6	1.8	2.4	1.7	1.8	1.8	1.8	1.8	1.7	-	-	-	-	-	-	20.4
	2.7	9.3	11.9	14.4	19.5	27.4	31.2	24.2	26.0	21.8	20.6	12.7	5.6	4.0	3.2	2.6	2.8	239.9

1/ Port Installation at Port Swettenham

APPENDIX 26-2

FLDA ANNUAL RECURRENT EXPENDITURE

	Cost Per Acre M$ Oil Palms 65,500 acres	Cost Per Acre M$ Rubber 27,500 acres	Triangle Total M$ Million	
1. Crop Maintenance	82		5.4	
		43	1.2	
				6.6
2. Harvesting Roads and Transport				
Road Maintenance	11		0.7	
		3	0.1	
Transport to Factory				
FFB	32 1/		2.1	
Latex		14 2/	0.4	
				3.3
3. Processing and Marketing				
Processing (excl. capital)	63 3/	41 4/	5.2	
Freight at (M$ 15 per ton)	33	11	2.4	
Port and Handling Charges:				
Palm Oil M$9 per ton / Kernels/Rubber M$6 per ton	20	4	1.4	
	116	56	9.0	
		less	0.3 5/	
				8.7

1/ Represents an average haul which varies from Project to Project.

2/ M$7 per acre for Transport and M$7 per acre for collection stations.

3/ M$7 per ton FFB.

4/ M¢ 2.3 per lb. latex; M¢ 3.3 per lb. scrap.

5/ The constant assumed in Table 24-1 is for the Triangle as a whole. In fact by the time Project VI comes into full production rubber production in Project II is falling. Thus the constant average processing and marketing cost for rubber is M$46 per acre.

FLDA ANNUAL RECURRENT EXPENDITURE (Contd.)

4. Management (M$000)

	Headquarters[1]	Settlement Management[2]			Triangle Total M$ Million
		Cost per Settlement	Number	Total	
Project I	305	29	12	348	.7
Project II	305	29	17	493	.8
Project III	305	29	21	609	.9
Project IV	305	29	14	406	.8
Project V	305	29	18	522	.9
Project VI	305	33[3]	15	494	.8
Triangle	906	-	-	-	.9
					5.8

5. Settler Income 1997/8

Project I	1210 settlers @ M$ 1800	2.2
Project II	1560 settlers @ M$ 1800	2.8
Project III	1880 settlers @ M$ 1800	3.4
Project IV	1350 settlers @ M$ 1800	2.4
Project V	1720 settlers @ M$ 1800	3.1
Project VI	1580 settlers @ M$ 1800	2.8
		16.7

1/ See Appendices 25-1 (Table 3) and 25-2 (Tables 3 and 5)

2/ See Appendix 25-3

3/ Project VI contains two large settlements to which two service supervisors have been allocated per settlement unit.

APPENDIX 26-3

FLDA EXPENDITURE, REVENUE AND CASH FLOW

Table 1 - FLDA Capital and Recurrent Expenditure by Projects

	1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	1977/8	1978/9	1979/80	1980/1	1981/2	1985/6	1990/1	1997/8
Total Capital Expenditure																			
Project I	1.9	6.1	5.7	2.7	4.5	5.6	2.4	0.6	0.3	0.2	0.1	-	-	-	-	-	-	-	-
II	-	-	4.6	6.1	4.8	7.7	7.5	3.4	1.9	0.9	1.2	0.1	0.1	0.1	-	-	-	-	-
III	-	-	-	3.8	7.8	7.0	8.0	6.9	5.9	3.2	1.3	0.6	0.3	0.1	0.1	-	-	-	-
IV	-	-	-	-	-	5.4	6.5	3.7	6.8	7.1	3.1	0.9	0.4	0.1	0.1	0.1	-	-	-
V	-	-	-	-	-	-	5.0	4.3	5.5	3.6	8.7	6.5	1.8	2.2	1.9	0.6	0.1	-	-
VI	-	-	-	-	-	-	-	3.5	3.8	5.0	4.5	4.6	3.0	1.5	1.1	1.9	0.1	-	-
Triangle Headquarters	0.8	3.2	1.6	1.8	2.4	1.7	1.8	1.8	1.8	1.8	1.7	-	-	-	-	-	-	-	-
	2.7	9.3	11.9	14.4	19.5	27.4	31.2	24.2	26.0	21.8	20.6	12.7	5.6	4.0	3.2	2.6	0.2	-	-
Recurrent Expenditure																			
Project I	-	-	-	-	0.2	1.3	4.6	5.2	5.3	5.2	5.4	5.4	5.5	5.7	5.8	5.8	6.0	6.0	6.1
II	-	-	-	-	-	-	0.3	2.5	4.7	4.9	5.5	5.9	6.1	6.2	6.2	6.3	6.4	6.7	6.6
III	-	-	-	-	-	-	-	0.3	2.2	6.2	6.7	7.0	7.6	7.8	3.1	8.2	8.3	8.3	8.6
IV	-	-	-	-	-	-	-	-	-	0.5	3.1	5.5	5.5	5.7	5.9	6.0	6.1	6.1	6.3
V	-	-	-	-	-	-	-	-	-	-	0.5	1.7	3.5	3.7	4.6	6.0	6.7	6.8	7.2
VI	-	-	-	-	-	-	-	-	-	-	-	0.4	2.1	3.5	3.7	4.1	5.9	6.7	6.3
Triangle Headquarters	-	-	-	-	-	-	-	-	-	-	-	1.5	1.2	1.0	0.9	1.0	0.9	0.9	0.9
Less Transfer Payments	-	-	-	-	-	-	-	-	-	-	0.4	0.3	0.6	0.7	0.8	0.8	0.9	0.9	0.9
	-	-	-	-	0.2	1.3	4.9	8.0	12.2	16.8	20.8	27.1	30.9	32.9	34.4	36.6	39.4	40.1	41.1
Land Taxes																			
Project I	-	-	-	-	0.3	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-	0.1	0.1	0.1
II	-	-	-	-	0.1	0.1	0.6	0.3	0.1	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
III	-	-	-	-	-	-	-	0.5	0.8	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
IV	-	-	-	-	-	-	-	-	0.1	0.8	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
V	-	-	-	-	-	-	-	-	-	-	0.5	-	0.1	0.4	0.6	0.1	0.1	0.1	0.1
VI	-	-	-	-	-	-	-	-	-	-	-	0.5	0.1	0.1	0.2	0.6	0.1	0.1	0.1
	-	-	-	-	0.4	0.6	0.8	0.9	1.1	1.3	1.3	1.0	0.7	0.9	1.2	1.0	0.6	0.6	0.6
Total Expenditure																			
Project I	1.9	6.1	5.7	2.7	5.0	7.4	7.2	5.9	5.7	5.5	5.6	5.5	5.6	5.8	5.9	5.8	6.1	6.1	6.2
II	-	-	4.6	6.1	4.9	7.8	8.4	6.2	6.7	6.0	7.0	6.1	6.3	6.4	6.3	6.4	6.5	6.8	6.7
III	-	-	-	3.8	7.8	7.0	8.0	7.7	8.9	9.6	8.1	7.8	8.1	8.0	3.3	8.3	8.4	8.4	8.7
IV	-	-	-	-	-	5.4	6.5	3.7	6.9	8.4	6.5	6.5	6.0	5.9	6.1	6.2	6.2	6.2	6.4
V	-	-	-	-	-	-	5.0	4.3	5.5	3.6	9.7	8.2	5.4	6.3	7.1	6.7	6.9	6.9	7.3
VI	-	-	-	-	-	-	-	3.5	3.8	5.0	4.5	5.5	5.2	5.1	5.0	6.6	6.1	6.3	6.4
Triangle Headquarters	0.8	3.2	1.6	1.8	2.4	1.7	1.8	1.8	1.8	1.8	1.7	1.5	1.2	1.0	0.9	1.0	0.9	0.9	0.9
Less Transfer Payments	-	-	-	-	-	-	-	-	-	-	0.4	0.3	0.6	0.7	0.8	0.8	0.9	0.9	0.9
	2.7	9.3	11.9	14.4	20.1	29.3	36.9	33.1	39.3	39.9	42.7	40.8	37.2	37.8	38.8	40.2	40.2	40.7	41.7

APPENDIX 26-3

Table 2 - FLDA Expenditure, Revenue and Cash Flow (Full Triangle Development) by Projects

		1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	1977/8	1978/9	1979/80	1980/1	1981/2	1985/6	1990/1	1997/8
Total Expenditure																				
Project I		1.9	1.6	5.7	2.7	5.0	7.4	7.2	5.9	5.7	5.5	5.6	5.5	5.6	5.8	5.9	5.8	6.1	6.1	6.2
II		-	-	4.6	6.1	4.9	7.8	8.4	6.2	6.7	6.0	7.0	6.1	6.3	6.4	6.3	6.4	6.5	6.3	6.7
III		-	-	-	3.8	7.8	7.0	8.0	7.7	8.9	9.6	8.1	7.8	8.1	8.0	8.3	8.3	8.4	8.4	8.7
IV		-	-	-	-	-	5.4	6.5	3.7	6.9	8.4	6.5	6.5	6.0	5.9	6.1	6.2	6.2	6.7	6.4
V		-	-	-	-	-	-	5.0	4.3	5.5	3.6	9.7	8.2	5.4	6.3	7.1	6.7	6.9	6.9	7.3
VI		-	-	-	-	-	-	-	3.5	3.8	5.0	4.5	5.5	5.2	5.1	5.0	6.6	6.1	6.3	6.4
Triangle Headquarters		0.8	3.7	1.6	1.8	2.4	1.7	1.8	1.8	1.8	1.8	1.7	1.5	1.2	1.0	0.9	1.0	0.9	0.9	0.9
Less Transfer Payments		-	-	-	-	-	-	-	-	-	-	0.4	0.3	0.6	0.7	0.8	0.8	0.9	0.9	0.9
		2.7	5.3	11.9	14.4	20.1	29.3	36.9	33.1	39.3	39.9	42.7	40.8	37.2	37.8	38.8	40.2	40.2	40.7	41.7
FLDA Revenue																				
Project I		-	-	-	-	1.2	4.1	7.2	9.5	10.4	10.7	10.9	11.0	10.8	10.6	10.4	10.3	9.9	9.4	9.7
II		-	-	-	-	-	-	2.2	5.1	8.0	9.3	10.5	11.5	12.2	12.5	12.6	12.6	12.2	11.6	11.7
III		-	-	-	-	-	-	-	1.7	6.0	10.1	12.9	14.0	14.9	15.1	15.5	15.6	15.3	14.4	14.1
IV		-	-	-	-	-	-	-	-	-	2.6	6.4	9.6	10.4	11.0	11.2	11.4	11.3	10.9	10.6
V		-	-	-	-	-	-	-	-	-	-	1.8	3.5	5.8	6.7	9.6	10.5	13.4	13.1	17.5
VI		-	-	-	-	-	-	-	-	-	-	-	1.6	3.2	4.7	5.2	6.9	11.5	13.3	16.8
Less Transfer Payments		-	-	-	-	-	-	-	-	-	-	(0.4)	(0.3)	(0.6)	(0.7)	(0.8)	(0.8)	(0.9)	(0.9)	(0.9)
		-	-	-	-	1.2	4.1	9.4	16.3	24.4	32.7	42.1	50.9	56.7	60.1	63.7	66.5	72.7	69.4	87.1
Nett Cash Flow																				
Project I	Deficit	1.9	1.6	5.7	2.7	3.8	3.3	-	-	-	-	-	-	-	-	-	-	-	-	-
	Surplus	-	-	-	-	-	-	-	3.6	4.7	5.2	5.3	5.5	5.2	4.8	4.5	4.5	3.8	3.3	3.0
II	Deficit	-	-	4.6	6.1	4.9	7.8	6.2	1.1	-	-	-	-	-	-	-	-	-	-	-
	Surplus	-	-	-	-	-	-	-	-	1.3	3.3	3.5	5.4	5.9	6.1	6.3	6.2	5.7	4.8	4.5
III	Deficit	-	-	-	3.8	7.8	7.0	8.0	6.0	2.9	-	-	-	-	-	-	-	-	-	-
	Surplus	-	-	-	-	-	-	-	-	-	0.5	4.8	6.2	6.8	7.2	7.2	7.3	6.9	6.0	5.4
IV	Deficit	-	-	-	-	-	5.4	6.5	3.7	6.9	5.8	0.1	-	-	-	-	-	-	-	-
	Surplus	-	-	-	-	-	-	-	-	-	-	-	3.1	4.4	5.1	5.1	5.2	4.9	4.2	4.2
V	Deficit	-	-	-	-	-	-	5.0	4.3	5.5	3.6	7.9	4.7	-	-	-	-	-	-	-
	Surplus	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.4	2.5	3.8	6.5	6.2	5.2
VI	Deficit	-	-	-	-	-	-	-	3.5	3.8	5.0	4.5	3.9	2.0	0.4	-	-	-	-	-
	Surplus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.3	5.4	5.0	6.6
Triangle Headquarters	Deficit	0.8	3.7	1.6	1.8	2.4	1.7	1.8	1.8	1.8	1.8	1.7	1.5	1.2	1.0	0.9	1.0	0.9	0.9	0.9
	Surplus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Deficit	2.7	5.3	11.9	14.4	18.9	25.2	27.5	16.8	14.9	7.2	0.6	-	-	-	-	-	-	-	-
	Surplus	-	-	-	-	-	-	-	-	-	-	-	10.1	19.5	22.3	24.9	26.3	32.5	28.7	35.4

APPENDIX 26-3

Table 3 - Value of Production

Unit : f.o.b. price per acre by year of phase development)

Year of Initial Output	OIL PALM							RUBBER															
	4	5	6	7	8	9	10-27	6	7	8	9	10	11	12	13-19	20	21	22	23	24	25	26	27
1970/1	315	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1971/2	309	613	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1972/3	304	602	905	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1973/4	298	591	889	953	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1974/5	296	586	879	942	997	-	-	176	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975/6	287	569	856	917	970	1004	-	172	417	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1976/7	282	558	839	899	951	984	1013	169	410	543	-	-	-	-	-	-	-	-	-	-	-	-	-
1977/8	276	547	822	881	933	965	993	166	402	532	652	-	-	-	-	-	-	-	-	-	-	-	-
1978/9	-	536	806	864	914	945	973	163	395	523	641	727	-	-	-	-	-	-	-	-	-	-	-
1979/0	-	-	789	846	895	926	953	160	388	504	628	712	756	-	-	-	-	-	-	-	-	-	-
1980/1	-	-	-	828	876	906	933	157	381	495	617	700	742	771	-	-	-	-	-	-	-	-	-
1981/2	-	-	-	-	869	898	925	154	374	493	606	687	729	757	770	-	-	-	-	-	-	-	-
1982/3	-	-	-	-	-	888	915	154	372	484	604	684	727	755	768	-	-	-	-	-	-	-	-
1983/4	-	-	-	-	-	-	905	-	365	484	593	672	714	741	754	-	-	-	-	-	-	-	-
1984/5	-	-	-	-	-	-	897	-	-	484	593	672	714	741	740	-	-	-	-	-	-	-	-
1985/6	-	-	-	-	-	-	887	-	-	-	582	659	700	727	737	-	-	-	-	-	-	-	-
1986/7	-	-	-	-	-	-	879	-	-	-	-	657	698	724	737	-	-	-	-	-	-	-	-
1987/8	-	-	-	-	-	-	869	-	-	-	-	-	698	724	737	-	-	-	-	-	-	-	-
1988/9	-	-	-	-	-	-	861	-	-	-	-	-	-	711	723	715	-	-	-	-	-	-	-
1989/0	-	-	-	-	-	-	851	-	-	-	-	-	-	-	723	715	706	-	-	-	-	-	-
1990/1	-	-	-	-	-	-	843	-	-	-	-	-	-	-	723	715	706	692	-	-	-	-	-
1991/2	-	-	-	-	-	-	833	-	-	-	-	-	-	-	707	699	690	676	667	-	-	-	-
1992/3	-	-	-	-	-	-	833	-	-	-	-	-	-	-	707	699	690	676	667	653	-	-	-
1993/4	-	-	-	-	-	-	833	-	-	-	-	-	-	-	707	699	690	676	667	653	639	-	-
1994/5-	-	-	-	-	-	-	833	-	-	-	-	-	-	-	690	682	677	663	654	641	627	609	-
2000/1								-	-	-	-	-	-	-	690	682	677	663	654	641	627	609	581

Instructions - oil palm: read diagonally as far as table permits then vertically

rubber : as for oil palm until Years 13-19 reached; descend this column for seven years, i.e. Years 13-19; Then, resume diagonal reading as far as possible; finally read horizontally or vertically according to circumstances.

APPENDIX 26-3

Table 4 - Value of Duties and Cesses

(Unit: acre by year of phase development)

YEAR OF INITIAL OUTPUT EQUALS	OIL PALM (Export Duty @ 7½%)							RUBBER (Export Duty @ 4% plus Cesses @ 5⅜ per lb.)															
	4	5	6	7	8	9	10-27	6	7	8	9	10	11	12	13-19	20	21	22	23	24	25	26	27
1970/1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1971/2	23	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1972/3	23	45	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1973/4	22	44	67	71	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1974/5	22	44	66	71	75	-	-	25	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975/6	22	43	64	69	73	75	-	25	59	79	-	-	-	-	-	-	-	-	-	-	-	-	-
1976/7	21	42	63	67	71	74	76	25	59	78	96	-	-	-	-	-	-	-	-	-	-	-	-
1977/8	21	41	62	66	70	72	74	25	59	78	96	107	-	-	-	-	-	-	-	-	-	-	-
1978/9	-	40	60	65	69	71	73	24	59	78	95	107	114	-	-	-	-	-	-	-	-	-	-
1979/0	-	-	59	63	67	69	71	24	58	77	95	106	114	118	-	-	-	-	-	-	-	-	-
1980/1	-	-	-	62	66	68	70	24	58	77	94	106	113	117	120	-	-	-	-	-	-	-	-
1981/2	-	-	-	-	65	68	69	24	58	77	94	106	113	117	120	-	-	-	-	-	-	-	-
1982/3	-	-	-	-	-	67	69	-	58	76	94	106	113	117	119	-	-	-	-	-	-	-	-
1983/4	-	-	-	-	-	-	68	-	-	76	93	105	113	116	119	-	-	-	-	-	-	-	-
1984/5	-	-	-	-	-	-	68	-	-	-	93	105	112	116	119	-	-	-	-	-	-	-	-
1985/6	-	-	-	-	-	-	67	-	-	-	-	105	112	115	118	-	-	-	-	-	-	-	-
1986/7	-	-	-	-	-	-	66	-	-	-	-	-	112	115	118	-	-	-	-	-	-	-	-
1987/8	-	-	-	-	-	-	65	-	-	-	-	-	-	115	118	117	-	-	-	-	-	-	-
1988/9	-	-	-	-	-	-	65	-	-	-	-	-	-	-	118	117	115	-	-	-	-	-	-
1989/0	-	-	-	-	-	-	64	-	-	-	-	-	-	-	118	117	115	113	-	-	-	-	-
1990/1	-	-	-	-	-	-	63	-	-	-	-	-	-	-	117	116	115	112	110	-	-	-	-
1991/2	-	-	-	-	-	-	62	-	-	-	-	-	-	-	117	116	115	112	110	108	-	-	-
1992/3	-	-	-	-	-	-	62	-	-	-	-	-	-	-	117	116	115	112	109	108	105	-	-
1993/4	-	-	-	-	-	-	62	-	-	-	-	-	-	-	116	115	114	112	109	108	104	101	-
1994/5–2000/1	-	-	-	-	-	-	62	-	-	-	-	-	-	-	116	115	114	112	109	108	104	101	92

Instructions - oil palm: read diagonally as far as table permits then vertically

rubber: as for oil palm until Years 13-19 reached, descend this column for seven years i.e. Years 13-19; then; resume diagonal reading as far as possible; finally read horizontally or vertically according to circumstances.

APPENDIX 26-4

COMPARISON OF PROJECTS

(common prices)

Table 1 - Income Expenditure and Cash Flow during Project Repayment Periods 1/

	1972/3	1973/4	1974/5	1975/6	1976/7	1977/8	1978/9	1979/80	1980/1	1981/2	1982/3	1983/4	1984/5	1985/6	1986/7	1987/8	1988/9
Project I Expenditure	7.2	5.9	5.7	5.5	5.6	5.5	5.6	5.8	5.8	constant to 1993/4							
Revenue	7.1	9.4	10.3	10.6	10.8	11.0	11.1	11.1	11.1								
Cash Flow																	
Deficit	0.1	-	-	-	-	-	-	-	-								
Surplus	-	3.5	4.6	5.1	5.2	5.5	5.5	5.3	5.3	("	"	")					
Project II Expenditure			6.7	6.0	7.0	6.1	6.3	6.4	6.3	6.4	6.6	constant to 1995/6					
Revenue			8.1	9.5	10.8	11.8	12.5	13.1	13.3	13.5	13.5						
Cash Flow Surplus			1.4	3.5	3.8	5.7	6.2	6.7	7.0	7.1	6.9	("	"	")			
Project III Expenditure				9.6	8.1	7.8	8.1	8.0	8.3	8.3	8.4	8.4	8.5	constant to 1996/7			
Revenue				10.6	13.6	14.7	15.7	16.2	16.6	16.8	16.9	17.0	17.0				
Cash Flow Surplus				1.0	5.5	6.9	7.6	8.2	8.3	8.5	8.5	8.6	8.5	("	"	")	
Project IV Expenditure						6.5	6.0	5.9	6.1	6.2	6.3	constant to 1998/9					
Revenue						10.1	11.5	12.0	12.2	12.4	12.5						
Cash Flow Surplus						3.6	5.5	6.1	6.1	6.2	6.2	("	"	")			
Project V Expenditure							5.4	6.3	7.1	6.7	6.9	6.9	7.0	7.0	7.0	7.0	constant to 1999/0
Rovenue							5.7	6.6	8.7	10.6	11.9	12.9	13.6	13.8	14.0	14.0	
Cash Flow Surplus							0.3	0.3	1.6	3.9	5.0	6.0	6.6	6.8	7.0	7.0	(" " ")
Project VI Expenditure									5.0	6.6	6.1	6.9	6.1	6.1	6.2	6.1	6.2
Revenue									5.8	7.7	10.0	10.8	11.8	12.4	12.7	12.9	12.9
Cash Flow Surplus									0.8	1.1	3.9	3.9	5.7	6.3	6.5	6.8	6.7 2/

1/ Income, expenditure and cash flow during investment period of each project (cash flow deficits) as per Appendix 26-3; thereafter 1975-1982 palm oil prices used for the first seven years' production of each project; then final prices. Similar assumption for rubber (see Table 2).

2/ Constant to 2000/1.

APPENDIX 26-4

Table 2 - Adjustments made to assess Projects on a comparable basis

A. Prices — Incomes(M$ per acre) used for all phases of all projects

Year (Clearing year = 0)	Rubber	Oil Palm
4	-	201
5	-	560
6	160	820
7	390	865
8	495	895
9	605	905
10	685	925
11	715	Thereafter Constant
12	740	
13	740	
	Thereafter Constant	

B. Management Cost

Project VI which was designed with lower management densities than the earlier projects was weighted with additional expenditure on management to put it on a comparable basis with Projects I to IV. Projects IV and V which also have lower management densities were not adjusted and therefore are favoured to this extent.

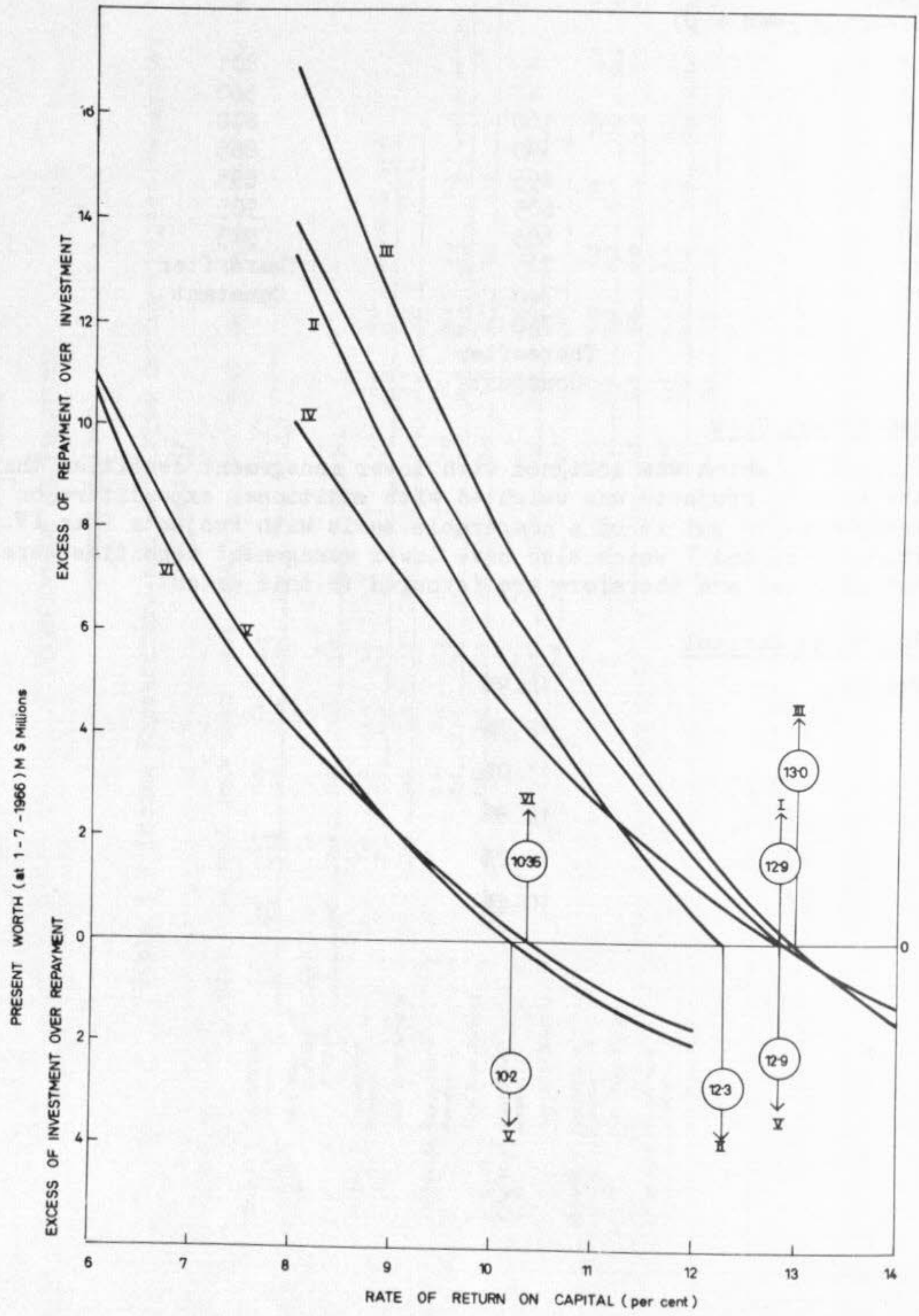
C. Return on Capital

Project I	12.9%
II	12.3%
III	13.0%
IV	12.8%
V	10.2%
VI	10.4%

APPENDIX 26-4

Figure 1

RATE OF RETURN ON CAPITAL OF PROJECTS I - VI



APPENDIX 26-5

FOREIGN EXCHANGE

Table 1 - Foreign Exchange Component of FLDA Fixed Capital Expenditure

PROJECTS	1966/7	1967/8	1968/9	1969/0	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	1977/8	1978/9 1983/4	TOTAL
1	0.2	0.5	0.6	-	0.5	0.9	0.7	-	-	-	-	-	-	3.4
II	-	-	0.5	0.2	0.2	1.9	1.6	-	0.1	-	0.1	-	-	4.6
III	-	-	-	0.4	0.5	0.1	1.6	1.0	0.4	0.7	-	-	-	4.7
IV	-	-	-	-	-	0.7	0.2	-	1.9	1.6	-	-	-	4.4
V	-	-	-	-	-	-	0.5	0.1	0.2	-	1.9	1.6	0.2	4.5
VI	-	-	-	-	-	-	-	0.4	0.1	0.2	-	-	0.2	0.9
Triangle Headquarters	-	0.4	0.1	-	0.2	-	-	-	-	-	-	-	-	0.7
TOTAL	0.2	0.9	1.2	0.6	1.4	3.6	4.6	1.5	2.7	2.5	2.0	1.6	0.4 1/	23.2
PERIPHERAL 2/														
Ulu Jempol Factory	0.5	-	0.4	-	-	-	-	-	-	-	-	-	-	0.9
Bkt. Tajau Factory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kg. Awah Factory	-	-	0.1	-	0.1	-	0.1	-	-	-	-	-	-	0.3
Port Swettenham	-	-	-	-	0.1	-	-	-	-	-	-	-	-	0.1
TOTAL	0.5	-	0.5	-	0.2	-	0.1	-	-	-	-	-	-	1.3
PLAN TOTAL	0.7	0.9	1.7	0.6	1.6	3.6	4.7	1.5	2.7	2.5	2.0	1.6	0.4	24.5

1/ Total distributed equally M$0.1 million per annum for Project V in the first two years and a similar sum in the last two years for Project VI.

2/ Apportioned between Triangle and other FLDA schemes in Appendix 26-1.

APPENDIX 26-5

Table 2 - Foreign Exchange Component of Fixed Capital Expenditure of other Government Departments

(M$ millions)

	1967/8	1968/9	1969/0	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	1977/8	1978/9	1979/0	TOTAL
RURAL														
Water Supply	0.1	0.3	0.3	0.4	0.4	0.5	0.4	0.3	0.3	0.2	-	-	-	3.2
Roads	0.7	1.4	0.5	0.9	1.9	1.1	1.4	0.8	1.2	1.6	0.5	-	-	12.0
TOTAL	0.8	1.7	0.8	1.3	2.3	1.6	1.8	1.1	1.5	1.8	0.5	-	-	15.2
URBAN														
Water Supply	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5
Roads	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6
Telecommunications	-	-	-	-	-	-	-	-	-	-	-	-	-	1.3
Police	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6
Electric Power	-	-	-	-	-	-	-	-	-	-	-	-	-	1.9
Sanitation	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5
Airport	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
-														
Health	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0
Education	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2
TOTAL	-	1.4	1.3	1.4	1.3	1.4	1.3	1.4	1.3	1.4	1.3	1.4	1.3	16.2

APPENDIX 26-6

FIRST STAGE DEVELOPMENT (PROJECTS I and II)

Table 1 - Cost of Infrastructure First Stage Development

(Expenditure by Other Government Departments)

(M$ thousands)

Urban (S.E. Town)	Fixed Capital Expenditure	Annual Operating Cost 1980/1 onwards
Site Preparation	250	
Town Roads	1,250	
Water Supply	460	
Telecommunications 1/	245	Assumed to be 20% of Total urban operation at Full Triangle Development
Postal Services 1/	110	
Police 1/	180	
Electricity	780	
Sanitation and Drainage	620	
Miscellaneous	140	
	4,035	395

Rural	Fixed Capital Expenditure	Annual Operating Cost 1980/1 onwards
Primary and Secondary Roads	7,649	438
Water Supply	4,235	310
Village Community Bldgs.	390	17
	12,274	765
Plus 10% for other miscellaneous services		77
		842

Urban and Rural		Fixed Capital Expenditure	Annual Operating Cost 1980/1 onwards
Education) Health)	30% of Full Triangle Development	9,010	11,931
Public Administration	20% of Full Triangle Development	1,000	50
		10,010	11,981 2/

1/ These also provide limited services for the rural areas

2/ excluded throughout the economic and financial analysis

APPENDIX 26-6

Table 2 - Cost of Infrastructure by years to 1981/2 - First Stage Development

(Expenditure by other Government Departments)

(M$ thousands)

	Total Capital Expenditure	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	1977/8	1978/9	1979/80	1980/1	1981/2	On-wards
Urban																	
Capital Expenditure	4,035	-	-	535	500	-	500	500	-	500	500	-	500	500	-	-	-
Recurrent Expenditure	-	-	-	137	137	281	287	291	315	343	344	389	395	395	395	395	395
		-	-	672	637	281	787	791	315	843	844	389	895	895	395	395	395
Rural																	
Capital Expenditure	12,274	2,116	4,655	2,591	2,187	455	45	45	45	45	45	45	-	-	-	-	-
Recurrent Expenditure	-	112	356	532	798	832	833	834	835	837	839	842	842	842	842	842	842
		2,228	5,011	3,123	2,985	1,287	878	879	880	882	884	887	842	842	842	842	842
Urban and Rural																	
Capital																	
Expenditure in Schools and Health Centre	9,010	-	2,219	-	1,250	1,250	-	1,250	-	1,250	-	591	300	300	300	300	-
Public Administration	1,000	-	500	-	250	250	-	-	-	-	-	-	-	-	-	-	-
			2,719	-	1,500	1,500	-	1,250	-	1,250	-	591	300	300	300	300	-
	26,319																
		2,228	7,730	3,795	5,122	3,068	1,665	2,920	1,195	2,975	1,728	1,867	2,037	2,037	1,537	1,557	1,237
Urban and Rural																	
Recurrent expenditure on Education, Health and Public Administration (30% of Full Triangle Development)			1,970	2,950	4,604	6,258	6,258	7,912	7,912	9,516	10,339	10,739	11,239	11,931	11,981	11,981	11,981

APPENDIX 26-6

Table 3 - Revenue to other Government Departments from First Stage Development

(M$ thousands)

	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	1977/8	1978/9	1979/80	1980/1	1985/6	1990/1	1995/6
Export duties and non-refundable rubber cess	-	-	-	96	331	767	1179	1490	1612	1708	1771	1804	1798	1787	1732	1634	1580
Motor taxes				192	192	192	192	192	374	374	374	374	374	374	374	374	374
Import duties	32	85	155	178	183	187	190	195	195	195	195	195	195	195	195	195	195
Port charges				13	35	42	49	61	65	70	73	76	78	80	80	80	80
Urban land sales			370	380		380	380		380	380		380	380				
Water supply	40	130	130	230	280	310	310	310	310	310)							
Revenue from public services		137	137	281	291	315	343	344	389	395)	705	705	705	705	705	705	705
	72	352	792	1370	1312	2193	2643	2592	3325	3432	3118	3534	3530	3141	3086	2988	2934

APPENDIX 26-7

THE TEKAM AREA

Table 1 - Assumptions made to assess inclusion of Tekam

A	Estimated Tekam gross area	40,200 acres	
	Estimated Tekam nett land use	22,000 acres oil palms 9,000 acres Rubber	
B	Projects used from Jengka	Oil Palms acres	Rubber acres
	Project I	11,500	600
	Project II	10,800	4,800
		22,300	5,400

C Phasing Programme Planted acres by years

	1977/8	1978/9	1979/80
Project I Oil Palm	4,000	6,400	1,100
Rubber	-	600	-
Project II Oil Palm	7,900	2,900	-
Rubber	-	2,000	2,800
	11,900	11,900	3,900

APPENDIX 26-7

Table 2 - Inclusion of Tekam at Social Prices

(M$ million)

	1976/7	1977/8	1978/9	1979/80	1980/1	1981/2	1982/3	1983/4	1984/5	1985/6	1997/8	2007/8
Benefits												
Agriculture:												
Projects I (-10%)	-	-	-	-	1.2	4.0	7.0	9.2	10.1	9.9	9.9	9.9
II (-10%)	-	-	-	-	2.1	5.0	7.8	9.1	10.3	11.3	11.3	11.3
					3.3	9.0	14.8	18.3	20.4	21.2	21.2	21.2
Forest Industry 1/												
Nett Sales	-	-	14.3	28.3	28.3	14.0	-	-	-	-	-	-
Less: Sale of Houses FLDA	-	2.0	2.0	2.0	-	-	-	-	-	-	-	-
	-	(2.0)	12.3	26.3	28.3	14.0	-	-	-	-	-	-
Total Benefits		(2.0)	12.3	26.3	31.6	23.0	14.8	18.3	20.4	21.2	21.2	21.2
Cost												
Agriculture:												
Project I	1.9	6.1	5.7	2.7	5.0	7.4	7.2	5.9	5.7	5.8	5.8	5.8
Project II	4.6	6.1	5.9	7.5	8.4	6.2	6.7	6.0	7.0	6.6	6.6	6.6
	6.5	12.2	10.6	10.2	13.4	13.6	13.9	11.9	12.7	12.4	12.4	12.4
Infrastructure												
Capital (incl. schools etc)	2.1	7.2	4.6	0.7	0.8	0.7	0.8	0.6	0.6	2.4 1/	-	-
Recurrent	-	-	0.1	0.1	0.2	0.4	0.5	0.5	0.5	0.5	0.5	0.5
	2.1	7.2	4.7	0.8	1.0	1.1	1.3	1.1	1.1	2.9	0.5	0.5
Forest Industry	-	-	8.2	16.8	15.5	7.6	-	-	-	-	-	-
Less:	8.6	19.4	23.5	27.8	29.9	22.3	15.2	13.0	13.8	15.3	12.9	12.9
Taxes and Cost of Houses	-	2.4	2.5	2.8	0.8	0.8	0.9	0.8	0.8	0.9	0.8	0.8
Settlers Income	-	0.7	1.8	2.1	2.4	2.9	3.1	3.4	3.6	4.0	4.0	4.0
	-	3.1	4.3	4.9	3.2	3.7	4.0	4.2	4.4	4.9	4.8	4.9
Total Cost	8.6	16.3	19.2	32.9	26.7	18.6	11.2	8.8	9.4	10.4	8.1	8.0

1/ Forest Industry Benefits and Cost have been extended for 3 full years.

APPENDIX 26-8

RATE OF RETURN CALCULATIONS

Calculation of Rates of Return on Capital

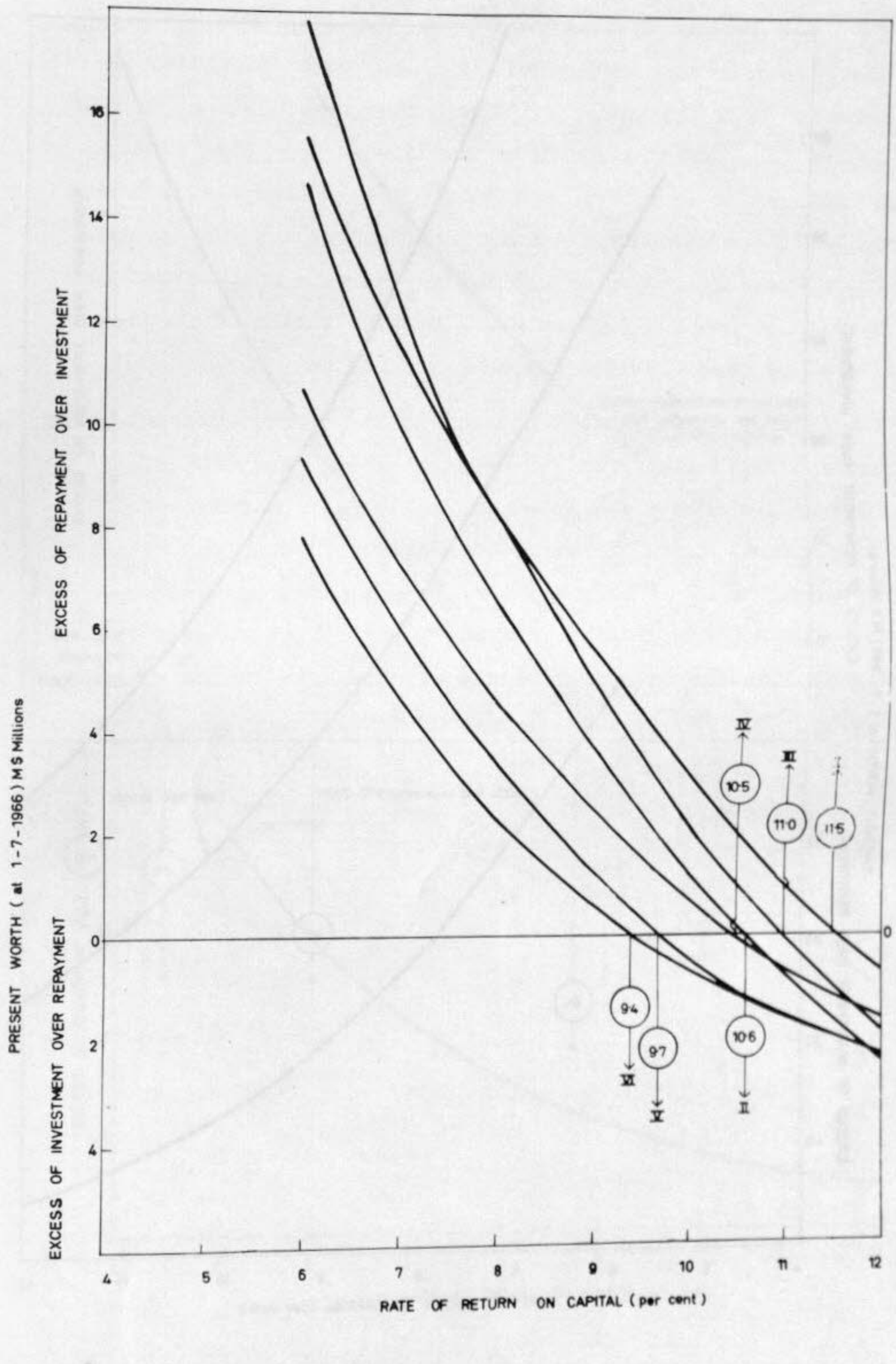
The rate of return on Capital (RRC) has been calculated in the same way throughout the analysis. The income, expenditure, or cash flow (income less expenditure) have been discounted using continuous compounding factors to a common point in time i.e. 1-7-1966. The total of these discounted annual sums is shown as the 'present worth'. The rate of return on capital is the rate of interest that would have to be used to produce equal present worths of income and expenditure, or cash flow deficit and surplus.

The figures shown in this appendix plot the nett present worth of income and expenditure for all aspects of the analysis (except comparison of projects; see Appendix 26-4). At low rates of interest the present worth of income less expenditure is positive while at higher rates of interest the present worth becomes negative. The point at which the present worth line crosses the zero axis denotes the rate of interest which equate income with expenditure. This is the rate of return on capital.

APPENDIX 26-8

Figure 1

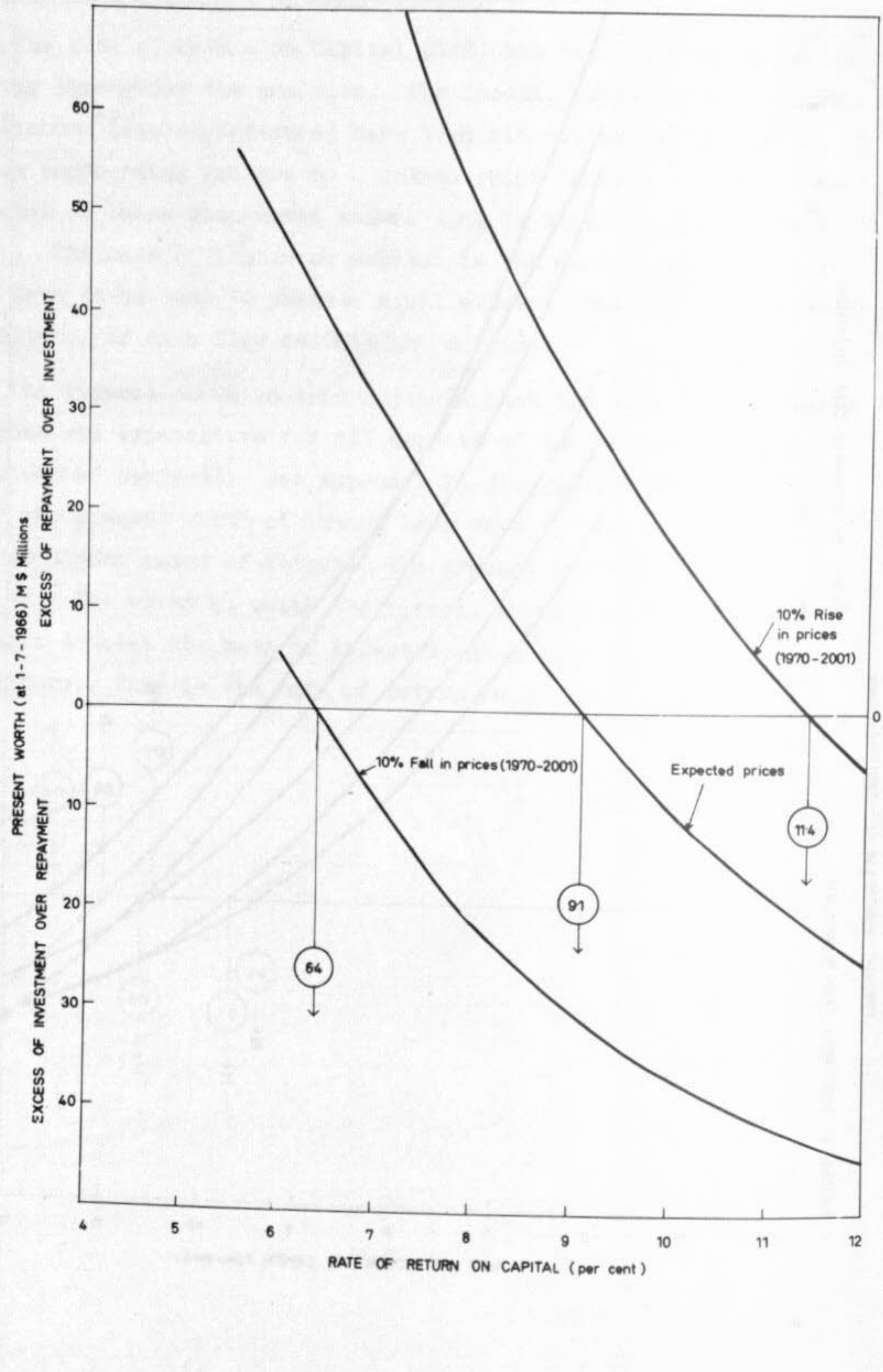
RATE OF RETURN ON CAPITAL IN INDIVIDUAL PROJECTS - FLDA



APPENDIX 26-8

Figure 2

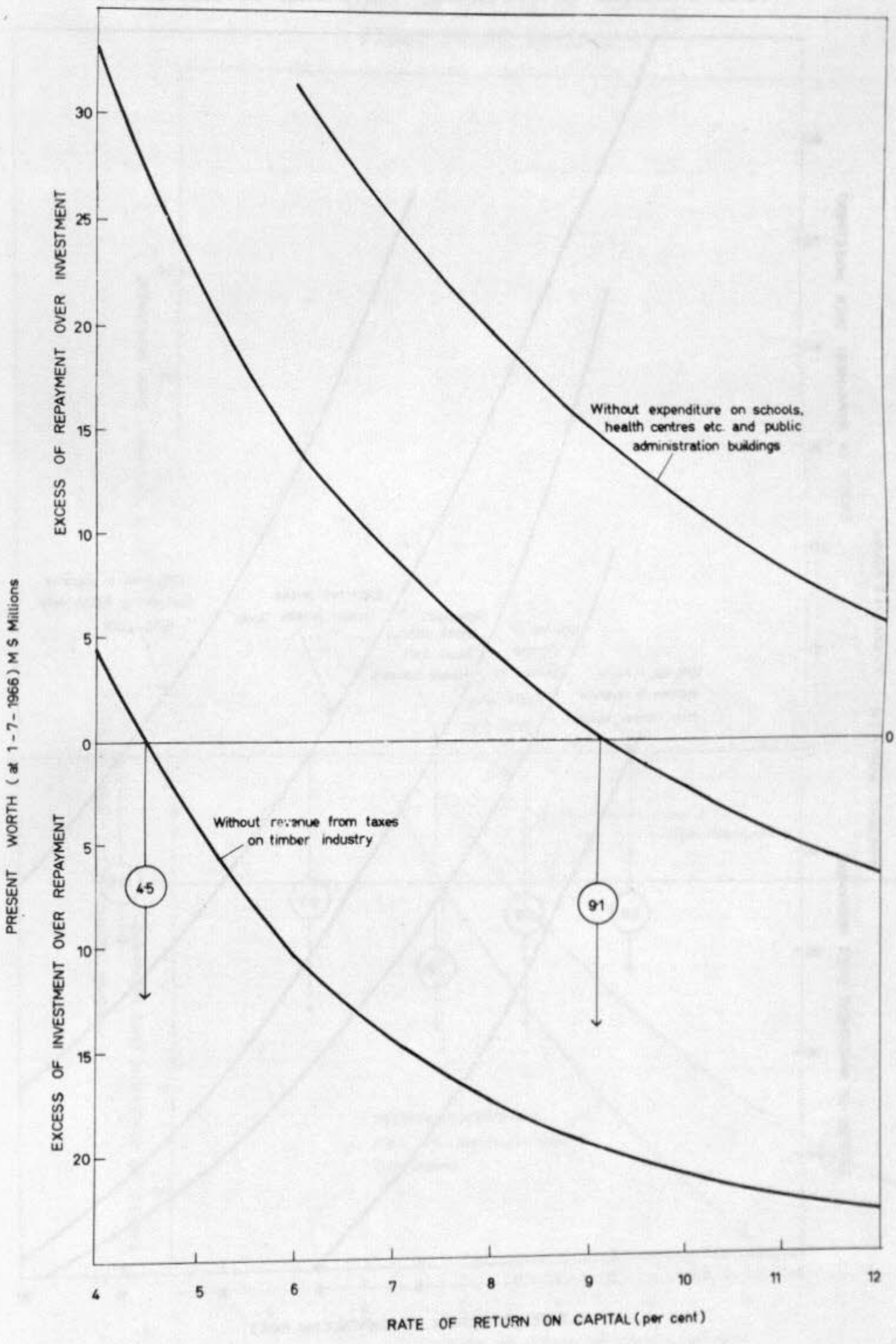
RATE OF RETURN ON CAPITAL
(FULL TRIANGLE DEVELOPMENT) FLDA



APPENDIX 26-8

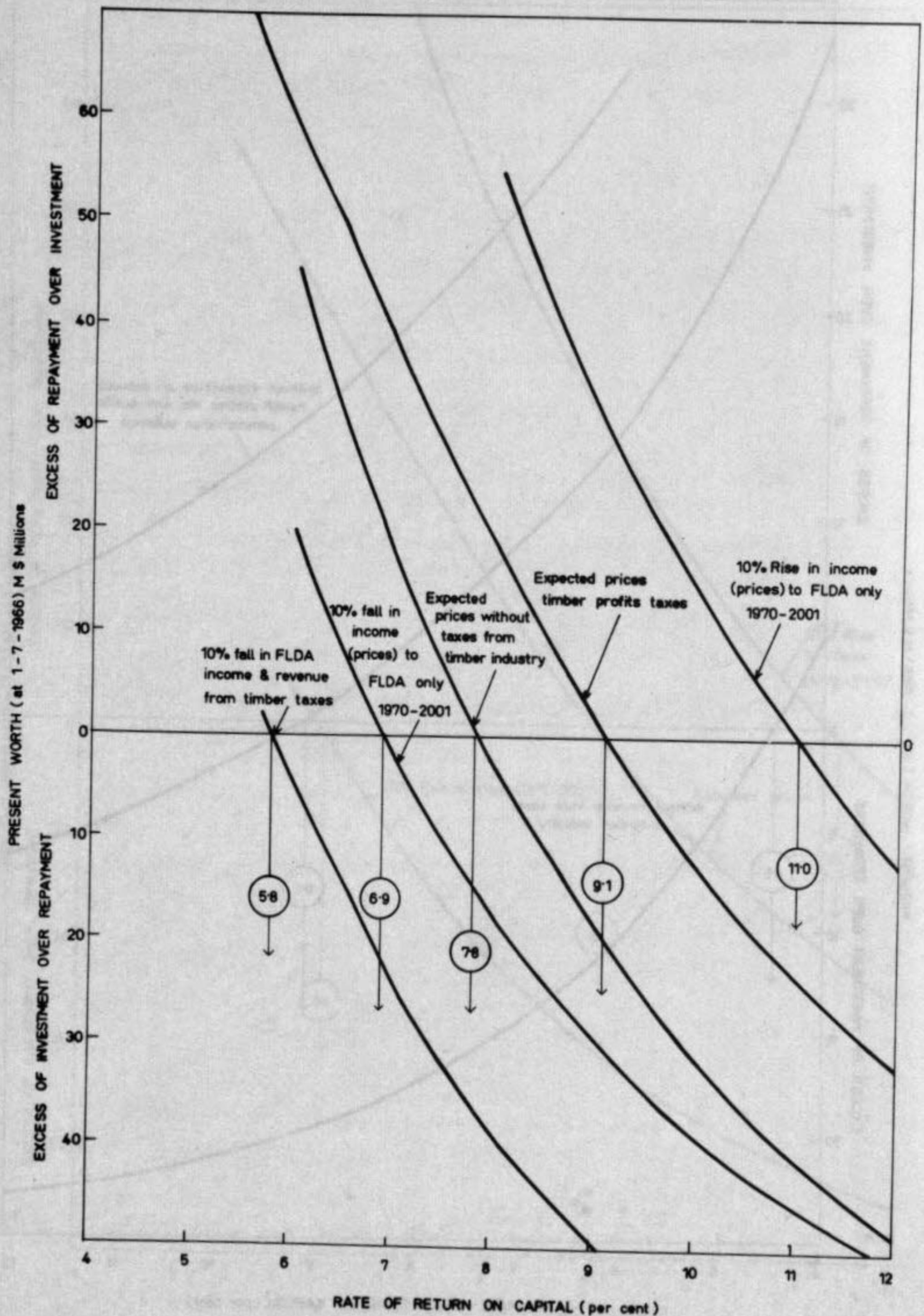
Figure 3

RATE OF RETURN ON CAPITAL
(FULL TRIANGLE DEVELOPMENT) - OTHER GOVERNMENT DEPARTMENTS



APPENDIX 26-8

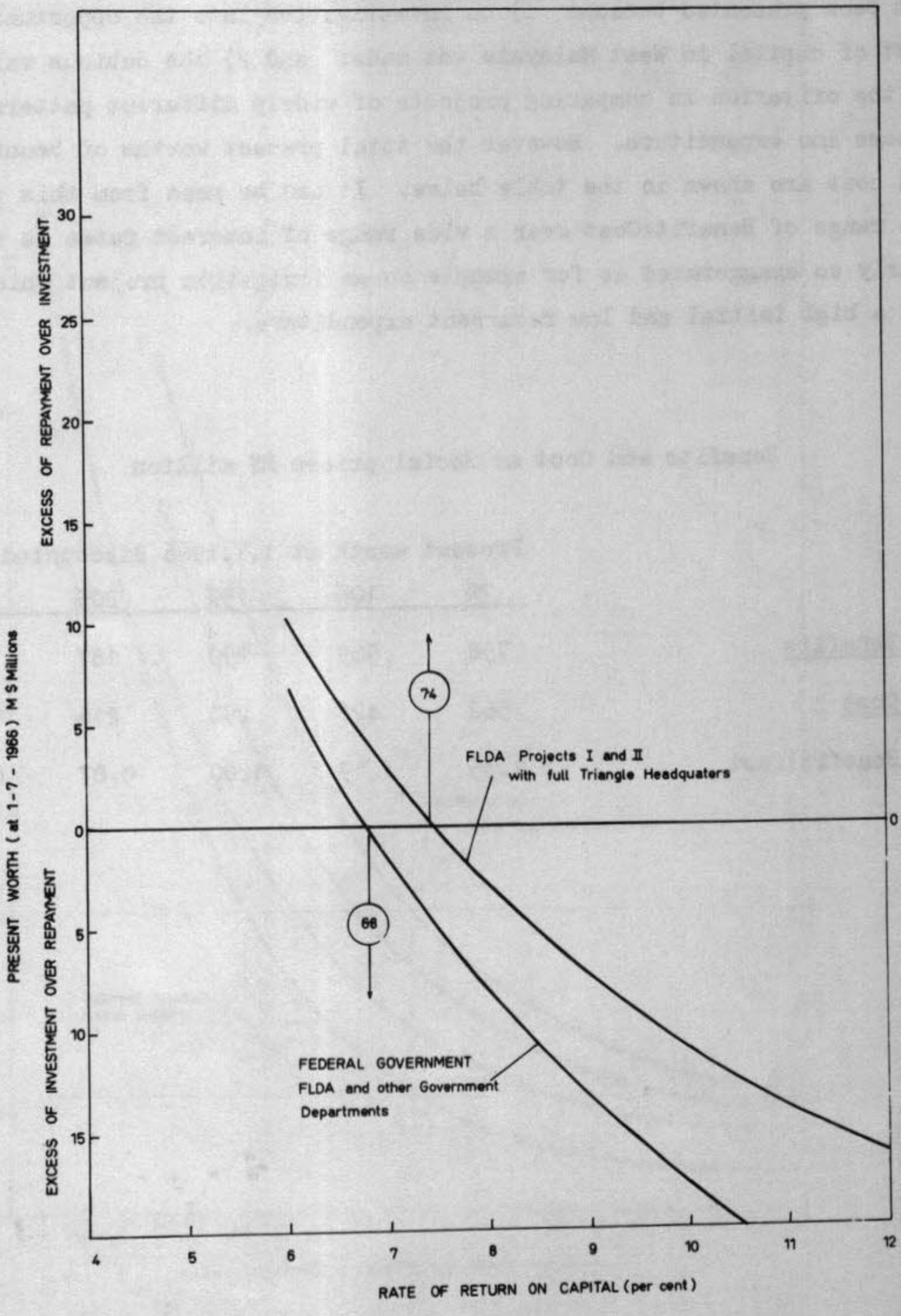
Figure 4
RATE OF RETURN ON CAPITAL
(FULL TRIANGLE DEVELOPMENT) - FEDERAL GOVERNMENT



APPENDIX 26-8

Figure 5

RATE OF RETURN ON CAPITAL
FIRST STAGE DEVELOPMENT



Calculation of S.M.P.

The calculation of S.M.P. is identical to the method used in assessing the rate of return on capital for other aspects of the analysis.

Benefit:Cost - As explained in the text a Benefit:Cost criterion has not been presented because, 1) no investigation into the opportunity cost of capital in West Malaysia was made; and 2) the dubious validity of the criterion in comparing projects of widely different patterns of income and expenditure. However the total present worths of benefits and cost are shown in the table below. It can be seen from this that the range of Benefit:Cost over a wide range of interest rates is not nearly so exaggerated as for example on an irrigation project which has a high initial and low recurrent expenditure.

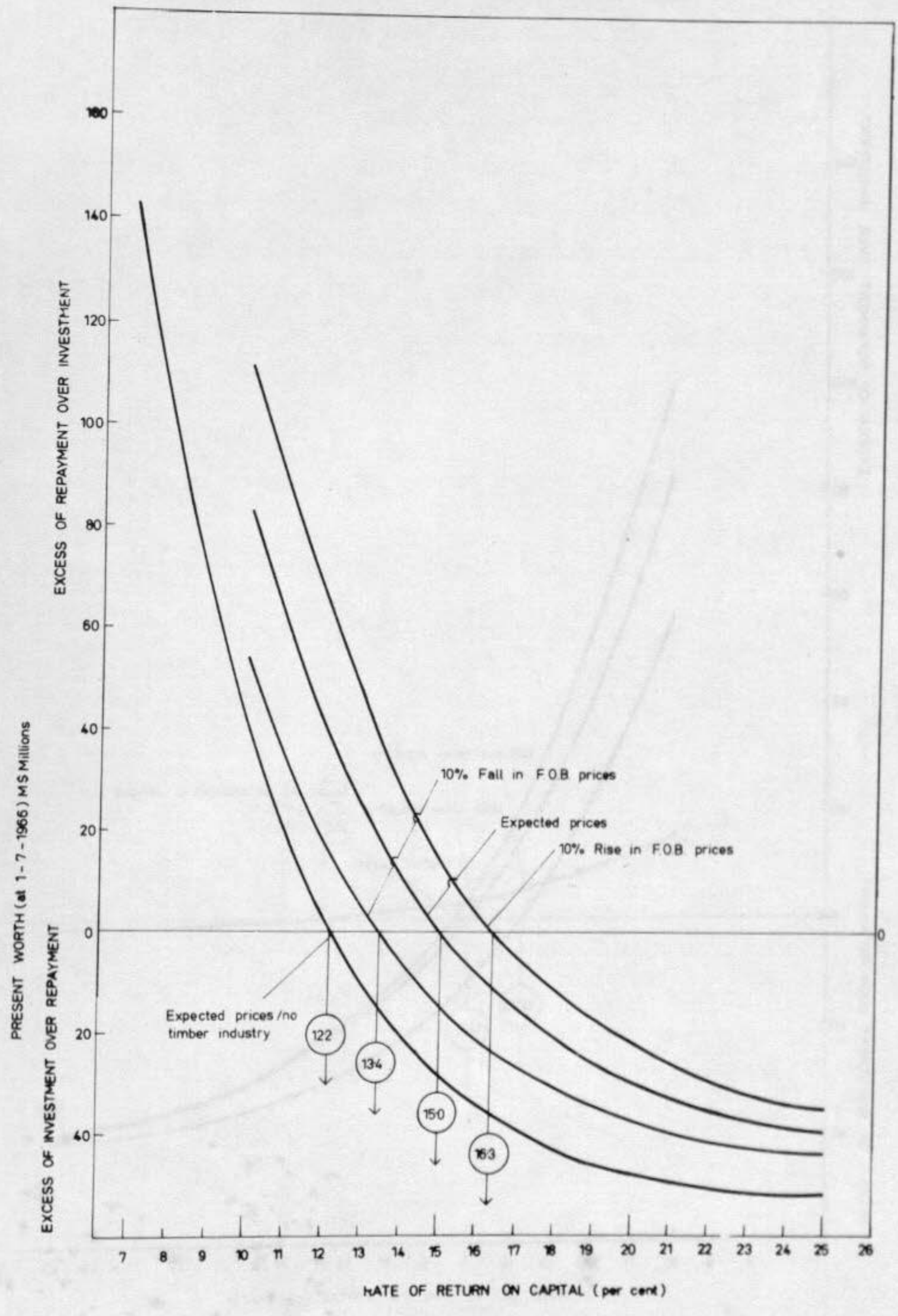
Benefits and Cost at Social prices M$ million

	Present worth at 1.7.1966 discounted at				
	7%	10%	15%	20%	25%
Benefits	758	509	290	187	130
Cost	562	426	290	216	169
Benefit:Cost	1.35	1.19	1.00	0.87	0.77

APPENDIX 26-8

Figure 6

RATE OF RETURN ON CAPITAL AT SOCIAL PRICES (S.M.P.)



APPENDIX 26-8

Figure 7

RATE OF RETURN ON CAPITAL AT SOCIAL PRICES (S.M.P.)
(INCLUSION OF TEKAM AREA)